

# **SBC8600B**

## **Single Board Computer**



# **User Manual**

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Version 1.0 – Dec. 12, 2012

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# Chapter 1 Product Overview

## 1.1 Introduction

Measuring only 60mm by 27mm, the Mini8600B processor card is a small form-factor controller board based on TI's Sitara AM3359 ARM Cortex-A8 processor. The tiny module integrates 2\*256MBytes DDR3 SDRAM and 512Mbytes NAND Flash and uses two 0.4mm space 2\*40-pin board-to-board male expansion connectors to bring out many hardware peripheral signals and GPIOs from the CPU.

Embest has designed a single board computer SBC8600B which has an expansion board to carry the Mini8600B. The flexible design allows the fast and easy way of realizing and upgrading the controller's capabilities. In addition to those features offered by Mini8600B, the SBC8600B features 5 serial ports (including 2 RS232 and 3 TTL), 2 USB Host and 1 USB OTG, 2 Ethernet ports, CAN, RS485, LCD, Touch screen, Audio, ADC and more other peripherals. The SBC8600B is a ready-to-run platform to support for Linux 3.2.0, Android 2.3 and WinCE 7 operating systems.

## 1.2 Hardware Overview

The following sections list out all the hardware features of the two parts of SBC8600B respectively.

### 1.2.1 Mini8600B

#### Electric Features

- Working Temperature: 0 °C~ 70°C
- Working Humidity: 20% ~ 90%, Non-Condensing

- Dimesions: 60mm x 27mm
- Input Voltage: 3.3V

**Processor**

- 720-MHz ARM Cortex™-A8 32-Bit RISC Microprocessor
  - NEON™ SIMD Coprocessor
  - 32KB/32KB of L1 Instruction/Data Cache with Single-Error Detection (parity)
  - 256KB of L2 Cache with Error Correcting Code (ECC)
- SGX530 Graphics Engine
- Programmable Real-Time Unit Subsystem

**Memories**

- 512MB NAND Flash
- 2\*256MB DDR3 SDRAM

**Expansion Interfaces and Signals Routed to Pins**

- Two 0.4-pitch 2\*40-pin DIP Interfaces
- A TFT LCD Interface (Support LCDs with 24-bpp parallel RGB interface)
- Two USB2.0 High-Speed OTG Interfaces
- Six UART Interfaces
- A SPI Interface
- Two 10/100 /1000Mb/s Ethernet MAC(EMAC) with Management Data Input/Output(MDIO) Module
- A Multichannel Audio Serial Ports (McASP)
- 8-Channel 12bit ADC Interface
- Three IIC Signals
- Two 4-line SD/MMC card interfaces
- GPMC Signals

**Note:**

Some of the pins are multiplexed for UART、IIC、SPI、CAN. Please refer to the CPU datasheet and schematics in the DVD-ROM for details.

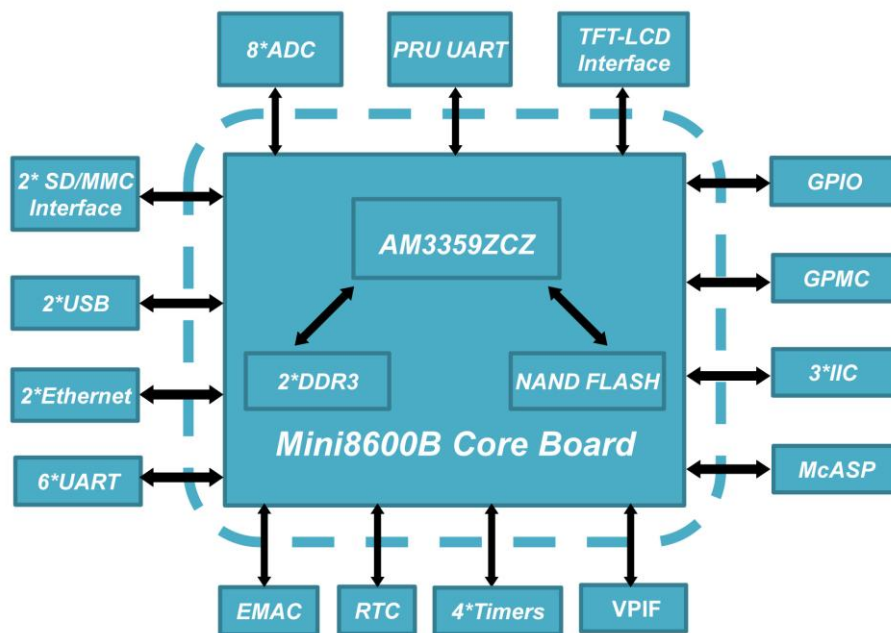


Figure 1-1 Mini8600 Structure Chart

## 1.2.2 Extension Board

### Electric Features

- Working Temperature: 0 °C~ 70°C
- Working Humidity: 20% ~ 90%, Non-Condensing
- Dimesions: 95m x 95m
- Input Voltage: 12V/1.25A

### Audio/Video Interfaces

- LCD/4-Line Resistive Touch-Screen Interface (50-pin FPC connector with 24-bit RGB output)
- An Audio Input Interface (3.5mm connector)



- An Dual-Channel Audio Output Interface (3.5mm connector)

#### **Data Transfer Interface**

- Two 10/100/1000Mbps Ethernet Interface (WinCE 7 support only one Ethernet interface)
- A CAN 2.0 Interface and a RS485 Interface (8-pin Phoenix Contact Connector)
- A USB 2.0 High-Speed OTG Ports with Integrated PHY (480Mbps, Mini USB Interface)
- Two USB 2.0 High-Speed HOST Ports with Integrated PHY (480Mbps, USB-A Interfaces)
- A TF Slot (SD/MMC compatible, 3.3V logic level)
- **Serial Interfaces**
  - UART0, 3-Line RS232 Level, DB9 Debugging Serial Interface
  - UART2, 3-Line RS232 Level, DB9 General-Purpose Serial Interface
  - UART3, 3-Line TTL Level, DIP Interface
  - UART4, 3-Line TTL Level, DIP Interface
  - UART5, 3-Line TTL Level, DIP Interface
- GPIO Interfaces

#### **Input Interfaces and others**

- Two Customizable Buttons (MENU and BACK)
- A Reset Button
- A Buzzer
- A Power Indication LED
- Two Customizable LEDs

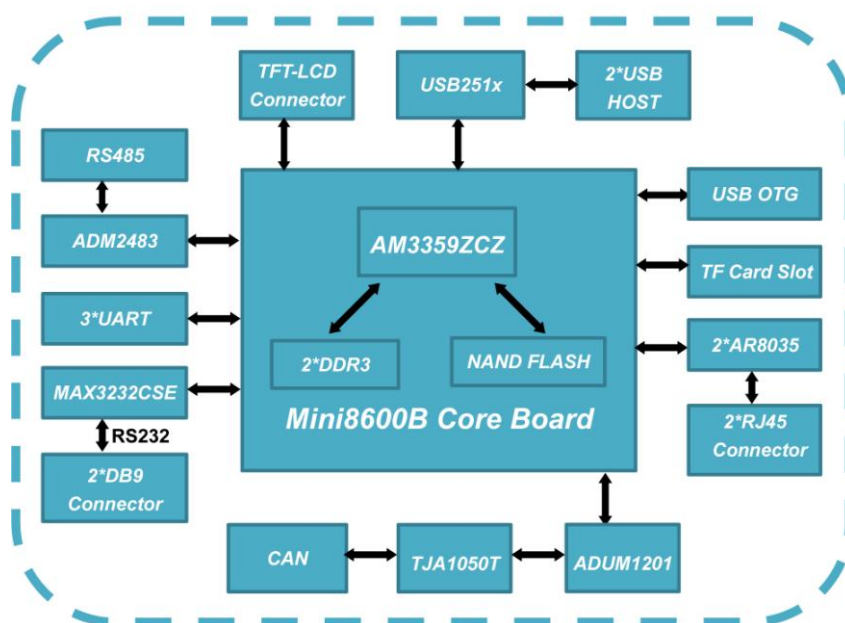


Figure 1-2 Mini8600 Structure Chart

## 1.3 Modules Suitable for the Extension Board

Table 1

| Names       | Linux | Android | WinCE | Relevant Materials                  |
|-------------|-------|---------|-------|-------------------------------------|
| VGA8000     | YES*  | YES*    | YES*  | Available in DVD-ROM                |
| WF8000-U    | YES*  | NO      | NO    | Available in DVD-ROM                |
| CAM8100-U   | YES*  | NO      | NO    | Available in DVD-ROM                |
| CDMA8000-U  | YES*  | NO      | NO    | <a href="#">Download</a>            |
| WCDMA8000-U | YES*  | NO      | NO    | <a href="#">Download</a>            |
| LVDS8000    | YES*  | YES*    | YES*  | Available in DVD-ROM and on website |

## Chapter 2 Hardware System

### 2.1 CPU

#### 2.1.1 Introduction to CPU

The AM335x microprocessors, based on the ARM Cortex-A8, are enhanced with image, graphics processing, peripherals and industrial interface options such as EtherCAT and PROFIBUS. The device supports the following high-level operating systems (HLOSs) such as Linux, WinCE and Android.

The AM335x microprocessor contains these subsystems:

- Microprocessor unit (MPU) subsystem based on the ARM Cortex-A8 microprocessor.
- POWERVR SGX™ Graphics Accelerator subsystem for 3D graphics acceleration to support display and gaming effects.
- The Programmable Real-Time Unit and Industrial Communication Subsystem (PRU-ICSS) is separate from the ARM core, allowing independent operation and clocking for greater efficiency and flexibility.

#### 2.1.2 CPU Features

##### Clock

AM3359 has two clock inputs, OSC1 and OCC0, and two clock outputs, LCKOUT1 and LCKOUT2.

OSC1 provides RTC with a 32.768KHz reference clock. And it is used to connect RTC\_XTALIN terminal to RTC\_XTALOUT terminal.

OSC0 provides reference clocks such as 19.2-MHz, 24-MHz, 25-MHz or 26-MHz for the clocks without RT function. It is also used to connect XTALIN terminal and XTALOUT terminal.

### **Reset**

Resetting is controlled by PWRONRSTn signals from CPU. The device is reset when it is a low level signal.

### **General-Purpose Interfaces**

There are 4 GPIO banks, each of which has 32 I/O pins, and therefore the total pin number of GPIO would be 128 (4x32).

### **Programmable Real-Time Unit Subsystem**

The PRUSS of AM3359 consists of 2 programmable real-time units, a 12KB shared RAM with single-error detection (parity), tree 120B register bank that can be accessed by each PRU, an interrupt controller module used to process input events of the system, and the following peripherals:

- An UART with data flow control and maximum rate of 12Mbps
- Two MII Ethernet interface with support to industrial Ethernet such as EtherCAT™
- A MDIO interface
- An enhanced capture module (eCAP)

### **3D Graphics Engine**

POWERVR® SGX graphics acceleration subsystem is used to improve 3D image processing, as well as provide regular display and gaming effect. The subsystem features:

- Tile-Based Architecture Delivering Up to 20 MPloy/sec

- Universal Scalable Shader Engine is a Multi-Threaded Engine Incorporating Pixel and Vertex Shader Functionality
- Advanced Shader Feature Set in Excess of Microsoft VS3.0, PS3.0 and OGL2.0
- Industry Standard API Support of Direct3D Mobile, OGL-ES 1.1 and 2.0, OpenVG 1.0, and OpenMax

## **2.2 Introduction to Peripherals**

### **2.2.1 NAND Flash H27U4G8F2DTR-BC**

H27U4G8F2DTR-BC is a 512M NAND Flash used on SBC8600B.

If you need more information about the NAND Flash, please refer to

H27U4G8F2DTR-BC.pdf under Disk-SBC8600B\HW design\datasheet\ NAND Flash\

### **2.2.2 DDR H5TQ2G83CFR-H9C**

H5TQ2G83DFR-H9C is a 256MB DDR3 SDRAM used on SBC8600B. There are two H5TQ2G83DFR-H9C on SBC8600B.

If you need to know more about the SDRAM, please refer to H5TQ2G83DFR.pdf under Disk-SBC8600B\HW design\datasheet\DDR\.

### **2.2.3 Ethernet AR8035**

AR8035 is a low-power and low-cost Ethernet PHY used on SBC8600B and integrated with a 10/100/1000Mb transceiver. It is a single-port tri-speed Ethernet PHY and supports MAC.TM RGMII interfaces.

AR8035 is compliant with the IEEE 802.3az Energy Efficiency Ethernet Standard and the Atheros's proprietary SmartEEE standard, which allows traditional MAC/SoC devices incompatible with 802.3az to function as a complete 802.3az system.

SBC8600B can be connected to a hub with a straight-through network cable, or connected to a computer with a crossover cable.

If you need know more about the Ethernet chip, please refer to AR8035.pdf under Disk-SBC8600B\HW design\datasheet\LAN\.

#### **2.2.4 MAX3232**

MAX3232 is used to convert TTL levels into RS232 levels so that the board can communicate with the RS232 interfaces of PCs.

SBC8600B uses UART0 as debugging serial interface. The default voltage of UART0 is 1.8V, which needs to be boosted up to 3.3V for satisfying the external use.

If you need to know more about the this chip, please refer to MAX3232CSE.pdf under Disk-SBC8600B\HW design\datasheet\Serial\.

## 2.3 Hardware Interfaces

### 2.3.1 Mini8600B

#### 2.3.1.1 CN1 Interface



**Figure 2-1** Mini8600B CN1 Interface

**Table 2** CN1 Interface

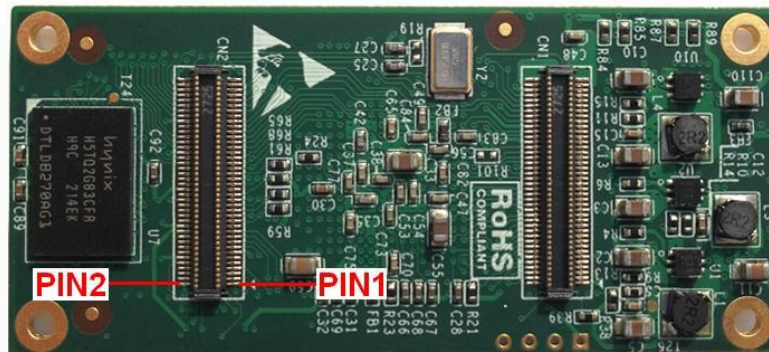
| CN1 |                      |                           |
|-----|----------------------|---------------------------|
| PIN | Signal               | Function                  |
| 1   | GND                  | GND                       |
| 2   | VDDS_RTC             | Supply voltage for RTC    |
| 3   | CLK_OUT1             | Clock out1                |
| 4   | CLK_OUT2             | Clock out2                |
| 5   | MMC0_DAT0            | MMC0 data bus             |
| 6   | MMC0_DAT1            | MMC0 data bus             |
| 7   | MMC0_DAT2            | MMC0 data bus             |
| 8   | GLOBLE_RESETN        | SYS_RESET IN/ OUTPUT      |
| 9   | MMC0_DAT3            | MMC0 data bus             |
| 10  | AM335X_PWRON_RESETN  | CPU PWRON Reset           |
| 11  | GND                  | GND                       |
| 12  | GND                  | GND                       |
| 13  | AM355X_PRU_UART0_CTS | PRU UART0 Clear To Send   |
| 14  | AM355X_PRU_UART0_RX  | PRU UART0 receive data    |
| 15  | AM355X_PRU_UART0_RTS | PRU UART0 request to send |
| 16  | AM355X_PRU_UART0_TX  | PRU UART0 transmit data   |

| CN1 |                     |                                     |
|-----|---------------------|-------------------------------------|
| PIN | Signal              | Function                            |
| 17  | AM355X_UART0_RX     | UART0 receive data                  |
| 18  | AM355X_UART3_RX     | UART3 receive data                  |
| 19  | AM355X_UART0_TX     | UART0 transmit data                 |
| 20  | AM355X_UART3_TX     | UART3 transmit data                 |
| 21  | AM355X_CAN0_RX      | CAN0 receive data                   |
| 22  | AM355X_I2C0_SDA     | I2C0 master serial data             |
| 23  | AM355X_CAN0_TX      | CAN0 transmit data                  |
| 24  | AM355X_I2C0_SCL     | I2C0 master serial clock            |
| 25  | AM355X_UART4_RX     | UART4 receive data                  |
| 26  | AM355X_UART1_RX     | UART1 receive data                  |
| 27  | AM355X_UART4_TX     | UART4 transmit data                 |
| 28  | AM355X_UART1_TX     | UART1 transmit data                 |
| 29  | GND                 | GND                                 |
| 30  | GND                 | GND                                 |
| 31  | MII1_COL            | MII1 collision detect               |
| 32  | AM355X_USB0_DRVVBUS | USB0 controller VBUS control output |
| 33  | MII1_TX_CLK         | MII1 transmit clock                 |
| 34  | AM355X_USB1_DRVVBUS | USB1 controller VBUS control output |
| 35  | MII1_TX_EN          | MII1 transmit enable                |
| 36  | MII1_REF_CLK        | MII1 reference clock                |
| 37  | MII1_TXD3           | MII1 transmit data                  |
| 38  | MII1_CRS            | MII1 carrier sense                  |
| 39  | MII1_TXD2           | MII1 transmit data                  |
| 40  | MII1_RX_ER          | MII1 receive data error             |
| 41  | MII1_TXD1           | MII1 transmit data                  |
| 42  | MII1_RX_DV          | MII1 receive data valid             |
| 43  | MII1_TXD0           | MII1 transmit data                  |
| 44  | MII1_RX_CLK         | MII1 receive clock                  |
| 45  | MII_MDIO            | MII MDIO DATA                       |
| 46  | MII1_RXD3           | MII1 receive data                   |
| 47  | MII_MDC             | MII MDIO CLK                        |
| 48  | MII1_RXD2           | MII1 receive data                   |
| 49  | GND                 | GND                                 |



| CN1 |                |                     |
|-----|----------------|---------------------|
| PIN | Signal         | Function            |
| 50  | MII1_RXD1      | MII1 receive data   |
| 51  | AM355X_USB0_DM | USB0 DM-            |
| 52  | MII1_RXD0      | MII1 receive data   |
| 53  | AM355X_USB0_DP | USB0 DP             |
| 54  | MMC0_CMD       | MMC0 Command Signal |
| 55  | GND            | GND                 |
| 56  | USB0_VBUS      | USB0 bus voltage    |
| 57  | AM355X_USB1_DM | USB1 data-          |
| 58  | AM355X_USB1_ID | USB1 ID             |
| 59  | AM355X_USB1_DP | USB1 data+          |
| 60  | AM355X_USB0_ID | USB0 ID             |
| 61  | GND            | GND                 |
| 62  | USB1_VBUS      | USB1 bus voltage    |
| 63  | GPMC_A0        | GPMC address        |
| 64  | GPMC_A7        | GPMC address        |
| 65  | GPMC_A5        | GPMC address        |
| 66  | GPMC_A11       | GPMC address        |
| 67  | GPMC_A4        | GPMC address        |
| 68  | GPMC_A10       | GPMC address        |
| 69  | GPMC_A3        | GPMC address        |
| 70  | GPMC_A9        | GPMC address        |
| 71  | GPMC_A2        | GPMC address        |
| 72  | GPMC_A8        | GPMC address        |
| 73  | GPMC_A6        | GPMC address        |
| 74  | GPMC_A1        | GPMC address        |
| 75  | GND            | GND                 |
| 76  | GND            | GND                 |
| 77  | VDD_3V3        | Power               |
| 78  | VDD_3V3        | Power               |
| 79  | VDD_3V3        | Power               |
| 80  | VDD_3V3        | Power               |

### 2.3.1.2 CN2 Interface



**Figure 2-2** SBC8600B CN2 Interface

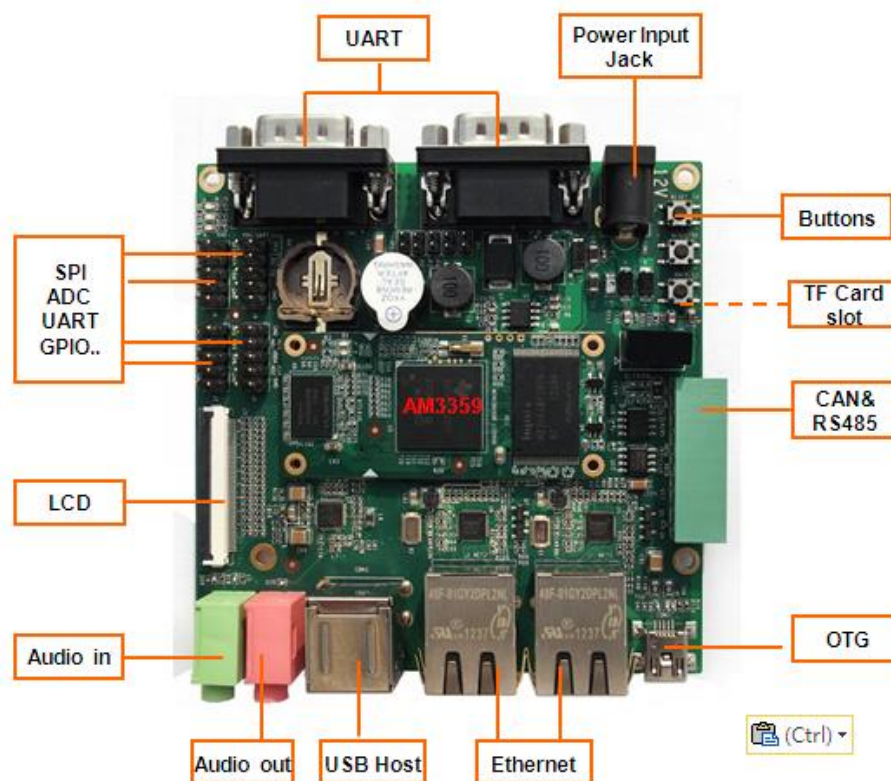
**Table 3** CN2 Interface

| CN2 |               |                              |
|-----|---------------|------------------------------|
| PIN | MODE1         | Function                     |
| 1   | GND           | GND                          |
| 2   | GND           | GND                          |
| 3   | MCASP0_AHCLKX | MCASP0 transmit master clock |
| 4   | MCASP0_ACLKX  | MCASP0 transmit bit clock    |
| 5   | MCASP0_FSX    | MCASP0 transmit frame sync   |
| 6   | MCASP0_AXR0   | MCASP0 serial data(I/O)      |
| 7   | MCASP0_AHCLKR | MCASP0 receiver master clock |
| 8   | MMC0_CLK      | MMC0 clock                   |
| 9   | MCASP0_FSR    | MCASP0 receive frame sync    |
| 10  | MCASP0_AXR1   | MCASP0 serial data(I/O)      |
| 11  | GND           | GND                          |
| 12  | GND           | GND                          |
| 13  | VDDA_ADC      | Supply voltage range for ADC |
| 14  | AM355X_ADC0   | ADC0                         |
| 15  | AM355X_ADC1   | ADC1                         |
| 16  | AM355X_ADC2   | ADC2                         |
| 17  | AM355X_ADC3   | ADC3                         |
| 18  | AM355X_ADC4   | ADC4                         |
| 19  | AM355X_ADC5   | ADC5                         |
| 20  | AM355X_ADC6   | ADC6                         |
| 21  | AM355X_ADC7   | ADC7                         |
| 22  | GND_ADC       | GND ADC                      |

| CN2 |            |                                |
|-----|------------|--------------------------------|
| PIN | MODE1      | Function                       |
| 23  | GND        | GND                            |
| 24  | GND        | GND                            |
| 25  | LCD_DATA1  | LCD data bus                   |
| 26  | LCD_DATA12 | LCD data bus                   |
| 27  | LCD_DATA0  | LCD data bus                   |
| 28  | LCD_DATA10 | LCD data bus                   |
| 29  | LCD_DATA5  | LCD data bus                   |
| 30  | LCD_DATA13 | LCD data bus                   |
| 31  | LCD_DATA4  | LCD data bus                   |
| 32  | LCD_DATA11 | LCD data bus                   |
| 33  | LCD_DATA6  | LCD data bus                   |
| 34  | LCD_DATA14 | LCD data bus                   |
| 35  | LCD_DATA8  | LCD data bus                   |
| 36  | LCD_VSYNC  | LCD vertical sync              |
| 37  | GND        | GND                            |
| 38  | GND        | GND                            |
| 39  | LCD_DATA9  | LCD data bus                   |
| 40  | LCD_PCLK   | LCD pixel clock                |
| 41  | LCD_DATA15 | LCD data bus                   |
| 42  | GPMC_AD11  | GPMC address & data            |
| 43  | LCD_DATA3  | LCD data bus                   |
| 44  | GPMC_AD15  | GPMC address & data            |
| 45  | LCD_DATA2  | LCD data bus                   |
| 46  | GPMC_AD14  | GPMC address & data            |
| 47  | LCD_DATA7  | LCD data bus                   |
| 48  | GPMC_WAIT0 | GPMC wait0                     |
| 49  | LCD_HSYNC  | LCD horizontal sync            |
| 50  | GPMC_BEN1  | GPMC byte enable 1             |
| 51  | GND        | GND                            |
| 52  | GND        | GND                            |
| 53  | LCD_EN     | LCD AC bias enable chip select |
| 54  | GPMC_WPN   | GPMC write protect             |
| 55  | GPMC_AD13  | GPMC address & data            |
| 56  | GPMC_CSN3  | GPMC chip select               |

| CN2 |                |   |
|-----|----------------|---|
| PIN | MODE1          | Function                                |
| 57  | GPMC_AD9       | GPMC address & data                     |
| 58  | GPMC_CSN2      | GPMC chip select                        |
| 59  | GPMC_AD10      | GPMC address & data                     |
| 60  | GPMC_CLK       | GPMC clock                              |
| 61  | GPMC_AD8       | GPMC address & data                     |
| 62  | GPMC_AD6       | GPMC address & data                     |
| 63  | GPMC_AD12      | GPMC address & data                     |
| 64  | GND            | GND                                     |
| 65  | GND            | GND                                     |
| 66  | GPMC_CSN1      | GPMC chip select1                       |
| 67  | GPMC_ADV_N_ALE | GPMC address valid/address latch enable |
| 68  | GPMC_AD5       | GPMC address & data                     |
| 69  | GPMC_BEN0_CLE  | GPMC byte enable 0/Command latch enable |
| 70  | GPMC_AD4       | GPMC address & data                     |
| 71  | GPMC_OEN_REN   | GPMC output /read enable                |
| 72  | GPMC_AD1       | GPMC address & data                     |
| 73  | GPMC_AD2       | GPMC address & data                     |
| 74  | GPMC_AD0       | GPMC address & data                     |
| 75  | GPMC_AD3       | GPMC address & data                     |
| 76  | GPMC_CSN0      | GPMC chip select0                       |
| 77  | GPMC_AD7       | GPMC address & data                     |
| 78  | GPMC_WEN       | GPMC write enable                       |
| 79  | GND            | GND                                     |
| 80  | GND            | GND                                     |

## 2.3.2 Extension Board



**Figure 2-3** Extension board interfaces

--- The interface is on the bottom of the board

— The interface is on the top of the board

### 2.3.2.1 Power Jack

**Table 4** Power Jack

| CON1 |        |                     |
|------|--------|---------------------|
| Pin  | Singal | Description         |
| 1    | GND    | GND                 |
| 2    | +12V   | Power supply (+12V) |
| 3    | NC     | NC                  |

### 2.3.2.2 TFT\_LCD Interface

Table 5 TFT\_LCD Interface

| J3  |        |  |
|-----|--------|--|
| Pin | Singal | Description                                      |
| 1   | B0     | GND  |
| 2   | B1     | GND  |
| 3   | B2     | GND  |
| 4   | B3     | LCD Pixel data bit 0                             |
| 5   | B4     | LCD Pixel data bit 1                             |
| 6   | B5     | LCD Pixel data bit 2                             |
| 7   | B6     | LCD Pixel data bit 3                             |
| 8   | B7     | LCD Pixel data bit 4                             |
| 9   | GND1   | GND  |
| 10  | G0     | GND  |
| 11  | G1     | GND  |
| 12  | G2     | LCD Pixel data bit 5                             |
| 13  | G3     | LCD Pixel data bit 6                             |
| 14  | G4     | LCD Pixel data bit 7                             |
| 15  | G5     | LCD Pixel data bit 8                             |
| 16  | G6     | LCD Pixel data bit 9                             |
| 17  | G7     | LCD Pixel data bit 10                            |
| 18  | GND2   | GND  |
| 19  | R0     | GND  |
| 20  | R1     | GND  |
| 21  | R2     | GND  |
| 22  | R3     | LCD Pixel data bit 11                            |
| 23  | R4     | LCD Pixel data bit 12                            |
| 24  | R5     | LCD Pixel data bit 13                            |
| 25  | R6     | LCD Pixel data bit 14                            |
| 26  | R7     | LCD Pixel data bit 15                            |
| 27  | GND3   | GND  |
| 28  | DEN    | AC bias control (STN) or pixel data enable (TFT) |
| 29  | HSYNC  | LCD Horizontal Synchronization                   |
| 30  | VSYNC  | LCD Vertical Synchronization                     |

| <b>J3</b>  |               |                               |
|------------|---------------|-------------------------------|
| <b>Pin</b> | <b>Singal</b> | <b>Description</b>            |
| 31         | GND           | GND                           |
| 32         | CLK           | LCD Pixel Clock               |
| 33         | GND4          | GND                           |
| 34         | X+            | X+ Position Input             |
| 35         | X-            | X- Position Input             |
| 36         | Y+            | Y+ Position Input             |
| 37         | Y-            | Y- Position Input             |
| 38         | NC            | NC                            |
| 39         | NC            | NC                            |
| 40         | NC            | NC                            |
| 41         | NC            | NC                            |
| 42         | IIC_CLK       | IIC master serial clock       |
| 43         | IIC_DAT       | IIC serial bidirectional data |
| 44         | GND5          | GND                           |
| 45         | VDD1          | 3.3V                          |
| 46         | VDD2          | 3.3V                          |
| 47         | VDD3          | 5V                            |
| 48         | VDD4          | 5V                            |
| 49         | RESET         | Reset                         |
| 50         | PWREN         | Backlight enable              |

**Note:**

 Please do NOT disconnect the LCD flat cable when the board is powered on.

### 2.3.2.3 Audio Output Interface

Table 6 Audio Output Interface

| HEADPHONE1 |        |              |
|------------|--------|--------------|
| Pin        | Singal | Description  |
| 1          | GND    | GND          |
| 2          | NC     | NC           |
| 3          | Right  | Right output |
| 4          | NC     | NC           |
| 5          | Left   | Left output  |

### 2.3.2.4 Audio Input Interface

Table 7 Audio Input Interface

| MIC1 |        |             |
|------|--------|-------------|
| Pin  | Singal | Description |
| 1    | GND    | GND         |
| 2    | NC     | NC          |
| 3    | MIC IN | Input       |
| 4    | NC     | NC          |
| 5    | MIC IN | Input       |

### 2.3.2.5 USB HOST Interface

Table 8 USB HOST Interface

| CON3 |        |             |
|------|--------|-------------|
| Pin  | Singal | Description |
| 1    | VBUA   | +5V         |
| 2    | DA-    | USB Data-   |
| 3    | DA+    | USB Data+   |
| 4    | GNDA   | GND         |



### 2.3.2.6 USB OTG Interface

Table 9 USB OTG Interface

| CON2 |        |             |
|------|--------|-------------|
| Pin  | Singal | Description |
| 1    | VB     | +5V         |
| 2    | D-     | USB Data-   |
| 3    | D+     | USB Data+   |
| 4    | ID     | USB ID      |
| 5    | G1     | GND         |

### 2.3.2.7 TF Card Interface

Table 10 TF Card Interface

| TF1 |         |                |
|-----|---------|----------------|
| Pin | Singal  | Description    |
| 1   | DAT2    | Card data 2    |
| 2   | CD/DAT3 | Card data 3    |
| 3   | CMD     | Command Signal |
| 4   | VDD     | VDD            |
| 5   | CLOCK   | Clock          |
| 6   | VSS     | VSS            |
| 7   | DAT0    | Card data 0    |
| 8   | DAT1    | Card data 1    |
| 9   | CD      | Card detect    |

### 2.3.2.8 LAN Interface

Table 11 LAN Interface

| J1,J2 |        |                          |
|-------|--------|--------------------------|
| Pin   | Singal | Description              |
| 1     | TD1+   | Transmit Data1+          |
| 2     | TD1-   | Transmit Data1-          |
| 3     | TD2+   | Transmit Data2+          |
| 4     | TD2-   | Transmit Data2-          |
| 5     | TCT    | Transmit common terminal |

| <b>J1,J2</b> |               |                         |
|--------------|---------------|-------------------------|
| <b>Pin</b>   | <b>Singal</b> | <b>Description</b>      |
| 6            | RCT           | Receive common terminal |
| 7            | RD1+          | Receive Data1+          |
| 8            | RD1-          | Receive Data1-          |
| 9            | RD2+          | Receive Data2+          |
| 10           | RD2-          | Receive Data2-          |
| 11           | GRLA          | +2.5V                   |
| 12           | GRLC          | LINK active LED         |
| 13           | YELC          | 100M linked LED         |
| 14           | YELA          | +2.5V                   |

### 2.3.2.9 Serial Interface

**Table 12** Serial Interface

| <b>J4(UART0), J5(UART2)</b> |               |                    |
|-----------------------------|---------------|--------------------|
| <b>Pin</b>                  | <b>Singal</b> | <b>Description</b> |
| 1                           | NC            | NC                 |
| 2                           | RXD           | Receive data       |
| 3                           | TXD           | Transmit data      |
| 4                           | NC            | NC                 |
| 5                           | GND           | GND                |
| 6                           | NC            | NC                 |
| 7                           | RTS           | Request To Send    |
| 8                           | CTS           | Clear To Send      |
| 9                           | NC            | NC                 |

### 2.3.2.10 CAN&RS485 接口

**Table 13** CAN&RS485 Interface

| <b>U22</b> |               |                    |
|------------|---------------|--------------------|
| <b>Pin</b> | <b>Singal</b> | <b>Description</b> |
| 1          | +12V          | +12V               |
| 2          | GND           | GND                |
| 3          | GND2          | Isolated GND       |
| 4          | 485B1         | 485B               |
| 5          | 485A1         | 485A               |

|   |       |              |
|---|-------|--------------|
| 6 | GND1  | Isolated GND |
| 7 | CANL1 | CANL         |
| 8 | CANH  | CANH         |

### 2.3.2.11 ADC Interface

**Table 14** ADC Interface

| <b>J9</b>  |               |                    |
|------------|---------------|--------------------|
| <b>Pin</b> | <b>Singal</b> | <b>Description</b> |
| 1          | GND           | GND                |
| 2          | GND           | GND                |
| 3          | ADC_CH1       | ADC1               |
| 4          | ADC_CH3       | ADC3               |
| 5          | VDDA_ADC      | Power              |
| 6          | VDDA_ADC      | Power              |
| 7          | ADC_CH2       | ADC2               |
| 8          | ADC_CH4       | ADC4               |
| 9          | GND           | GND                |
| 10         | GND           | GND                |

### 2.3.2.12 SPI Interface

**Table 15** SPI Interface

| <b>J8</b>  |               |                    |
|------------|---------------|--------------------|
| <b>Pin</b> | <b>Singal</b> | <b>Description</b> |
| 1          | +3.3V         | 3.3V               |
| 2          | +3.3V         | 3.3V               |
| 3          | SPI0_D1       | SPI0 data1         |
| 4          | SPI0_CLK      | SPI0 clock         |
| 5          | SPI0_CS0      | SPI enable0        |
| 6          | SPI0_D0       | SPI data0          |
| 7          | GND           | GND                |
| 8          | GND           | GND                |
| 9          | GND           | GND                |
| 10         | GND           | GND                |

### 2.3.2.13 Extension Interface

Table 16 Extension Interface

| J6  |              |                               |
|-----|--------------|-------------------------------|
| Pin | Singal       | Description                   |
| 1   | VIO_3V3      | +3.3V                         |
| 2   | VIO_3V3      | +3.3V                         |
| 3   | UART3_TX_3V3 | UART3 Transit data 3.3V level |
| 4   | UART4_TX_3V3 | UART4 Transit data 3.3V level |
| 5   | UART3_RX_3V3 | UART3 receive data 3.3V level |
| 6   | UART4_RX_3V3 | UART4 receive data 3.3V level |
| 7   | GND          | GND                           |
| 8   | GND          | GND                           |
| 9   | GND          | GND                           |
| 10  | GND          | GND                           |

Table 17 Extension Interface

| J7  |              |                               |
|-----|--------------|-------------------------------|
| Pin | Singal       | Description                   |
| 1   | VIO_3V3      | +3.3V                         |
| 2   | VIO_3V3      | +3.3V                         |
| 3   | UART5_TX_3V3 | UART5 Transit data 3.3V level |
| 4   | GPIO0_9      | GPIO                          |
| 5   | UART5_RX_3V3 | UART5 receive data 3.3V level |
| 6   | GPIO2_0      | GPIO                          |
| 7   | GND          | GND                           |
| 8   | GND          | GND                           |
| 9   | GND          | GND                           |
| 10  | GND          | GND                           |

### 2.3.2.14 Buttons

Table 18 Buttons

| S1-3 |        |                  |
|------|--------|------------------|
| Pin  | Singal | Description      |
| S2   | MENU   | System menu key  |
| S3   | BACK   | System back key  |
| S4   | Reset  | System Reset key |

### 2.3.2.15 LED

Table 19 LED

| LEDs |            |                 |
|------|------------|-----------------|
| LED  | Definition | Description     |
| 1    | D4         | Power Indicator |
| 2    | D35        | User Custom LED |
| 3    | D36        | User Custom LED |

## Chapter 3 Linux Operating System

### 3.1 Introduction

This chapter will introduce the Linux software system of SBC8600B by the following sections:

- Introducing the software resources provided along with SBC8600B;
- Introducing the software features.
- Introducing the creation of development environment, system development, driver principles and development.
- Details of system updating.
- Notes for the use of system.
- Introducing the development of upper layers.

**Note:**

It is recommended referring to Appendix II for details of Ubuntu Linux installation and learning about embedded Linux development technology before you get started.

### 3.2 Software Resources

This section provides an overview of software system components of SBC8600B. A basic software system consists of four parts: x-loader, u-boot, kernel and rootfs. The Figure 3-1 shows the structure of the system:

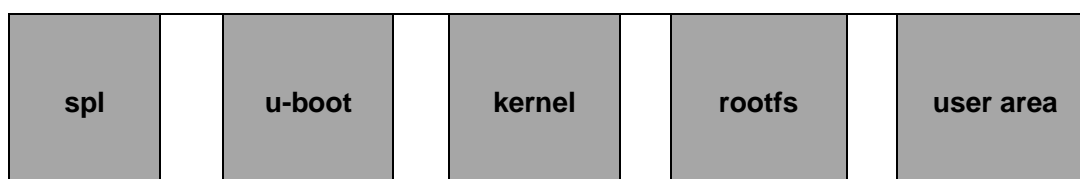


Figure 3-1

Features and functions of each part of the system are listed below:

- 1) spl is a first level bootstrap program. After the system starts up, the ROM inside the CPU will copy spl to internal RAM and perform its routine work. Its main function is to initialize the CPU, copy u-boot into the memory and let u-boot lead the booting process;
- 2) u-boot is a second level bootstrap program. It is used for interacting with users and updating images and boot the kernel;
- 3) A Linux version with kernel 3.2.0 is employed here and it can be customized based on SBC8600B;
- 4) Rootfs employs open-source system ubifs. It is small in capacity and powerful, very suitable for embedded systems;

### 3.3 Software Features

Table 20

| Name          |              | Note   |
|---------------|--------------|--|
| BIOS          | spl          | NAND   |
|               |              | MMC/SD   |
|               |              | FAT  |
|               | u-boot       | NAND   |
|               |              | MMC/SD   |
|               |              | FAT  |
|               |              | NET  |
| Kernel        | Linux-3.2.0  | Supports ROM/CRAM/EXT2/EXT3/FAT/NFS/JFFS2/UBIFS and various file systems |
| Device Driver | serial       | Seires driver  |
|               | rtc          | Hardware clock driver  |
|               | net          | 10/100M/1000M Ethernet driver  |
|               | can          | Can bus driver   |
|               | flash        | nand flash driver (supports nand boot)                                   |
|               | lcd          | TFT LCD driver   |
|               | touch screen | 4-line touch-screen controller driver                                    |
|               | mmc/sd       | mmc/sd controller driver   |

|      |         |  |
|------|---------|--|
|      | usb otg | usb otg 2.0 driver                                   |
|      | audio   | Audio driver (supports audio recording and playback) |
|      | keypad  | Gpio keypad driver                                   |
|      | led     | User custom led driver                               |
| Demo | Android | android 2.3.4 system                                 |
|      | TISDK   | TISDK system   |

## 3.4 System Development

### 3.4.1 Establishment of development environment


Before the software development based on SBC8600B, users have to establish a Linux cross development environment on PC. This section will take Ubuntu operating system as an example to introduce how to establish a cross development environment.

#### 3.4.1.1 Installing Cross Compilation Tools

After you insert the DVD-ROM to your PC, Ubuntu will mount it automatically under the directory /media/cdrom. The cross compilation tools can be found under /media/cdrom/linux/tools.

The following instructions are executed at the Ubuntu terminal to decompress the cross compilation tools under the directory \$HOME:

#### Note:

 Each instruction has been put a bullets “•” before it to prevent confusion caused by the long instructions that occupy more than one line in the context.

- `mkdir $HOME/tools`
- `cd /media/cdrom/linux/tools`
- `tar xvf arm-2009q1-203-arm-none-linux-gnueabi-i686-pc-linux-gnu.tar.bz2 -C $HOME/tools`
- `tar xvf arm-eabi-4.4.0.tar.bz2 -C $HOME/tools`



Some of the other development tools used for source code compilation are saved under the same directory; the user can execute the following commands to copy them to local folder:


```
• cp /media/cdrom/linux/tools/mkimage $HOME/tools
• cp /media/cdrom/linux/tools/mkfs.ubifs $HOME/tools
• cp /media/cdrom/linux/tools/ubinize $HOME/tools
• cp /media/cdrom/linux/tools/ubinize.cfg $HOME/tools
```

#### 3.4.1.2 Addition of environment variables

After all above tools are installed, it is necessary to use the following commands to add them in the temporary environment variables:

```
• export
  PATH=$HOME/tools/arm-2009q1/bin:$HOME/tools/arm-eabi-4.4.0/bin:$HOME/tools:$PATH
```

##### Note:

 The instructions can be added in the .bashrc file located at the user directory, so that the addition of environment variables will be loaded automatically when the system is booting up; command **echo \$PATH** can be used to check the path.

#### 3.4.1.3 Establishment of Android Development Environment

Apart from the cross compilation tools and environment variables, there are a few additional software packages need to be installed and configurations to be set in Ubuntu system before Android system source code could be compiled. Please visit <http://source.android.com/source/initializing.html> for more information.

## 3.4.2 System Compilation


### 3.4.2.1 Preparation

Source codes of all components of the system are saved under the directory linux/source in the disc; user has to decompress them in the Ubuntu system before executing development:

```
• mkdir $HOME/work
• cd $HOME/work
• tar xvf /media/cdrom/linux/source/u-boot-2011.09-psp04.06.00.03.tar.bz2
• tar xvf /media/cdrom/linux/source/linux-3.2.0-psp04.06.00.08.sdk.tar.bz2
• tar xvf
  /media/cdrom/linux/demo/android/source/linux-3.1.0-android.tar.bz2
• sudo tar xvf /media/cdrom/linux/source/rootfs.tar.bz2
• tar xvf
  /media/cdrom/linux/demo/android/source/rowboat-android-gingerbread-am335xevm.tar.bz2
```

When the above steps are finished, the directories u-boot-2011.09-psp04.06.00.03, Linux-3.2.0-psp04.06.00.08.sdk, Linux-3.1.0-android, rootfs and rowboat-android-gingerbread-am335xevm will be created under current directory.

#### Note:

 Please make sure the uncompressed source code is saved under the directory specified in the above instructions, or errors might occur in compilation process.

### 3.4.2.2 Compilation of booting code

SBC8600B can boot up from TF card or NAND Flash, with the former as first boot-up device and the latter as the secondary.

We will introduce the generation of booting code image files for both the boot-up devices.

```
• cd u-boot-2011.09-psp04.06.00.03
• make distclean
• make sbc8600_config
• make
```

When the above steps are finished, two files named MLO and u-boot.img can be found under current directory.

### 3.4.2.3 Kernel compilation

The operations for Linux system are as follows:

```
• cd Linux-3.2.0-psp04.06.00.08.sdk
• make distclean
• make sbc8600_defconfig
• make ulmage
```

The operations for Android system are as follows:

```
• cd Linux-3.1.0-android
• make distclean
• make sbc8600_android_defconfig
• make ulmage
```

After above operations are executed, a ulmage file will be generated under the directory arch/arm/boot.

### 3.4.2.4 Generation of file system

#### 1) Ramdisk file

Please visit [http://www.elinux.org/DevKit8600\\_FAQ](http://www.elinux.org/DevKit8600_FAQ) for details of how to generate Ramdisk file.

#### 2) UBI file

```
• cd $HOME/work
• sudo $HOME/tools/mkfs.ubifs -r rootfs -m 2048 -e 126976 -c 812 -o ubifs.img
• sudo $HOME/tools/ubinize -o ubi.img -m 2048 -p 128KiB -s 512 -O 2048
  $HOME/tools/ubinize.cfg
```

After above operations are executed, a ubi.img file will be generated under the current directory.

### 3.4.2.5 Android system compilation

- 1) Execute the following instructions to start compilation of Android system;

```
• cd rowboat-android-gingerbread-am335xevm
• make TARGET_PRODUCT=am335xevm clean
• make TARGET_PRODUCT=am335xevm OMAPES=4.x
```

- 2) Modify Rules.make under hardware/ti/sgx/ ;

**Vi hardware/ti/sgx/Rules.make**

Replace "KERNEL\_INSTALL\_DIR=\$(HOME)/work/Linux-3.1.0-android" with "KERNEL\_INSTALL\_DIR=/home/user\_name/work/Linux-3.1.0-android"


/home/user\_name is the directory where usernames are saved, in other words, it's the value of \$(HOME). To view the value, please enter whoami in the terminal window of Linux system.

- 3) Please enter the following instructions to start making ubi file system;

**source ./build\_ubi.sh**

ubi.img can be found under temp/.

#### Note:

 Before the compilation of Android file system, the Android kernel source code Linux-3.1.0-android needs to compile first, or errors might occur during the process.

### 3.4.3 System Customization

As Linux kernel has many kernel configuration options, users can add or remove drivers and some kernel features in the default configuration to meet specific requirement. The common process of system customization will be described with examples below.

### 3.4.3.1 Modification of kernel configuration


A default configuration file is provided in the factory kernel source codes:

Linux-3.2.0-psp04.06.00.08.sdk/arch/arm/configs/sbc8600\_defconfig

Users can carry out system customization based on it:

- `cd Linux-3.2.0-psp04.06.00.08.sdk`
- `cp arch/arm/configs/sbc8600_defconfig .config`
- `make menuconfig`

#### Note:

 If an error occurs when command 'make menuconfig' is executed, you might need to install 'ncurses' in the Ubuntu system; 'ncurses' is a character graphic library required to generate configuration menu; please enter the following instruction to install the library:  
**`sudo apt-get install ncurses-dev`**

Select the configuration below: The system customization will be described below by taking an example of usb mass storage device emulated with usb gadget:

- > Device Drivers
  - > USB support
    - > USB Gadget Support
      - > USB Gadget Drivers

```

--- USB Gadget Support
[ ] Debugging messages (DEVELOPMENT)
[ ] Debugging information files (DEVELOPMENT)
[ ] Debugging information files in debugfs (DEVELOPMENT)
(2) Maximum VBUS Power usage (2-500 mA)
(2) Number of storage pipeline buffers
<*> USB Peripheral Controller (Inventra HDRC USB Peripheral (TI, ADI, ...)) --->
<*> Select one gadget as builtin for one port
      Select USB port to bind builtin gadget (USB-0) --->
<M> USB Gadget Drivers
<M>   Gadget Zero (DEVELOPMENT)
< >   Audio Gadget (EXPERIMENTAL)
<M>   Ethernet Gadget (with CDC Ethernet support)
[*]    RNDIS support
[ ]    Ethernet Emulation Model (EEM) support
< >    Network Control Model (NCM) support
< >    Gadget Filesystem (EXPERIMENTAL)
< >    Function Filesystem (EXPERIMENTAL)
<M>    File-backed Storage Gadget (DEPRECATED)
[*]    File-backed Storage Gadget testing version
< >    Mass Storage Gadget
< >    Serial Gadget (with CDC ACM and CDC OBEX support)
< >    MIDI Gadget (EXPERIMENTAL)
< >    Printer Gadget
< >    CDC Composite Device (Ethernet and ACM)
< >    Multifunction Composite Gadget (EXPERIMENTAL)
< >    HID Gadget
< >    USB Webcam Gadget

```

**Figure 3-2**

Type <M> for “File-backed Storage Gadget”, and select Save when you exit, and compile the kernel again.

### 3.4.3.2 Compilation

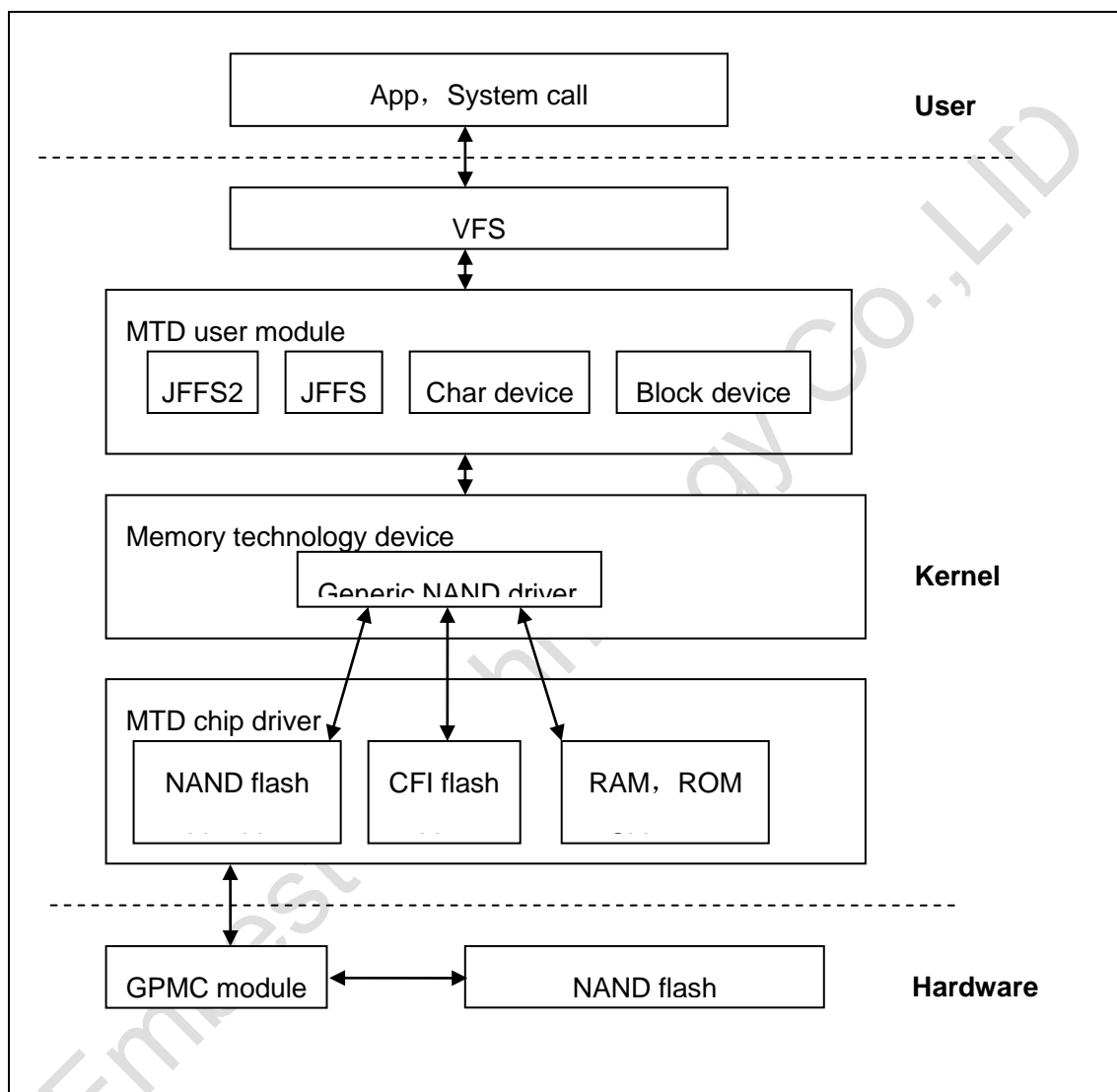
Save configuration, execute the following commands to recompile kernel:

- **make ulmage**
- **make modules**

After above operations are finished, a new kernel image ulmage will be generated under the directory arch/arm/boot, and a module file g\_file\_storage.ko can be found under the directory drivers/usb/gadget.

## 3.5 Introduction of Driver

### 3.5.1 NAND



**Figure 3-3** Modular structure for NAND

The solid-state memory used in embedded systems is typically a flash; it is NAND Flash in this system.

NAND Flash is used as a block device, on which the file system is established; interaction between user and NAND Flash is mainly realized by a specific file system. In order to realize compatibility with different Flash memories, an MTD subsystem is used to

implement management between the file system and the specific flash driver for management.

Therefore, users need to access NAND Flash through the following process:

User->System Call->VFS->Block Device Driver->MTD->NAND Flash Driver->NAND Flash.

#### Drivers and relevant documents:

Linux-3.2.0-psp04.06.00.08.sdk/drivers/mtd/nand/

Linux-3.2.0-psp04.06.00.08.sdk/drivers/mtd/nand/omap2.c

### 3.5.2 SD/MMC

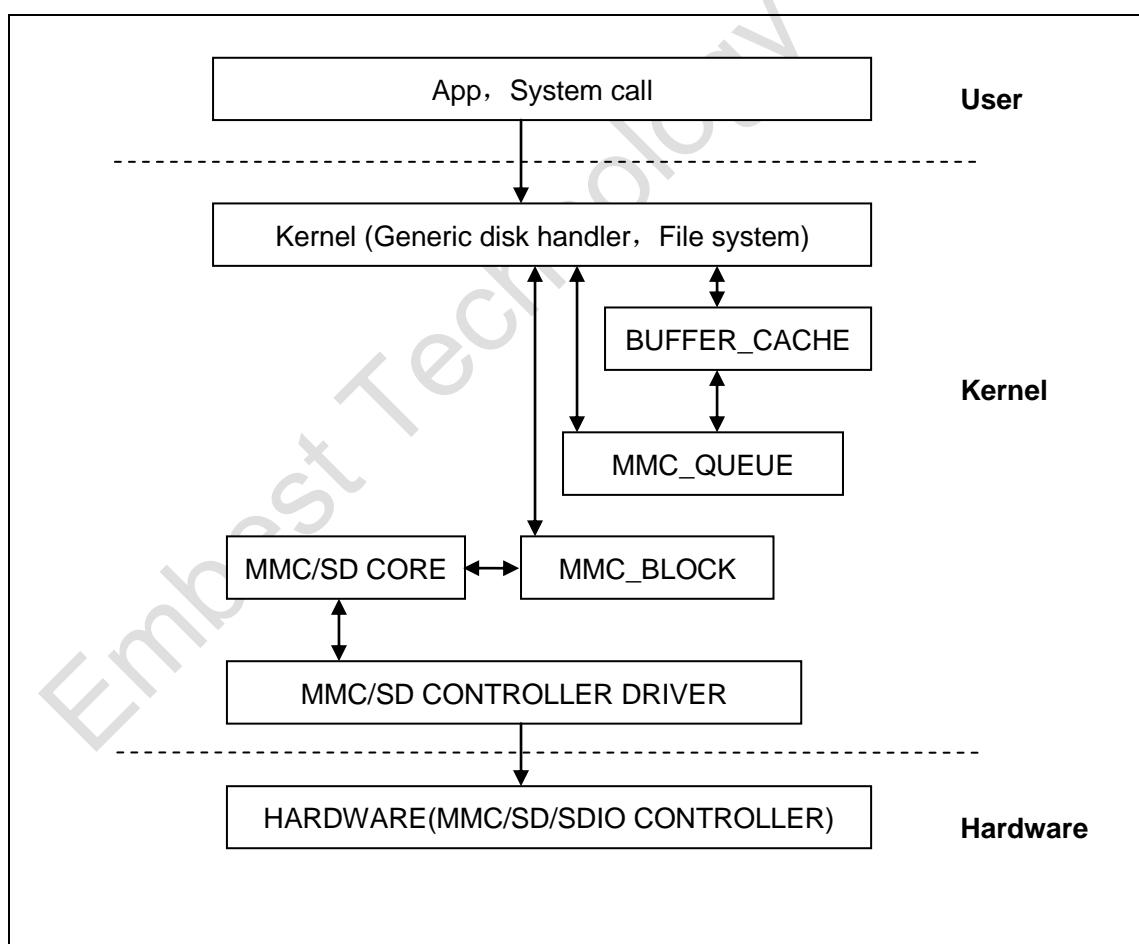


Figure 3-4 Modular structure for SD/MMC



SD/MMC card drivers for Linux mainly include SD/MMC core, mmc\_block, mmc\_queue and SD/MMC driver:

- 1) SD/MMC core realizes the codes unrelated to structure in the SD/MMC card operation.
- 2) mmc\_block realizes driver structure when SD/MMC card is used as a block device.
- 3) mmc\_queue realizes management of request queue.
- 4) SD/MMC driver realizes specific controller driver.

**Drivers and relevant documents:**

Linux-3.2.0-psp04.06.00.08.sdk/drivers/mmc/

Linux-3.2.0-psp04.06.00.08.sdk/drivers/mmc/host/omap\_hsmmc.c

### 3.5.3 LCDC

The LCD controller (LCDC) of AM335x is the latest version integrated in OMAP-L138 SoC which has differences as follows comparing with OMAP-L138.

- 1) Different interrupt configuration and status register
- 2) 2048\*2048 Higher display resolution of up to 2048\*2048
- 3) 24-bit active TFT grating per pixel

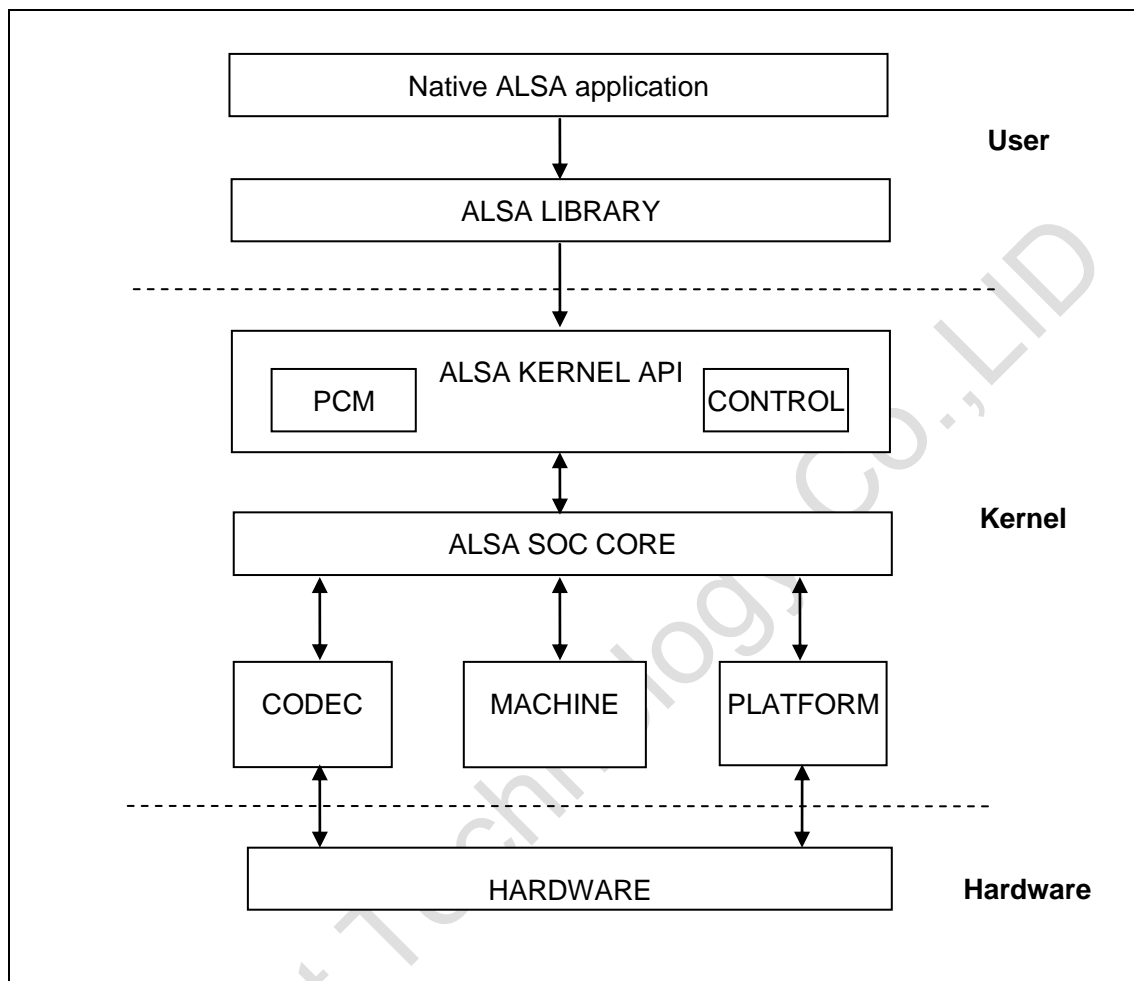
So da8xx-fb LCD driver can be used to improve the LCD\_VERSION2 code. By reading PID register, the update of LCDC version can be found.

**Drivers and relevant documents:**

Linux-3.2.0-psp04.06.00.08.sdk/drivers/video/

Linux-3.2.0-psp04.06.00.08.sdk/drivers/video/da8xx-fb.c

### 3.5.4 Audio in/out



**Figure 3-5** Modular structure for Audio

ASoC embedded audio system basically consists of three components:

- 1) Codec driver: The codec driver is platform independent and contains audio controls, audio interface capabilities, codec dapm definition and codec IO functions.
- 2) Platform driver: The platform driver contains the audio dma engine and audio interface drivers (e.g. I2S, AC97, PCM) for that platform.
- 3) Machine driver: The machine driver handles any machine specific controls and audio events i.e. turning on an amp at start of playback.

**Drivers and relevant documents:**

Linux-3.2.0-psp04.06.00.08.sdk/sound/soc/

Linux-3.2.0-psp04.06.00.08.sdk/sound/soc/davinci/davinci-evm.c

Linux-3.2.0-psp04.06.00.08.sdk/sound/soc/codecs/sgtl5000.c

## 3.6 Driver Development

### 3.6.1 GPIO\_keys Driver

#### 1) Device Definition

Linux-3.2.0-psp04.06.00.08.sdk/arch/arm/mach-omap2/board-am335xevm.c

define gpio0.20 as “menu” key, return value as “KEY\_F1”, triggered by low level;

gpio2.1 as “back” key, return value as “KEY\_ESC”, triggered by low level

```
static struct gpio_keys_button gpio_key_buttons[] = {
    {
        .code           = KEY_F1,
        .gpio           = GPIO_TO_PIN(0, 20),
        .active_low     = true,
        .desc           = "menu",
        .type           = EV_KEY,
        // .wakeup       = 1,
    },
    {
        .code           = KEY_ESC,
        .gpio           = GPIO_TO_PIN(2, 1),
        .active_low     = true,
        .desc           = "back",
        .type           = EV_KEY,
        // .wakeup       = 1,
    },
};

static struct gpio_keys_platform_data gpio_key_info = {
    .buttons           = gpio_key_buttons,
    .nbuttons          = ARRAY_SIZE(gpio_key_buttons),
};

static struct platform_device gpio_keys = {
```

```
.name   = "gpio-keys",
.id     = -1,
.dev    = {
        .platform_data = &gpio_key_info,
    },
};
```

## 2) GPIO pinmux Configuration

Define the GPIO0.20 and GPIO2.1 as MODE7 (GPIO mode) and AM33XX\_PIN\_INPUT (configuration input).

Linux-3.2.0-psp04.06.00.08.sdk/arch/arm/mach-omap2/board-am335xevm.c

```
static struct pinmux_config gpio_keys_pin_mux[] = {
    {"xdma_event_intr1.gpio0_20",OMAP_MUX_MODE7 | AM33XX_PIN_INPUT},
    {"gpmc_clk.gpio2_1",OMAP_MUX_MODE7|AM33XX_PIN_INPUT},
    {NULL, 0},
};
```

## 3) Driver Design

Linux-3.2.0-psp04.06.00.08.sdk/drivers/input/keyboard/gpio\_keys.c

### a) Call platform\_driver\_register to register gpio\_keys driver

```
static struct platform_driver gpio_keys_device_driver = {
    .probe      = gpio_keys_probe,
    .remove     = __devexit_p(gpio_keys_remove),
    .driver     = {
        .name    = "gpio-keys",
        .owner   = THIS_MODULE,
        .pm      = &gpio_keys_pm_ops,
        .of_match_table = gpio_keys_of_match,
    }
};

static int __init gpio_keys_init(void)
{
    return platform_driver_register(&gpio_keys_device_driver);
}

static void __exit gpio_keys_exit(void)
{
    platform_driver_unregister(&gpio_keys_device_driver);
}
```

```
}

late_initcall(gpio_keys_init);
module_exit(gpio_keys_exit);

MODULE_LICENSE("GPL");
MODULE_AUTHOR("Phil Blundell <pb@handhelds.org>");
MODULE_DESCRIPTION("Keyboard driver for GPIOs");
MODULE_ALIAS("platform:gpio-keys");
```

**b) Call input\_register\_device to register input driver**

```
static int __devinit gpio_keys_probe(struct platform_device *pdev)
{
    ...

    input = input_allocate_device();

    ...

    for (i = 0; i < pdata->nbuttons; i++) {
        struct gpio_keys_button *button = &pdata->buttons[i];
        struct gpio_button_data *bdata = &ddata->data[i];
        unsigned int type = button->type ?: EV_KEY;

        bdata->input = input;
        bdata->button = button;

        error = gpio_keys_setup_key(pdev, bdata, button);
        if (error)
            goto fail2;

        if (button->wakeup)
            wakeup = 1;

        input_set_capability(input, type, button->code);
    }
    error = sysfs_create_group(&pdev->dev.kobj, &gpio_keys_attr_group);
    if (error) {
        dev_err(dev, "Unable to export keys/switches, error: %d\n",
            error);
        goto fail2;
    }

    error = input_register_device(input);
```

```
        if (error) {
            dev_err(dev, "Unable to register input device, error: %d\n",
                    error);
            goto fail3;
        }
    ...
}
```

**c)** Apply for gpio and define the gpio as input, and register gpio interrupt.

```
static int __devinit gpio_keys_setup_key(struct platform_device *pdev,
                                         struct gpio_button_data *bdata,
                                         struct gpio_keys_button *button)
{
    const char *desc = button->desc ? button->desc : "gpio_keys";
    struct device *dev = &pdev->dev;
    unsigned long irqflags;
    int irq, error;

    setup_timer(&bdata->timer, gpio_keys_timer, (unsigned long)bdata);
    INIT_WORK(&bdata->work, gpio_keys_work_func);

    error = gpio_request(button->gpio, desc);
    if (error < 0) {
        dev_err(dev, "failed to request GPIO %d, error %d\n",
                button->gpio, error);
        goto fail2;
    }

    error = gpio_direction_input(button->gpio);
    if (error < 0) {
        dev_err(dev, "failed to configure"
                " direction for GPIO %d, error %d\n",
                button->gpio, error);
        goto fail3;
    }

    if (button->debounce_interval) {
        error = gpio_set_debounce(button->gpio,
                                  button->debounce_interval * 1000);
        /* use timer if gpiolib doesn't provide debounce */
        if (error < 0)
            bdata->timer_debounce = button->debounce_interval;
    }
}
```

```
    }

    irq = gpio_to_irq(button->gpio);
    if (irq < 0) {
        error = irq;
        dev_err(dev, "Unable to get irq number for GPIO %d, error %d\n",
                button->gpio, error);
        goto fail3;
    }
    irqflags = IRQF_TRIGGER_RISING | IRQF_TRIGGER_FALLING;
    /*
     * If platform has specified that the button can be disabled,
     * we don't want it to share the interrupt line.
     */
    if (!button->can_disable)
        irqflags |= IRQF_SHARED;

    error = request_threaded_irq(irq, NULL, gpio_keys_isr, irqflags, desc, bdata);
    if (error < 0) {
        dev_err(dev, "Unable to claim irq %d; error %d\n",
                irq, error);
        goto fail3;
    }

    return 0;

fail3:
    gpio_free(button->gpio);
fail2:
    return error;
}
```

#### d) Interrupt processing

When button is pressed, an interrupt is generated and key value is displayed.

```
static irqreturn_t gpio_keys_isr(int irq, void *dev_id)
{
    ...
    schedule_work(&bdata->work);
    ...
}

static void gpio_keys_work_func(struct work_struct *work)
{
    ...
    gpio_keys_report_event(bdata);
    ...
}

static void gpio_keys_report_event(struct gpio_button_data *bdata)
{
    struct gpio_keys_button *button = bdata->button;
    struct input_dev *input = bdata->input;
    unsigned int type = button->type ?: EV_KEY;
    int state = (gpio_get_value(button->gpio) ? 1 : 0) ^ button->active_low;

    input_event(input, type, button->code, !state);
    input_sync(input);
}
```

### 3.6.2 GPIO\_leds Driver

#### 1) Device Definition

Linux-3.2.0-psp04.06.00.08.sdk/arch/arm/mach-omap2/board-am335xevm.c

Configure GPIO1.30 as "sys\_led" ( system indicator ) and GPIO1.31 as "user\_led", both lighted up by high level signal.

```
static struct gpio_led gpio_leds[] = {
    {
        .name           = "sys_led",
        .default_trigger = "heartbeat",
        .gpio            = GPIO_TO_PIN(1, 30),
    },
    {
```



```

        .name          = "user_led",
        .gpio          = GPIO_TO_PIN(1, 31),
    },
};

static struct gpio_led_platform_data gpio_led_info = {
    .leds              = gpio_leds,
    .num_leds          = ARRAY_SIZE(gpio_leds),
};

static struct platform_device leds_gpio = {
    .name              = "leds-gpio",
    .id                = -1,
    .dev               = {
        .platform_data = &gpio_led_info,
    },
};

```

## 2) GPIO pinmux Configuration

Linux-3.2.0-psp04.06.00.08.sdk/arch/arm/mach-omap2/board-am335xevm.c

Configure GPIO1.30 and GPIO1.31 as MODE7 (gpio mode) and  
AM33XX\_PIN\_OUTPUT (configuration output)

```

static struct pinmux_config gpio_led_pin_mux[] = {
    {"gpmc_csn1.gpio1_30",  OMAP_MUX_MODE7 | AM33XX_PIN_OUTPUT},
    {"gpmc_csn2.gpio1_31",  OMAP_MUX_MODE7 | AM33XX_PIN_OUTPUT},
    {NULL, 0},
};

```

## 3) Driver Design

Linux-3.2.0-psp04.06.00.08.sdk/drivers/leds/leds-gpio.c

### a) Call platform\_driver\_register to register gpio\_leds driver

```

static struct platform_driver gpio_led_driver = {
    .probe          = gpio_led_probe,
    .remove         = __devexit_p(gpio_led_remove),
    .driver         = {
        .name       = "leds-gpio",
        .owner      = THIS_MODULE,
        .of_match_table = of_gpio_leds_match,
    },
};

```

```
};

MODULE_ALIAS("platform:leds-gpio");

static int __init gpio_led_init(void)
{
    return platform_driver_register(&gpio_led_driver);
}

static void __exit gpio_led_exit(void)
{
    platform_driver_unregister(&gpio_led_driver);
}

module_init(gpio_led_init);
module_exit(gpio_led_exit);

MODULE_AUTHOR("Raphael Assenat <raph@8d.com>, Trent Piepho  
<tpiepho@freescale.com>");
MODULE_DESCRIPTION("GPIO LED driver");
MODULE_LICENSE("GPL");
```

**b)** Apply for gpio and call led\_classdev\_register to led\_classdev driver

```
static int __devinit gpio_led_probe(struct platform_device *pdev)
{
    ...

    if (pdata && pdata->num_leds) {
        priv = kzalloc(sizeof_gpio_leds_priv(pdata->num_leds),
                        GFP_KERNEL);
        if (!priv)
            return -ENOMEM;

        priv->num_leds = pdata->num_leds;
        for (i = 0; i < priv->num_leds; i++) {
            ret = create_gpio_led(&pdata->leds[i],
                                &priv->leds[i],
                                &pdev->dev,
                                pdata->gpio_blink_set);
            if (ret < 0) {
                /* On failure: unwind the led creations */
                for (i = i - 1; i >= 0; i--)
```

```

                                delete_gpio_led(&priv->leds[i]);
                                kfree(priv);
                                return ret;
                            }
                        }
                    }
...
}

static int __devinit create_gpio_led(const struct gpio_led *template,
                                     struct gpio_led_data *led_dat, struct device *parent,
                                     int (*blink_set)(unsigned, unsigned long *, unsigned long *))
{
    ...

    ret = gpio_request(template->gpio, template->name);
    ...

    ret = gpio_direction_output(led_dat->gpio, led_dat->active_low ^ state);
    ...

    ret = led_classdev_register(parent, &led_dat->cdev);
    ...
}

```

- c) Users may access the file named brightness under  
 /sys/class/leds/xxx/brightness, and call gpio\_led\_set to configure LED  
 status

```

static void gpio_led_set(struct led_classdev *led_cdev,
                        enum led_brightness value)
{
    ...

    gpio_set_value(led_dat->gpio, level);
}

```

## 3.7 System Update

### 3.7.1 Update of TF Card System Image

#### 1) Formatting TF Card

HP USB Disk Storage Format Tool 2.0.6 is recommended as the formatting tool:

Please download it from:

<http://www.embedinfo.com/english/download/SP27213.exe>

- a) Insert TF card into a card reader and then insert the reader into your PC.
- b) Open HP USB Disk Storage Format Tool to show the following window:

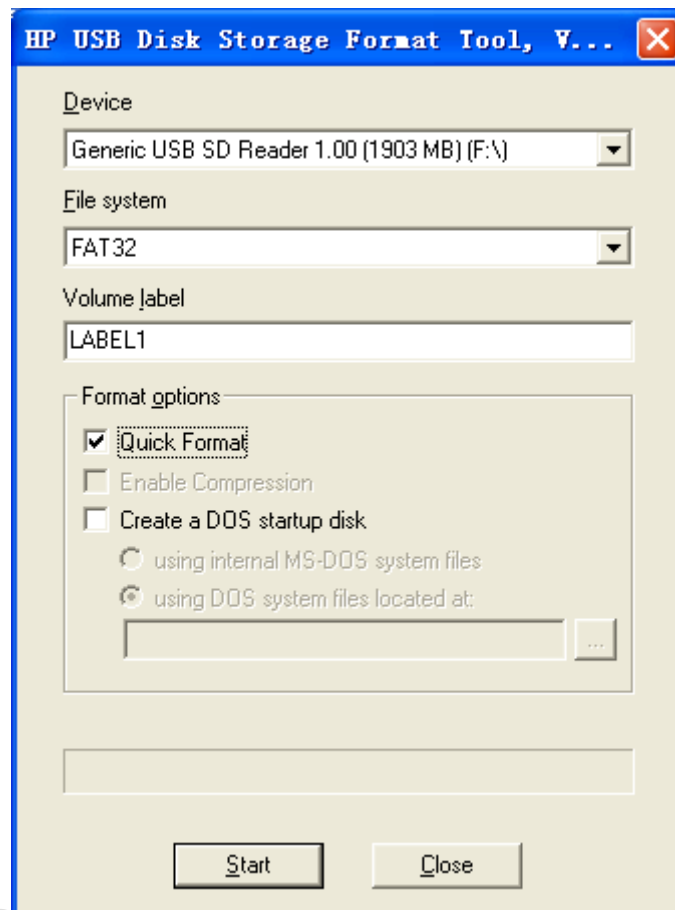



Figure 3-6

- c) Select "FAT32" file system
- d) Click "Start"
- e) When formatting is complete, click "OK"



**Note:**

 HP USB Disk Storage Format Tool will erase partitions of TF card. If you want to maintain the partitions, please use the formatting software of Windows.

## 2) Image update

Copy all files under the directory linux\image to the TF card, insert it on the board, and then power up the board. The information on serial interface will be shown as below:

### Note:

-  The default display is a 4.3-inch LCD. If you are working with the LCDs of other size, please enter u-boot when the board is booting up to configure the display mode, and then type boot to continue boot-up process. Please refer to 3.8.1 Selecting Display Mode for more details
-  If there is already an image in NAND Flash, you need to short the jumper **JP5** on the board so as to make it boot up from TF card. Disconnect JP5 after successful boot-up of the system.

```
Booting from MMC...
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.img

U-Boot 2011.09-svn55 (Dec 04 2012 - 09:29:02)

I2C:  ready
DRAM:  512 MiB
WARNING: Caches not enabled
Did not find a recognized configuration, assuming General purpose EVM in Profile 0
with Daughter board
NAND:  HW ECC Hamming Code selected
512 MiB
MMC:   OMAP SD/MMC: 0
*** Warning - bad CRC, using default environment

Net:   cpsw
Hit any key to stop autoboot:  0
SD/MMC found on device 0
reading uEnv.txt

** Unable to read "uEnv.txt" from mmc 0:1 **
```

```
reading ulmage

3224184 bytes read
reading ramdisk.gz

12514633 bytes read
## Booting kernel from Legacy Image at 80007fc0 ...
   Image Name:   Linux-3.2.0
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    3224120 Bytes = 3.1 MiB
   Load Address: 80008000
   Entry Point:  80008000
   Verifying Checksum ... OK
   XIP Kernel Image ... OK
OK

Starting kernel ...

Uncompressing Linux... done, booting the kernel.
Linux version 3.2.0 (luofc@TIOP) (gcc version 4.3.3 (Sourcery G++ Lite 2009q1-203) )
#17 Fri Dec 7 10:04:07 CST 2012
.....
.....
RAMDISK: gzip image found at block 0
VFS: Mounted root (ext2 filesystem) on device 1:0.
Freeing init memory: 260K
INIT: version 2.86 booting
Starting udevdevd (741): /proc/741/oom_adj is deprecated, please use
/proc/741/oom_score_adj instead.
tar: removing leading '/' from member names

Remounting root file system...
mount: mounting /dev/root on / failed: Invalid argument
mount: mounting /dev/root on / failed: Invalid argument
root: mount: mounting rootfs on / failed: No such file or directory
Setting up IP spoofing protection: rp_filter.
Configuring network interfaces... udhcpc (v1.11.3) started
Sending discover...
udhcpc: sendto: Network is down
Sending discover...
udhcpc: sendto: Network is down
```

```
Sending discover...
udhcpc: sendto: Network is down
No lease, failing
done.
Tue Jan 27 08:47:00 UTC 2009
INIT: Entering runlevel: 5
Starting syslogd/klogd: done

.....
|           |                               .-
|   |   |-----|-----|.||   .-----|-----|
|           |   |___|   --'|'--|   .'|   |       |
|   |   |   |   |   |-- ||   -'|   |   |   |||
'|---'|---'|   |-----"'---"'   '|---'|---'|
               -'|   |
               '|---'
```

The Angstrom Distribution SBC8600 ttyO0

Angstrom 2008.1-test-20090127 SBC8600 ttyO0

SBC8600 login: (**Type "root"**)

The above information indicates a successful boot-up of Linux from TF card.



### 3.7.2 Update of NAND Flash

Update of NAND boot-up image is accomplished by u-boot. No matter whether NAND Flash has data or not, u-boot can be used to update NAND Flash images.

- 1) Preparation
  - a) Format the TF card as FAT or FAT32 file system by using HP USB Disk Storage Format Tool 2.0.6
  - b) Copy files **MLO**, **u-boot.img**, **ulmage** and **ubi.img** from DVD-ROM into TF card.
- 2) Update

- a) Insert the TF card which contains the system images into the development board, and then connect power supply. Press any key on keyboard to enter the u-boot when a message "Hit any key to stop autoboot" appears:

**Note:**

-  You may short the jumper JP5 on the board to allow SBC8600B boot up from TF card and enter uboot to write the image in NAND Flash, and then disconnect JP5 to allow system boot up from NAND Flash.
-  Alternatively, you may leave **JP5** disconnected and insert TF card on the board to boot up from NAND Flash, and then write the image in NAND Flash through uboot.

```
U-Boot SPL 2011.09-svn55 (Nov 20 2012 - 10:37:42)
Texas Instruments Revision detection unimplemented
Booting from MMC...
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.img

U-Boot SPL 2011.09-svn55 (Nov 20 2012 - 10:37:42)
I2C:   ready
DRAM:  512 MiB
WARNING: Caches not enabled
Did not find a recognized configuration, assuming General purpose EVM in Profile 0
with Daughter board
NAND:  HW ECC Hamming Code selected
512 MiB
MMC:   OMAP SD/MMC: 0
*** Warning - bad CRC, using default environment

Net:   cpsw
Hit any key to stop autoboot:  0 (press any key to enter uboot)
```

- b) After entering the u-boot command line, type "run updatesys" to start update process of the system:



```
SBC8600# run updatesys
```

```
NAND erase.chip: device 0 whole chip
```

```
Erasing at 0x7fe0000 -- 100% complete.
```

```
OK
```

```
reading MLO
```

```
36079 bytes read
```

```
HW ECC BCH8 Selected
```

```
NAND write: device 0 offset 0x0, size 0x8cef
```

```
36079 bytes written: OK
```

```
reading u-boot.img
```

```
234896 bytes read
```

```
HW ECC BCH8 Selected
```

```
NAND write: device 0 offset 0x80000, size 0x39590
```

```
234896 bytes written: OK
```

```
reading ulmage
```

```
3224184 bytes read
```

```
HW ECC BCH8 Selected
```

```
NAND write: device 0 offset 0x280000, size 0x313278
```

```
3224184 bytes written: OK
```

```
reading ubi.img
```

```
14811136 bytes read
```

```
SW ECC selected
```

```
NAND write: device 0 offset 0x780000, size 0xe20000
```

```
Skip bad block 0x00ce0000
```

```
14811136 bytes written: OK
```

Flashing LED on the board indicates that the update has been finished; please remove TF and reboot the board.

### 3) U-boot configuration

The system image has a default setting for 4.3-inch LCD. You can change the settings in UBOOT according to the detailed instructions contained in 3.8.1

Selecting Display Mode.

## 3.8 Instructions

### 3.8.1 Selecting Display Mode

System supports a wide range of display mode. Users can change the display mode by modifying the U-Boot configure parameters.

#### How to enter the u-boot command mode:

Power on the board and press any key on PC's keyboard to enter u-boot when you see "Hit any key to stop autoboot" in your terminal window.

```
U-Boot SPL 2011.09-svn55 (Nov 20 2012 - 10:37:42)
Texas Instruments Revision detection unimplemented
Booting from MMC...
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.img

U-Boot SPL 2011.09-svn55 (Nov 20 2012 - 10:37:42)
I2C:  ready
DRAM:  512 MiB
WARNING: Caches not enabled
Did not find a recognized configuration, assuming General purpose EVM in Profile 0
with Daughter board
NAND:  HW ECC Hamming Code selected
512 MiB
MMC:   OMAP SD/MMC: 0
*** Warning - bad CRC, using default environment

Net:   cpsw
Hit any key to stop autoboot:  0 (press any key to enter uboot)
```

### 3.8.1.1 Using a 4.3" LCD Display

Modify the parameter by executing the command as follows in the U-boot command mode.

```
SBC8600# setenv dispmode 4.3inch_LCD
```

```
SBC8600# saveenv
```

### 3.8.1.2 Using a 7" LCD Display

Modify the parameter by executing the command as follows in the U-boot command mode.

```
SBC8600# setenv dispmode 7inch_LCD
```

```
SBC8600# saveenv
```

### 3.8.1.3 Using a VGA Display

Modify the parameter by executing the command as follows in the U-boot command mode.

```
SBC8600# setenv dispmode VGA
```

```
SBC8600# saveenv
```

### 3.8.1.4 Using a LVDS Display

Modify the parameter by executing the command as follows in the U-boot command mode.

```
SBC8600# setenv dispmode LVDS
```

```
SBC8600# saveenv
```

## 3.8.2 Testing

### 3.8.2.1 LED Testing

The D35 LED on the board is the system indicator, D36 is an user custom LED.

The following operations are accomplished in HyperTerminal:

4) Controlling system indicator

```
root@SBC8600:~# echo 1 > /sys/class/leds/sys_led/brightness
```

```
root@SBC8600:~# echo 0 > /sys/class/leds/sys_led/brightness
```

5) Controlling user custom LED

```
root@SBC8600:~# echo 1 > /sys/class/leds/user_led/brightness
```

```
root@SBC8600:~# echo 0 > /sys/class/leds/user_led/brightness
```

The LED will respond accordingly to the instructions.

### 3.8.2.2 KEYPAD Testing

The board has two user custom keys, BACK and MENU. You can test them by executing the following instructions.

```
root@SBC8600:~# evtest /dev/input/event1
Input driver verevdev: (EVIOCGBIT): Suspicious buffer size 511
Input device ID: bus 0x19 vendor 0x1 product 0x1 version 0x100
Input device name: "gpio-keys"
Supported events:
  Event type 0 (Sync)
  Event type 1 (Key)
    Event code 1 (Esc)
    Event code 59 (F1)
Testing ... (interrupt to exit)
Event: time 1233046135.256046, type 1 (Key), code 1 (Esc), value 1
Event: time 1233046135.256053, ----- Report Sync -----
Event: time 1233046135.426967, type 1 (Key), code 1 (Esc), value 0
Event: time 1233046135.426970, ----- Report Sync -----
Event: time 1233046136.373255, type 1 (Key), code 59 (F1), value 1
Event: time 1233046136.373260, ----- Report Sync -----
Event: time 1233046136.548841, type 1 (Key), code 59 (F1), value 0
```

Event: time 1233046136.548844, ----- Report Sync -----

**Note:**

 Press Ctrl+C to quit the test. These combined keys can be used to quit any following test.

### 3.8.2.3 Touch Screen Testing

This test requires that Linux system boots up from NAND Flash.

- 1) Execute the following instruction to test touch-screen

```
root@SBC8600: # ts_calibrate
```

The information on LCD will guide you to click the icon "+" for 5 times to complete the calibration.

- 2) Calibration is complete, enter the following commands for Touch Panel Test

```
root@SBC8600: # ts_test
```

Select drawing dots or drawing lines from the prompt information to start testing.

### 3.8.2.4 Backlight Testing

The backlight brightness has a range from 0 to 100, in which 100 means highest brightness, 0 means lowest.

Execute the following instructions to test backlight brightness.

- 1) View the default brightness

```
root@SBC8600:~# cat /sys/class/backlight/pwm-backlight/brightness  
80
```

- 2) Set the brightness to 0

```
root@SBC8600:~# echo 0 > /sys/class/backlight/pwm-backlight/brightness
root@SBC8600:~# cat /sys/class/backlight/pwm-backlight/brightness
0
```

Now backlight is turned off and the LCD shows a black screen.

**3) Set the brightness to 100**

```
root@SBC8600:~# echo 100 > /sys/class/backlight/pwm-backlight/brightness
root@SBC8600:~# cat /sys/class/backlight/pwm-backlight/brightness
100
```

The screen is turned on.

### 3.8.2.5 RTC Testing

The development board contains hardware clock to save and synchronize the system time.

Test can be accomplished with the following steps:

**1) Set the system time as Mar 22 20:00:00 2012**

```
root@SBC8600: # date 032220002012
Thu Mar 22 20:00:00 UTC 2012
```

**2) Write the system clock into RTC**

```
root@SBC8600: # hwclock -w
```

**3) Read the RTC**

```
root@SBC8600: # hwclock
Thu Mar 22 20:00:10 2012  0.000000 seconds
```



We can see that the RTC clock has been set as Mar 22, 2012; the system clock will be saved in the hardware clock.

**4) Restart the system; enter the following commands to update the system clock**

```
root@SBC8600: # hwclock -s
root@SBC8600: # date
Thu Mar 22 20:01:30 2012  0.000000 seconds
```

We can see the system time is set as hardware time.

**Note:**

-  You may find the RTC stop running in the scenario where the board is powered off and then powered on again. This is caused by the bug of the CPU. Please refer to the errata provided by TI.
-  The development board does not have a RTC battery (model CR1220) by default; and users need to use a battery of their own.

### 3.8.2.6 TF Card Testing

- 1) After inserting TF card, the system will mount the TF card under the directory /media automatically:

```
root@SBC8600:~# df -h
```

| Filesystem     | Size   | Used   | Available | Use% | Mounted on       |
|----------------|--------|--------|-----------|------|------------------|
| rootfs         | 31.0M  | 19.7M  | 11.3M     | 64%  | /                |
| /dev/root      | 31.0M  | 19.7M  | 11.3M     | 64%  | /                |
| none           | 250.6M | 684.0k | 249.9M    | 0%   | /dev             |
| tmpfs          | 250.6M | 20.0k  | 250.6M    | 0%   | /var/volatile    |
| tmpfs          | 250.6M | 0      | 250.6M    | 0%   | /dev/shm         |
| tmpfs          | 250.6M | 3.0M   | 247.6M    | 1%   | /media/ram       |
| /dev/mmcblk0p1 | 1.8G   | 101.8M | 1.8G      | 5%   | /media/mmcblk0p1 |

- 2) Enter the following command to see the contents inside the TF card:

```
root@SBC8600:~# ls /media/mmcblk0p1
```

|            |         |         |
|------------|---------|---------|
| u-boot.img | mlo     | ulimage |
| ramdisk.gz | ubi.img |         |

- 3) Unmount TF card manually.

```
root@SBC8600:~# umount /media/mmcblk0p1
```

- 4) Mount TF card manually.

```
root@SBC8600:~# mount -t vfat /dev/mmcblk0p1 /mnt/cf
```


```
root@SBC8600:~# df -h
```

| Filesystem     | Size   | Used   | Available | Use% | Mounted on |
|----------------|--------|--------|-----------|------|------------|
| rootfs         | 31.0M  | 19.7M  | 11.3M     | 64%  | /          |
| ...            |        |        |           |      |            |
| tmpfs          | 250.6M | 3.0M   | 247.6M    | 1%   | /media/ram |
| /dev/mmcblk0p1 | 1.8G   | 101.8M | 1.8G      | 5%   | /media/cf  |

```
root@SBC8600:~# ls /media/cf
```

|            |         |        |
|------------|---------|--------|
| u-boot.img | mlo     | ulmage |
| ramdisk.gz | ubi.img |        |

**Note:**

 The system can mount the TF card automatically when you insert it on the board. However, we recommend mounting it manually because automatic mounting leads to slow writing speed.

### 3.8.2.7 USB DEVICE Testing

USB DEVICE testing is accomplished by using a cable to connect the miniUSB interface of the development board to the USB interface on PC; The development board is recognized by PC as a network device so that the two ends may communicate by Ping command.

- 1) After system boot-up, please use a USB cable to connect the development board to your PC. The Linux USB Ethernet driver needs to be installed on PC. Please refer to Appendix III Installation of Linux USB Ethernet/RNDIS Gadget for detailed information
- 2) Executing the following commands in the HyperTerminal:

```

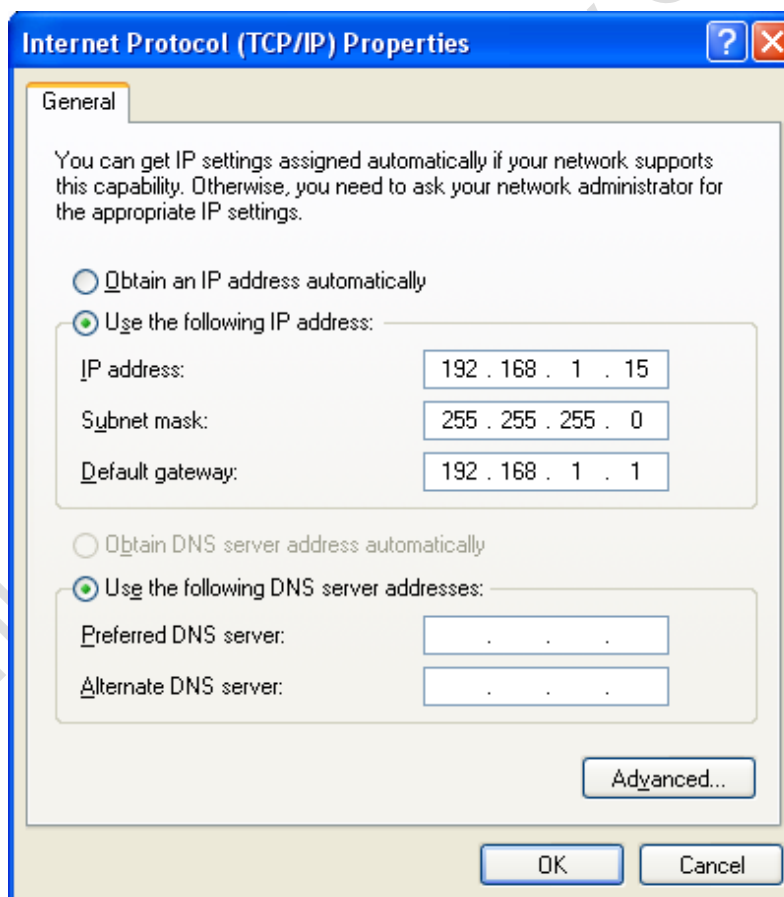
root@SBC8600:~# ifconfig usb0 192.168.1.115
root@SBC8600:~# ifconfig
lo          Link encap:Local Loopback
            inet addr:127.0.0.1  Mask:255.0.0.0
            UP LOOPBACK RUNNING  MTU:16436  Metric:1
            RX packets:26 errors:0 dropped:0 overruns:0 frame:0
            TX packets:26 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:0
            RX bytes:2316 (2.2 KiB)  TX bytes:2316 (2.2 KiB)

usb0       Link encap:Ethernet  HWaddr 5E:C5:F6:D4:2B:91
  
```



```
inet addr:192.168.1.115 Bcast:192.168.1.255 Mask:255.255.255.0
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:253 errors:0 dropped:0 overruns:0 frame:0
TX packets:43 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:35277 (34.4 KiB) TX bytes:10152 (9.9 KiB)
```

- 3) After the development board is configured, please click My Computer > Network Neighborhood > Check Network Connection, a virtual network adapter will be added into the PC.
- 4) Right-click virtual network adapter on PC and select "Attribute", and then double-click the "Internet Protocol (TCP/IP)" to configure the IP address of the virtual network adapter:




**Figure 3-7**

- 5) Use ping command in the HyperTerminal to test whether the settings of the development board are successful:

```
root@SBC8600:~# ping 192.168.1.15
PING 192.168.1.15 (192.168.1.15): 56 data bytes
64 bytes from 192.168.1.15: seq=0 ttl=128 time=0.885 ms
64 bytes from 192.168.1.15: seq=1 ttl=128 time=0.550 ms
```

- 6) The above information indicates a successful testing.

#### Note:

 IP address of the network adapter configured in OTG should not be as same as that of Ethernet interface.

### 3.8.2.8 USB HOST Testing

- 1) After inserting USB flash disk on the board, the system will mount disk under the directory `/media` automatically;

```
root@SBC8600:~# df -h
Filesystem      Size      Used Available Use% Mounted on
rootfs          31.0M    19.7M    11.3M   64% /
/dev/root       31.0M    19.7M    11.3M   64% /
none            250.6M    684.0k    249.9M    0% /dev
tmpfs           250.6M     20.0k    250.6M    0% /var/volatile
tmpfs           250.6M      0      250.6M    0% /dev/shm
tmpfs           250.6M     3.0M    247.6M    1% /media/ram
/dev/sda1       99.2M     3.3M    95.9M    3% /media/sda1

root@SBC8600:~# ls /media/sda1/
MLO    u-boot.img  ulmage
```

- 2) Unmount USB disk manually;

```
root@SBC8600:~# cd /home/root
```

```
root@SBC8600:~# umount /media/sda1/
```

- 3) Type command `df`. The absence of directory `/media/sda1/` indicates that the USB disk is unmounted successfully;

```
root@SBC8600:~# df
```

| Filesystem     | 1k-blocks | Used   | Available | Use% | Mounted on       |
|----------------|-----------|--------|-----------|------|------------------|
| rootfs         | 31729     | 20185  | 11544     | 64%  | /                |
| /dev/root      | 31729     | 20185  | 11544     | 64%  | /                |
| none           | 256624    | 684    | 255940    | 0%   | /dev             |
| /dev/mmcblk0p1 | 1939712   | 104316 | 1835396   | 5%   | /media/mmcblk0p1 |
| tmpfs          | 256624    | 20     | 256604    | 0%   | /var/volatile    |
| tmpfs          | 256624    | 0      | 256624    | 0%   | /dev/shm         |
| tmpfs          | 256624    | 3104   | 253520    | 1%   | /media/ram       |

#### 4) Mount USB disk manually;

```
root@SBC8600:~# mount -t vfat /dev/sda1 /mnt/card/
```

```
root@SBC8600:~# df -h
```

| Filesystem | Size   | Used   | Available | Use% | Mounted on    |
|------------|--------|--------|-----------|------|---------------|
| rootfs     | 31.0M  | 19.7M  | 11.3M     | 64%  | /             |
| /dev/root  | 31.0M  | 19.7M  | 11.3M     | 64%  | /             |
| none       | 250.6M | 684.0k | 249.9M    | 0%   | /dev          |
| tmpfs      | 250.6M | 20.0k  | 250.6M    | 0%   | /var/volatile |
| tmpfs      | 250.6M | 0      | 250.6M    | 0%   | /dev/shm      |
| tmpfs      | 250.6M | 3.0M   | 247.6M    | 1%   | /media/ram    |
| /dev/sda1  | 99.2M  | 3.3M   | 95.9M     | 3%   | /media/card   |

### 3.8.2.9 AUDIO Testing

The board has audio input and output interfaces. Users can enter the following instructions to test alsa-utils audio player and recorder in the file system:

#### 1) Audio Recorder Testing

Plug in a microphone to test the audio recorder.

```
root@SBC8600:~# arecord -t wav -c 1 -r 44100 -f S16_LE -v k
```

Recording WAVE 'k' : Signed 16 bit Little Endian, Rate 44100 Hz, Mono

Plug PCM: Route conversion PCM (sformat=S16\_LE)

Transformation table:

$$0 <- 0*0.5 + 1*0.5$$

Its setup is:

|           |                  |
|-----------|------------------|
| stream    | : CAPTURE        |
| access    | : RW_INTERLEAVED |
| format    | : S16_LE         |
| subformat | : STD            |
| channels  | : 1              |

```

rate      : 44100
exact rate : 44100 (44100/1)
msbits    : 16
buffer_size : 32768
period_size : 2048
period_time : 46439
tstamp_mode : NONE
period_step : 1
avail_min  : 2048
period_event : 0
start_threshold : 1
stop_threshold : 32768
silence_threshold: 0
silence_size : 0
boundary   : 1073741824
.....

```

## 2) Playback Testing

Plug in a headphone to listen to what you recorded.

```

root@SBC8600:~# aplay -t wav -c 2 -r 44100 -f S16_LE -v k
Playing WAVE 'k' : Signed 16 bit Little Endian, Rate 44100 Hz, Mono
Plug PCM: Route conversion PCM (sformat=S16_LE)

Transformation table:
    0 <- 0
    1 <- 0

Its setup is:
stream      : PLAYBACK
access      : RW_INTERLEAVED
format      : S16_LE
subformat   : STD
channels     : 1
rate        : 44100
exact rate   : 44100 (44100/1)
msbits      : 16
buffer_size  : 32768
period_size  : 2048
period_time  : 46439
tstamp_mode  : NONE
period_step  : 1
avail_min    : 2048
period_event : 0


```

```
start_threshold : 32768
stop_threshold : 32768
silence_threshold: 0
silence_size : 0
boundary : 1073741824
.....
```

### 3.8.2.10 Network Testing

- 1) There are two Ethernet interfaces, NET1 (J1) and NET2 (J2), associated with two device nodes, eth0 and eth1. Please use two network cables to connect the interfaces to a network and ensure that the IP addresses of the interfaces are set in different network segments.

#### Note:

 the IP addresses of the two network interfaces need to be set in different network segments, or the testing would be failed..

```
[root@SBC8600/]# ifconfig eth0 192.192.192.200
[root@SBC8600/]# ifconfig

eth0      Link encap:Ethernet  HWaddr D4:94:A1:8D:EB:25
          inet addr:192.192.192.200 Bcast:192.192.192.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:137 errors:0 dropped:4 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:13792 (13.4 KiB)  TX bytes:0 (0.0 B)
          Interrupt:40

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

[root@SBC8600/]# ping 192.192.192.170
PING 192.192.192.170 (192.192.192.170): 56 data bytes
```

```
64 bytes from 192.192.192.170: seq=0 ttl=128 time=4.486 ms
64 bytes from 192.192.192.170: seq=1 ttl=128 time=0.336 ms
[root@SBC8600/]# ifconfig eth1 192.168.168.116
[root@SBC8600/]# ifconfig
eth1      Link encap:Ethernet  HWaddr 00:17:EA:96:34:D5
          net addr:192.168.168.116  Bcast:192.168.168.255
Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

Lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

[root@SBC8600/]# ping 192.168.168.121
PING 192.168.168.121 (192.168.168.121): 56 data bytes
64 bytes from 192.168.168.121: seq=0 ttl=64 time=7.969 ms
64 bytes from 192.168.168.121: seq=1 ttl=64 time=0.319 ms
```

- 2) The above information indicates a successful network testing.

### 3.8.2.11 CAN Testing

SBC8600B can be working as a CAN device. Please connect the CAN interfaces on your SBC8600B and another CAN device according to the board schematic and the figure shown below:

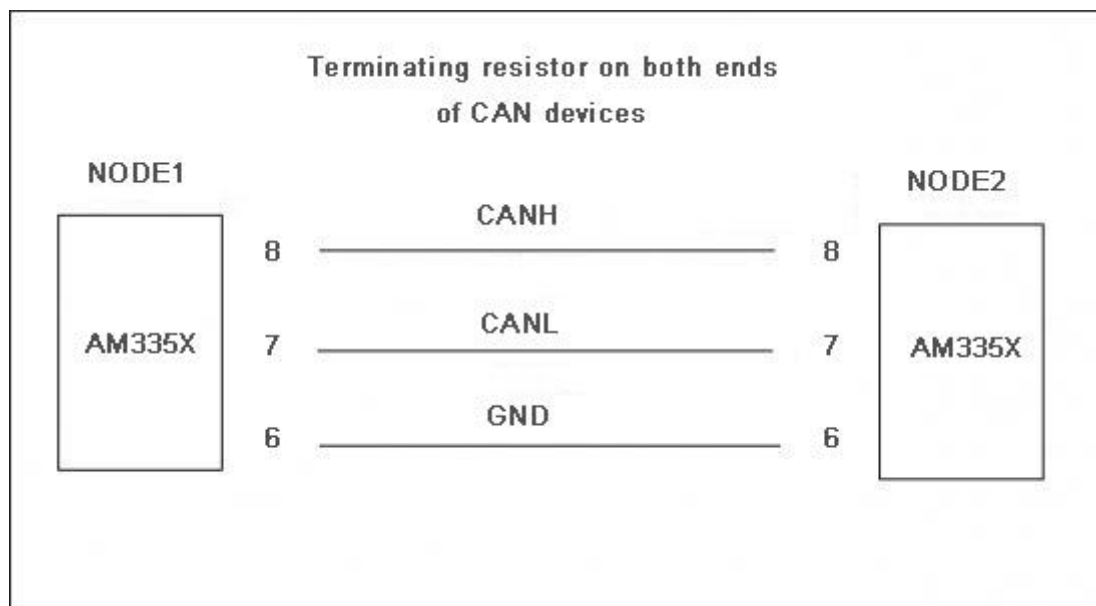


Figure 3-8

**Follow the steps listed below to complete CAN testing**

- 1) Set the communication bit rate to 125KBPS for both SBC8600B and the other CAN device, and enable CAN devices.

```
root@SBC8600:~# canconfig can0 bitrate 125000 ctrlmode triple-sampling on
```

```
root@SBC8600:~# canconfig can0 start
```

- 2) Transmit and receive data on the two devices respectively by typing the following instructions.

```
root@SBC8600:~# cansend can0 -i 0x10 0x11 0x22 0x33 0x44 0x55 0x66 0x77 0x88
```

**Note:**

- The instruction sends data only once. Type it again to send another data package.
- The receiving device needs to remain in receiving status so that the received information can be shown in the terminal window.

- 3) Receiving data package;

```
root@SBC8600:~# candump can0
```

The terminal window will print the information of the received data package

- 4) Stop the CAN device

```
root@SBC8600:~# canconfig can0 stop
```

Users can test with different bit rates by using the instructions above. CAN device need to be stopped before it is reconfigured. The following list contains the bit rate that can be used to testing.

25KBPS (250000)

50KBPS (50000)

125KBPS (125000)


500KBPS (500000)

650KBPS (650000)

1MKBPS (1000000 )

You can also try other bit rates that have not been listed here.

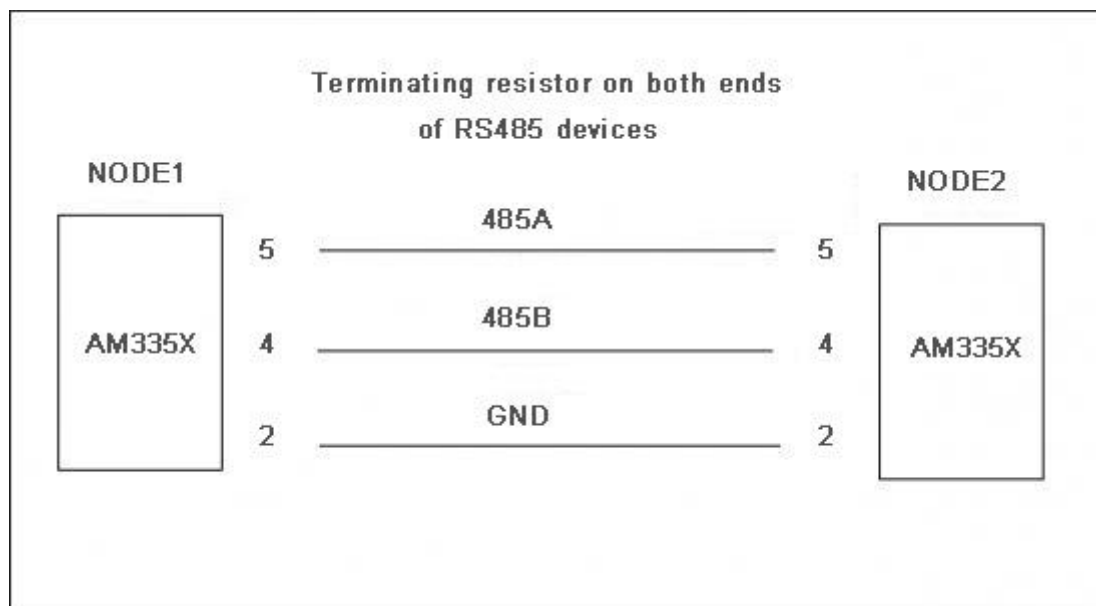
**Note:**

 Same bit rate has to be applied when testing over two development boards.

### 3.8.2.12 RS485 Testing

Please connect the RS485 interfaces on both SBC8600B and another device according to board schematic and the figure shown below:





**Figure 3-9**

RS485 interface works under half-duplex mode, which means each of two ends can only send or receive data at a time. Copy the file `uart_test` under `linux\example\uart_test` into TF card, and then insert the card on SBC8600B and execute the following instructions;

```

root@SBC8600:~# cd /media/mmcblk0p1/
root@SBC8600:/media/mmcblk0p1# ./uart_test -d /dev/ttyO1 -b 115200
/dev/ttyO1 SEND: 1234567890
/dev/ttyO1 RECV 10 total
/dev/ttyO1 RECV: 1234567890
/dev/ttyO1 SEND: 1234567890
/dev/ttyO1 RECV 10 total
/dev/ttyO1 RECV: 1234567890
/dev/ttyO1 SEND: 1234567890
/dev/ttyO1 RECV 10 total
/dev/ttyO1 SEND: 1234567890
/dev/ttyO1 RECV 10 total

```

### 3.8.2.13 Serial Interface Testing

Short the pins RX3V3 and TX3V3 of J5 on the board and copy the file `uart_test` under `linux\example\uart_test` into TF card, and then insert it on the board. Execute the following instructions in the terminal window;

```

root@SBC8600:~# cd /media/mmcblk0p1/

```

```
root@SBC8600:/media/mmcblk0p1# ./uart_test -d /dev/ttyO2 -b 115200
```

The following information in the terminal window indicates a successful testing.

```
dev/ttyO2 SEND: 1234567890
/dev/ttyO2 RECV 10 total
/dev/ttyO2 RECV: 1234567890
/dev/ttyO2 SEND: 1234567890
/dev/ttyO2 RECV 10 total
/dev/ttyO2 RECV: 1234567890
/dev/ttyO2 SEND: 1234567890
/dev/ttyO2 RECV 10 total
/dev/ttyO2 RECV: 1234567890
/dev/ttyO2 SEND: 1234567890
/dev/ttyO2 RECV 10 total
/dev/ttyO2 RECV: 1234567890
/dev/ttyO2 SEND: 1234567890
/dev/ttyO2 RECV 10 total
/dev/ttyO2 RECV: 1234567890
```

The same testing method can be applied on serial interface 3, 4 and 5 of J6 and J7 on SBC8600B

#### 3.8.2.14 Buzzer Testing

- 1) Enable the buzzer;

```
root@SBC8600:~# echo 1 > /sys/class/misc/buzzer_ctl/state
```

- 2) Disable the buzzer

```
root@SBC8600:~# echo 0 > /sys/class/misc/buzzer_ctl/state
```

#### 3.8.2.15 CDMA8000-U Module

CDMA8000-U is an optional module. You can download the relevant materials at

<http://www.timll.com/chinese/uploadFile/cdma8000.rar>

### 3.8.3 Demo

#### 3.8.3.1 Android System Demonstration

SBC8600B provides Android system demonstration, please follow the steps listed below:

- 1) Copy all files under the directory \linux\demo\Android\image of the DVD-ROM to a TF card;
- 2) Insert the TF card on the board and short jumper JP5, and then power on the board. The debugging tool will show the following information:

```
CCCCCCCC
U-Boot SPL 2011.09-svn55 (Dec 04 2012 - 09:36:25)
Texas Instruments Revision detection unimplemented
Booting from MMC...
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.img

U-Boot 2011.09-svn55 (Nov 22 2012 - 11:35:28)

I2C:  ready
DRAM:  512 MiB
WARNING: Caches not enabled
Did not find a recognized configuration, assuming General purpose EVM in Profile 0
with Daughter board
NAND:  HW ECC Hamming Code selected
512 MiB
MMC:   OMAP SD/MMC: 0
*** Warning - bad CRC, using default environment

NAND erase.chip: device 0 whole chip
Skipping bad block at 0x03620000
Erasing at 0x1ffe0000 -- 100% complete.
OK
reading MLO

36079 bytes read
```

```
HW ECC BCH8 Selected

NAND write: device 0 offset 0x0, size 0x8cef
36079 bytes written: OK
reading flash-uboot.img

234620 bytes read
HW ECC BCH8 Selected

NAND write: device 0 offset 0x80000, size 0x3947c
234620 bytes written: OK
reading ulmage

2719416 bytes read
HW ECC BCH8 Selected

NAND write: device 0 offset 0x280000, size 0x297eb8
2719416 bytes written: OK
reading ubi.img

72744960 bytes read
SW ECC selected

NAND write: device 0 offset 0x780000, size 0x4560000
72744960 bytes written: OK
```

- 3) When the writing process is complete, on-board LED will be flashing. Please remove TF card and the jumper cap.
- 4) Power on the board again to load Android operating system;
- 5) U-boot configuration

The system image has a default setting for 4.3-inch LCD. You can change the settings in UBOOT according to the detailed instructions contained in 3.8.1 Selecting Display Mode.

### 3.8.3.2 TISDK System Demonstration

- 1) Format a TF card into two partitions by following the steps described in Appendix IV Formatting Linux Boot Disk;

- 2) Insert DVD-ROM and TF card on PC, and then execute the following instructions;

```
cp /media/cdrom/linux/demo/tisdk/image/MLO /media/LABEL1
cp /media/cdrom/linux/demo/tisdk/image/u-boot.img /media/LABEL1
cp /media/cdrom/linux/demo/tisdk/image/ulmage/media/LABEL1/ulmage
rm -rf /media/LABEL2/*
sudo tar xvf
/media/cdrom/linux/demo/tisdk/image/tisdk-rootfs-am335x-evm.tar.gz -C
/media/LABEL2
sync
umount /media/LABEL1
umount /media/LABEL2
```

- 3) After the above instructions are executed, please short jumper **JP5** and insert TF card on the board, and then plug in the power supply. The boot-up information is shown as below:

```
CCCCCCCC
U-Boot SPL 2011.09-svn55 (Dec 04 2012 - 09:33:23)
Texas Instruments Revision detection unimplemented
Booting from MMC...
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.img

U-Boot 2011.09-svn55 (Dec 04 2012 - 09:33:23)

I2C:   ready
DRAM:  512 MiB
WARNING: Caches not enabled
Did not find a recognized configuration, assuming General purpose EVM in Profile 0
with Daughter board
NAND:  HW ECC Hamming Code selected
512 MiB
MMC:   OMAP SD/MMC: 0
*** Warning - bad CRC, using default environment

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

```
Booting from dvsdk ...
reading ulmage

3175384 bytes read
## Booting kernel from Legacy Image at 80007fc0 ...
   Image Name:   Linux-3.2.0
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    3175320 Bytes = 3 MiB
   Load Address: 80008000
   Entry Point:  80008000
   Verifying Checksum ... OK
   XIP Kernel Image ... OK

OK
Starting kernel ...
.....                //Omitted part
Arago Project http://arago-project.org am335x-evm ttyO0

Arago 2011.09 am335x-evm ttyO0

am335x-evm login: root    //Type root to log in
```

- 4) TISDK file system is featured with some applications running on QT which allow users find and run example programs easily through a friendly graphic interface.

- 5) U-boot configuration

The system image supports 4.3-inch display by default. If you are working with a display of other size, you need to modify the parameters in UBOOT. Please refer to 3.8.1 Selecting Display Mode for details.

### 3.9 The Development of Applications

This section mainly introduces the development of application programs, and illustrates the general process of application programs development through examples.

#### Development example of LED application program

- 1) Composing Source Code

The following sentences are led\_acc.c source code: control the three LEDs on the development board to flash in a way of accumulator.

```
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/ioctl.h>
#include <fcntl.h>

#define LED1 "/sys/class/leds/sys_led/brightness"
#define LED2 "/sys/class/leds/user_led/brightness"

int main(int argc, char *argv[])
{
    int f_led1, f_led2;
    unsigned char i = 0;
    unsigned char dat1, dat2;
    if((f_led1 = open(LED1, O_RDWR)) < 0){
        printf("error in open %s", LED1);
        return -1;
    }
    if((f_led2 = open(LED2, O_RDWR)) < 0){
        printf("error in open %s", LED2);
        return -1;
    }
    for(;;){
        i++;
        dat1 = i&0x1 ? '1':'0';
        dat2 = (i&0x2)>>1 ? '1':'0';
        write(f_led1, &dat1, sizeof(dat1));
        write(f_led2, &dat2, sizeof(dat2));
        usleep(300000);
    }
}
```

## 2) Cross compiling

```
arm-none-linux-gnueabi-gcc led_acc.c -o led_acc
```

## 3) Downloading and running

Downloading to the development board system through TF card, USB flash disk or network and enter the directory where the led\_acc file is saved, and then execute the following instructions to run led\_acc in the background.

```
./led_acc &
```

Embest Technology Co., Ltd



# Chapter 4 Windows Embedded Compact 7 Operating System

## 4.1 Introduction

This section mainly introduces SBC8600B system and application development of Windows Embedded Compact 7, as well as software resources in DVD-ROM, software features, and installation of development environment, and how to compile project and build BSP (board support package)

## 4.2 Software Resources

### **BSP (Board Support Package)**

CD\WINCE700\BSP\SBC8600.rar

CD\WINCE700\BSP\COMMON\_TI\_V1.rar

CD\WINCE700\BSP\3rdParty.rar

CD\WINCE700\BSP\PowerVR.rar

### **Windows Embedded Compact 7 sample project**

CD\WINCE700\project\SBC8600

### **Example applications**

CD\WINCE700\app\

### **Pre-compiled image**

CD\WINCE700\Image\

MLO

First bootloader for TF card boot

|              |                                       |
|--------------|---------------------------------------|
| xldrnanb.nb0 | First bootloader for NAND flash boot  |
| Ebootsd.nb0  | Second bootloader for TF card boot    |
| Ebootnd.nb0  | Second bootloader for NAND flash boot |
| Nk.bin       | WinCE runtime image                   |

## 4.3 Features

Resources in BSP

Table 21

| Catalog                         | Item                      | Source code / binary |
|---------------------------------|---------------------------|----------------------|
| X-Loader<br>(First boot loader) | NAND                      | Source               |
|                                 | SD                        | Source               |
| EBOOT<br>(Second boot loader)   | NAND                      | Source               |
|                                 | SD                        | source               |
| OAL                             | Boot parameter            | Source               |
|                                 | KILT(EMAC)                | Source               |
|                                 | Serial debug              | Source               |
|                                 | REBOOT                    | Source               |
|                                 | Watchdog                  | Source               |
|                                 | RTC                       | Source               |
|                                 | Kernel profiler           | Source               |
|                                 | System timer              | Source               |
|                                 | Interrupt controller      | Source               |
|                                 | MMU                       | Source               |
| Driver                          | NLED driver               | Source               |
|                                 | GPIO/I2C/SPI/MCASP driver | Source               |
|                                 | Serial port driver        | Source               |
|                                 | Audio driver              | Source               |
|                                 | NAND driver               | Source               |
|                                 | Display driver            | Source               |
|                                 | TOUCH driver              | Source               |
|                                 | SD/MMC/SDIO driver        | Source               |
|                                 | EMAC driver               | Source               |
|                                 | USB OTG driver            | Source               |

|     |                      |                 |
|-----|----------------------|-----------------|
|     | GPIO keyboard driver | Source          |
|     | DMA driver           | Source          |
|     | Backlight driver     | Source          |
|     | Battery driver       | Source          |
|     | RPU driver           | Source          |
| SDK | powerVR DDK & SDK    | Binary & Source |

## 4.4 System Development

### 4.4.1 Installation of IDE (Integrated Development Environment)

Please install the software listed below under windows XP

- 1) Visual Studio 2008
- 2) Visual Studio 2008 SP1
- 3) Windows Embedded Compact 7
- 4) Windows Embedded Compact 7 Updates
- 5) ActiveSync 4.5

**Note:**


 The DVD-ROM doesn't contain the IDE for Windows Embedded Compact 7. Please download it from <http://www.microsoft.com/download/en/default.aspx>.

### 4.4.2 Extract BSP and project files to IDE

Please follow the steps listed below:

- 1) Uncompress [CD\WINCE700\BSP\SBC8600.rar] to [C:\WINCE700\PLATFORM]
- 2) Uncompress [CD\WINCE700\BSP\COMMON\_TI\_V1.rar] to [C:\WINCE700\PLATFORM\COMMON\SRC\SOC]
- 3) Uncompress [CD\WINCE700\BSP\3rdParty.rar] to [C:\WINCE700]
- 4) Uncompress [CD\WINCE700\BSP\powerVR.rar] to [C:\WINCE700\public]
- 5) Copy [CD\WINCE700\project\SBC8600] to [C:\WINCE700\OSDesigns]

**Note:**

 The default installation directory of Windows Embedded Compact 7 is [C:\WINCE700] hereafter.

### 4.4.3 Sysgen & BSP Compilation

Please follow the steps listed below to build Sysgen and BSP:

- 1) Open the existing project file SBC8600.sln under [C:\WINCE700\OSDesigns\SBC8600]
- 2) Select [Build-> Build Solution] in VS2008 to start the process of sysgen and BSP compilation.
- 3) Copy the files MLO, EBOOTSD.nb0 and NK.bin under [C:\WINCE700\OSDesigns\SBC8600\SBC8600\RelDir\SBC8600\_ARMV7\_Release] to the TF card after compilation is done.
- 4) Insert TF card on SBC8600B and power it on.

### 4.4.4 Introduction of Drivers

This table lists out all the drivers and the directories under which they are saved:

**Table 22**

|                    |  |
|--------------------|--|
| NLED driver        | BSP\SBC8600\SRC\DRIVERS\NLED   |
| GPIO               | BSP\SBC8600\SRC\DRIVERS\GPIO<br>BSP\COMMON_TI_V1\COMMON_TI_AMXX\GPIO   |
| I2C                | BSP\COMMON_TI_V1\COMMON_TI_AMXX\OAL\OALI2C                             |
| SPI                | BSP\COMMON_TI_V1\COMMON_TI_AMXX\SPI<br>BSP\SBC8600\SRC\DRIVERS\MCSPI   |
| MCASP driver       | BSP\COMMON_TI_V1\COMMON_TI_AMXX\MCASP                                  |
| Serial port driver | BSP\COMMON_TI_V1\COMMON_TI_AMXX\SERIAL<br>BSP\SBC8600\SRC\DRIVERS\UART |
| Audio driver       | BSP\SBC8600\SRC\DRIVERS\WAVEDEV2                                       |
| NAND driver        | BSP\SBC8600\SRC\DRIVERS\BLOCK  |

|                      |   |
|----------------------|---|
|                      | BSP\COMMON_TI_V1\COMMON_TI_AMXX\BLOCK   |
| Display driver       | BSP\COMMON_TI_V1\COMMON_TI_AMXX\DSS_Netra<br>BSP\SBC8600\SRC\DRIVERS\DISPLAY                            |
| TOUCH driver         | BSP\SBC8600\SRC\DRIVERS\TOUCH   |
| SD/MMC/SDIO driver   | BSP\SBC8600\SRC\DRIVERS\SDHC<br>BSP\COMMON_TI_V1\COMMON_TI_AMXX\SDHC<br>BSP\COMMON_TI_V1\COMMON_TI\SDHC |
| EMAC driver          | BSP\COMMON_TI_V1\AM33X\CPSW3Gminiport<br>BSP\SBC8600\SRC\DRIVERS\EMAC                                   |
| USB OTG driver       | BSP\SBC8600\SRC\DRIVERS\USB<br>BSP\COMMON_TI_V1\AM33X\USB   |
| GPIO keyboard driver | BSP\SBC8600\SRC\DRIVERS\KEYPAD  |
| Backlight driver     | BSP\SBC8600\SRC\DRIVERS\BACKLIGHT   |
| Battery driver       | BSP\SBC8600\SRC\DRIVERS\BATTERY   |
| PRU driver           | BSP\COMMON_TI_V1\AM33X\PRU<br>BSP\SBC8600\SRC\DRIVERS\PRU   |
| DMA driver           | BSP\SBC8600\SRC\DRIVERS\EDMA<br>BSP\COMMON_TI_V1\COMMON_TI_AMXX\EDMA                                    |

If users want to see more examples of driver development under Windows Embedded Compact 7, please refer to the reference document provided with PB7.0.

You can find the document on your PC by clicking:

Start->

All Programs->

Microsoft Visual Studio 2008->

Microsoft Visual Studio 2008 Document->

Content(C) ->

Windows Embedded Compact 7->Device Driver.

## 4.5 Update of System Image

SBC8600B can boot up from TF card and NAND Flash; this section will introduce two different ways of system update respectively.

### 4.5.1 Update of TF Card

#### 1) Formatting TF card

HP USB Disk Storage Format Tool 2.0.6 is recommended as the formatting tool;

You can download it from <http://www.embedinfo.com/english/download/SP27213.exe>

- a) Insert TF card into a card reader and then insert the reader into PC.
- b) Open the HP USB Disk Storage Format Tool, the following window will appear.

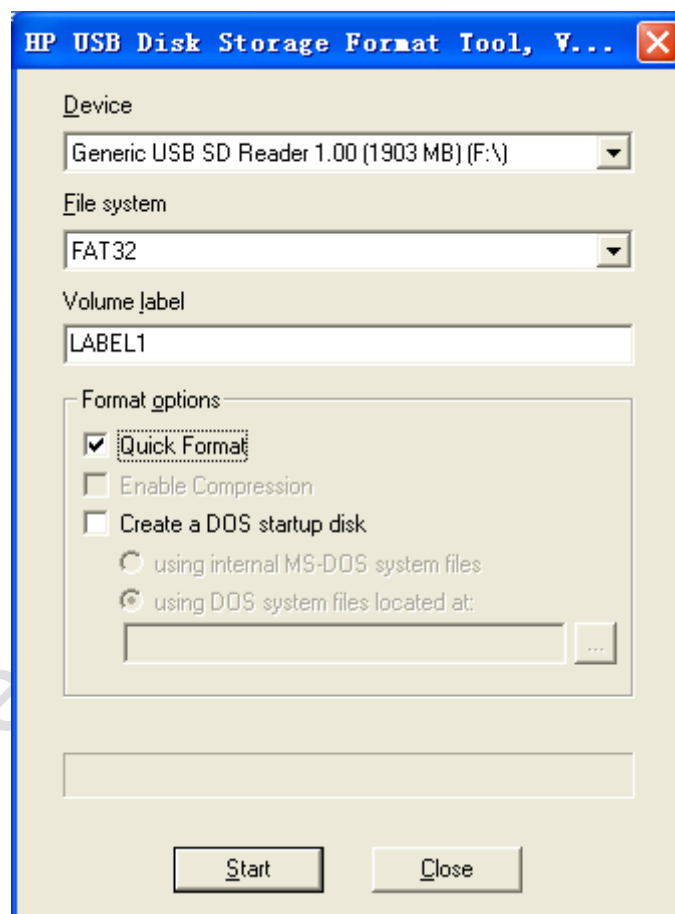



Figure 4-1

- c) Select "FAT32" file system
- d) Click "Start"
- e) Click "OK" when it's complete

**Note:**

 HP USB Disk Storage Format Tool will erase partitions of TF card. If you want to maintain the partitions, please use the formatting software of Windows.

**2) Copy runtime image**

Copy **MLO**, **EBOOTSD.nb0** and **NK.bin** image files under CD\WINCE700\image to the TF card;

**3) System Boot-up**

Insert TF card and short jumper **JP5**, reboot the system from TF card and press Space in a few seconds to enter to the EBOOT menu as shown below:

**a) Enter EBOOT Menu**

```
CCCCCCCC
Texas Instruments Windows CE SD X-Loader33X
Built Jul 27 2012 at 11:25:59
Version BSP_WINCE_ARM_A8 02.30.00.03
open ebootsd.nb0 file
Init HW: controller RST
SDCARD: requested speed 1000000, actual speed 1000000
SDCARD: requested speed 25000000, actual speed 19200000
read ebootsd.nb0 file

jumping to ebootsd image

Microsoft Windows CE Bootloader Common Library Version 1.4 Built Jul 27 2012
11:23:05
I2C EEPROM returned wrong magic value 0xffffffff
INFO:OALLogSetZones: dpCurSettings.ulZoneMask: 0x8409

Texas Instruments Windows CE EBOOT for AM33x, Built Jul 27 2012 at 11:25:53
EBOOT Version 0.0.1, BSP BSP_WINCE_ARM_A8 02.30.00.03
AHCLKX pinmux:0
AHCLKX CTRL:0x8001
pin function:0x0
pin dir:0x80000000

TI AM33X
```

```
ecc type:3
System ready!
Preparing for download...
INFO: Predownload...
Checking bootloader blocks are marked as reserved (Num = 18)

BOOT_CFG_SIGNATURE is different, read -1, expect 1111705159
WARN: Boot config wasn't found, using defaults
INFO: SW3 boot setting: 0x04
IsValidMBR: MBR sector = 0x480 (valid MBR)
OpenPartition: Partition Exists=0x1 for part 0x20.

>>> Forcing cold boot (non-persistent registry and other data will be wiped) <<<
e0311800 56e4 -> 0 18 31 e0 e4 56
e0311800 57e4 -> 0 18 31 e0 e4 57
Hit space to enter configuration menu [56] 5...(press SPACE to enter EBOOT menu)
```

**b) Type [2]->[2] to set the board to boot up from TF card**

```
-----
Main Menu
-----

[1] Show Current Settings
[2] Select Boot Device
[3] Select KITL (Debug) Device
[4] Network Settings
[5] SDCard Settings
[6] Set Device ID
[7] Save Settings
[8] Flash Management
[9] Enable/Disable OAL Retail Messages
[a] Select Display Resolution
[b] Select OPP Mode
[0] Exit and Continue

Selection: 2

-----

Select Boot Device
-----

[1] Internal EMAC
```



```
[2] NK from SDCard FILE
[3] NK from NAND
[0] Exit and Continue

Selection (actual Internal EMAC): 2
Boot device set to NK from SDCard FILE
```

- c)** Type [a] to enter “Select Display Resolution” menu and select LCD\LVDS as the output

```
-----
Main Menu
-----

[1] Show Current Settings
[2] Select Boot Device
[3] Select KITL (Debug) Device
[4] Network Settings
[5] SDCard Settings
[6] Set Device ID
[7] Save Settings
[8] Flash Management
[9] Enable/Disable OAL Retail Messages
[a] Select Display Resolution
[b] Select OPP Mode
[0] Exit and Continue

Selection: a

-----
Select Display Resolution
-----

[1] LCD  480x272 60Hz           //For 4.3-inch LCD
[2] DVI  640x480 60Hz(N/A)
[3] DVI  640x480 72Hz(N/A)
[4] LCD  800x480 60Hz           //For 7-inch LCD
[5] DVI  800x600 60Hz(N/A)      //For LVDS
[6] DVI  800x600 56Hz(N/A)
[7] VGA 1024x768 60Hz           //For VGA
[8] DVI 1280x720 60Hz(N/A)
[0] Exit and Continue Selection (actual LCD  480x272 60Hz): 4
```

- d)** Type [0] to continue the boot-up process

-----  
Main Menu  
-----

- [1] Show Current Settings
- [2] Select Boot Device
- [3] Select KITL (Debug) Device
- [4] Network Settings
- [5] SDCard Settings
- [6] Set Device ID
- [7] Save Settings
- [8] Flash Management
- [9] Enable/Disable OAL Retail Messages
- [a] Select Display Resolution
- [b] Select OPP Mode
- [0] Exit and Continue

Selection: 0

mode = 3

LcdPdd\_LCD\_GetMode:3

mode = 3

LcdPdd\_LCD\_Initialize:3

OEMPreDownload: Filename nk.bin

Init HW: controller RST

SDCARD: requested speed 1000000, actual speed 1000000

SDCARD: requested speed 25000000, actual speed 19200000

BL\_IMAGE\_TYPE\_BIN

+OEMMultiBinNotify(0x8feb24d8 -> 1)

Download file information:

-----  
[0]: Address=0x80002000 Length=0x03c9e9bc Save=0x80002000  
-----

Download file type: 1

+OEMIsFlashAddr(0x80002000) g\_eboot.type 1

.....rom\_offset=0x0.

..ImageStart = 0x80002000, ImageLength = 0x3c9e9bc, LaunchAddr = 0x8000b6a0

Completed file(s):

```
-----  
+OEMIsFlashAddr(0x80002000) g_eboot.type 1  
[0]: Address=0x80002000 Length=0x3c9e9bc Name="" Target=RAM  
ROMHDR at Address 80002044h  
Launch Windows CE image by jumping to 0x8000b6a0...  
  
Windows CE Kernel for ARM (Thumb Enabled)  
CPU CP15 Control Register = 0xc5387f  
CPU CP15 Auxiliary Control Register = 0x42  
I2C EEPROM returned wrong magic value 0xffffffff  
+OALTimerInit(1, 24000, 200)  
--- High Performance Frequency is 24 MHz---
```

## 4.5.2 Update of NAND Flash Image

### 1) Formatting TF card

Please refer to the contents of 4.5.1 Update of TF Card.

### 2) Copy runtime image

Copy **MLO**, **EBOOTND.nb0**, **NK.bin**, **XLDRNAND.nb0** and **EBOOTSD.nb0** image files under CD\WINCE700\image to the TF card.

### 3) Update of NAND Flash image files

Insert TF card and short jumper JP5, reboot the system from TF card and press Space in a few seconds to enter to the EBOOT menu, and then follow the steps listed below:

- Type [8] to enter the Flash menu;
- Type [9]->[4]->[A], [9]->[3]->[B] and [9]->[2]->[C] to write XLDR, EBOOT and NK images;
- Type [0] to return to the main menu, and then type [2] and [3] to select boot-up from NAND Flash; Type [A] to select LCD/DVI display mode; Type [7] and [y] to save the boot-up settings;

Remove TF card and the jumper cap, reboot the system. The system will boot from NAND Flash.

## 4.6 Instructions for Use

### 4.6.1 How to use OpenGL ES demo

- 1) Check PowerVR in the Catalog Items View of VS2008 as shown below;

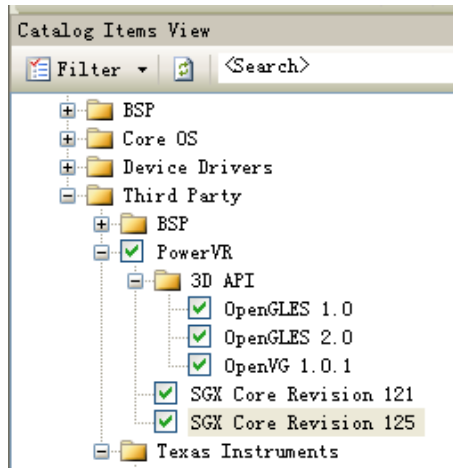


Figure 4-2

- 2) Select [Build-> Build Solution] in the menu bar of VS2008, and then replace the nk.bin in the TF card with the newly generated nk.bin after sysgen and BSP compilation is complete.
- 3) Copy C:\WINCE700\PUBLIC\PowerVR\oak\target\Rev125\ARMV4\retail\\*.exe to the windows embedded compact 7 system of SBC8600B, and then double-click the demo to start testing.

## 4.7 Application Development

This chapter introduces how to develop Windows Embedded Compact 7 applications for SBC8600B.

### 4.7.1 Application Interfaces and Examples

API used for development of SBC8600B applications is the standard application interface defined by Windows Embedded Compact 7. SBC8600B has extended the interface definition of GPIO based on the standard API. You can find the applications used to control the status of GPIO pins under \WINCE700\app\GPIOAppDemo of the DVD-ROM. Please refer to the help documents for MSDN Windows Embedded Compact 7 API to learn about the definitions of Windows Embedded Compact 7 standard API.

### 4.7.2 GPIO Application Interfaces and Examples

GPIO application interfaces and examples:

**Table 23**

| <b>IOCTL code</b>  | <b>Description</b>                     |
|--------------------|--|
| IOCTL_GPIO_SETBIT  | Set GPIO pin as 1                      |
| IOCTL_GPIO_CLRBIT  | Set GPIO pin as 0                      |
| IOCTL_GPIO_GETBIT  | Read GPIO pin                          |
| IOCTL_GPIO_SETMODE | Set the working mode of GPIO pin       |
| IOCTL_GPIO_GETMODE | Read the working mode of GPIO pin      |
| IOCTL_GPIO_GETIRQ  | Read the corresponding IRQ of GPIO pin |

Please follow the steps listed below:

- 1) Enable GPIO device

```
HANDLE hFile = CreateFile (_T ("GIO1:"), (GENERIC_READ|GENERIC_WRITE),
(FILE_SHARE_READ|FILE_SHARE_WRITE), 0, OPEN_EXISTING, 0, 0);
```

- 2) Configure GPIO operating mode

```
DWORD id = 48, mode = GPIO_DIR_OUTPUT;
```

Configure GPIO operating mode

```
DWORD pInBuffer [2];
pInBuffer [0] = id;
pInBuffer [1] = mode;
DeviceIoControl (hFile, IOCTL_GPIO_SETMODE, pInBuffer, sizeof (pInBuffer),
NULL, 0, NULL, NULL);
```

Read mode of GPIO:

```
DeviceIoControl (hFile, IOCTL_GPIO_GETMODE, &id, sizeof(DWORD), &mode,
sizeof(DWORD), NULL, NULL);
```

"id" refers to the pin code of GPIO, "mode" refers to the mode definition of GPIO, including:

**Table 24**

| Mode Definition      | Description               |
|----------------------|---------------------------|
| GPIO_DIR_OUTPUT      | Output mode               |
| GPIO_DIR_INPUT       | Input mode                |
| GPIO_INT_LOW_HIGH    | Rising edge trigger mode  |
| GPIO_INT_HIGH_LOW    | Falling edge trigger mode |
| GPIO_INT_LOW         | low level trigger mode    |
| GPIO_INT_HIGH        | high level trigger mode   |
| GPIO_DEBOUNCE_ENABLE | Jumping trigger enable    |

Table 4-4

### 3) Output of GPIO pins

**DWORD id = 48, pinState = 0;**

#### a) High level output:

```
DeviceIoControl (hFile, IOCTL_GPIO_SETBIT, &id, sizeof (DWORD), NULL, 0,
NULL, NULL);
```

#### b) Low level output

```
DeviceIoControl (hFile, IOCTL_GPIO_CLRBIT, &id, sizeof (DWORD), NULL, 0,
NULL, NULL);
```

#### c) Read the pin state

```
DeviceIoControl (hFile, IOCTL_GPIO_GETBIT, &id, sizeof (DWORD), &pinState,
sizeof (DWORD), NULL, NULL);
```

"id" refers to the pin code of GPIO, "pin" return the pin state.

### 4) Other Operations

Read the corresponding IRP number of GPIO pin:



```
DWORD id = 0, irq = 0;
DeviceIoControl (hFile, IOCTL_GPIO_GETIRQ, &id, sizeof (DWORD), &irq, sizeof
(DWORD), NULL, NULL);
```

"id" refers to pin code of GPIO, "irq" returns IRQ number.

**5) Disable GPIO device**

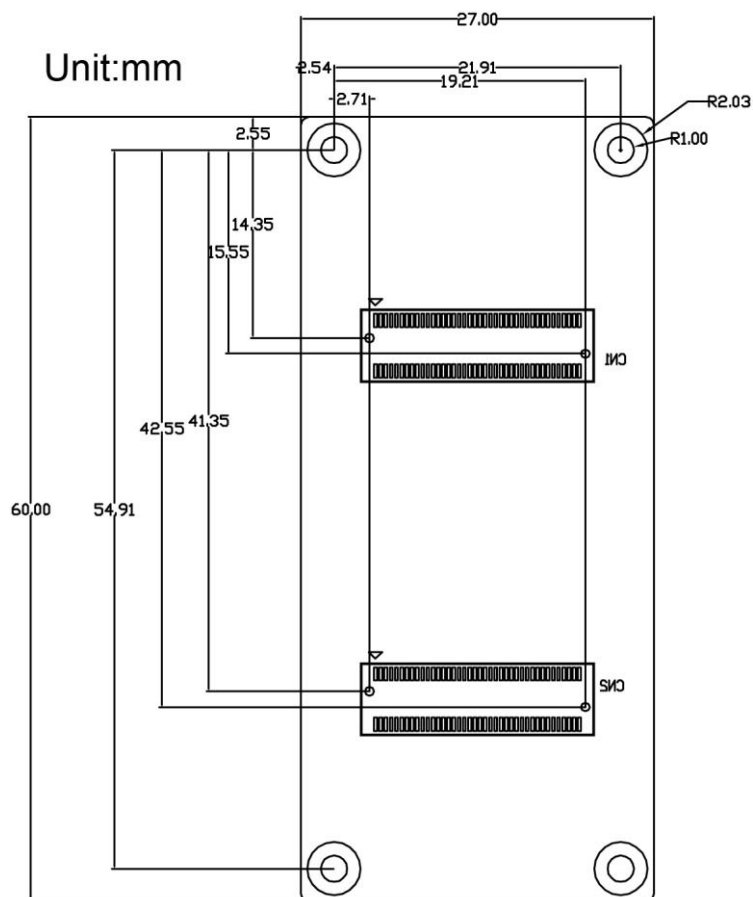
**CloseHandle (hFile);**

**Note:**

-  Definition of GPIO pin: 0~127 MPU Bank0~3 GPIO pin.
-  GPIO pins 0~127 must be configured as GPIO in bsp\_padcfg.h located at SBC8600/SRC/inc/.

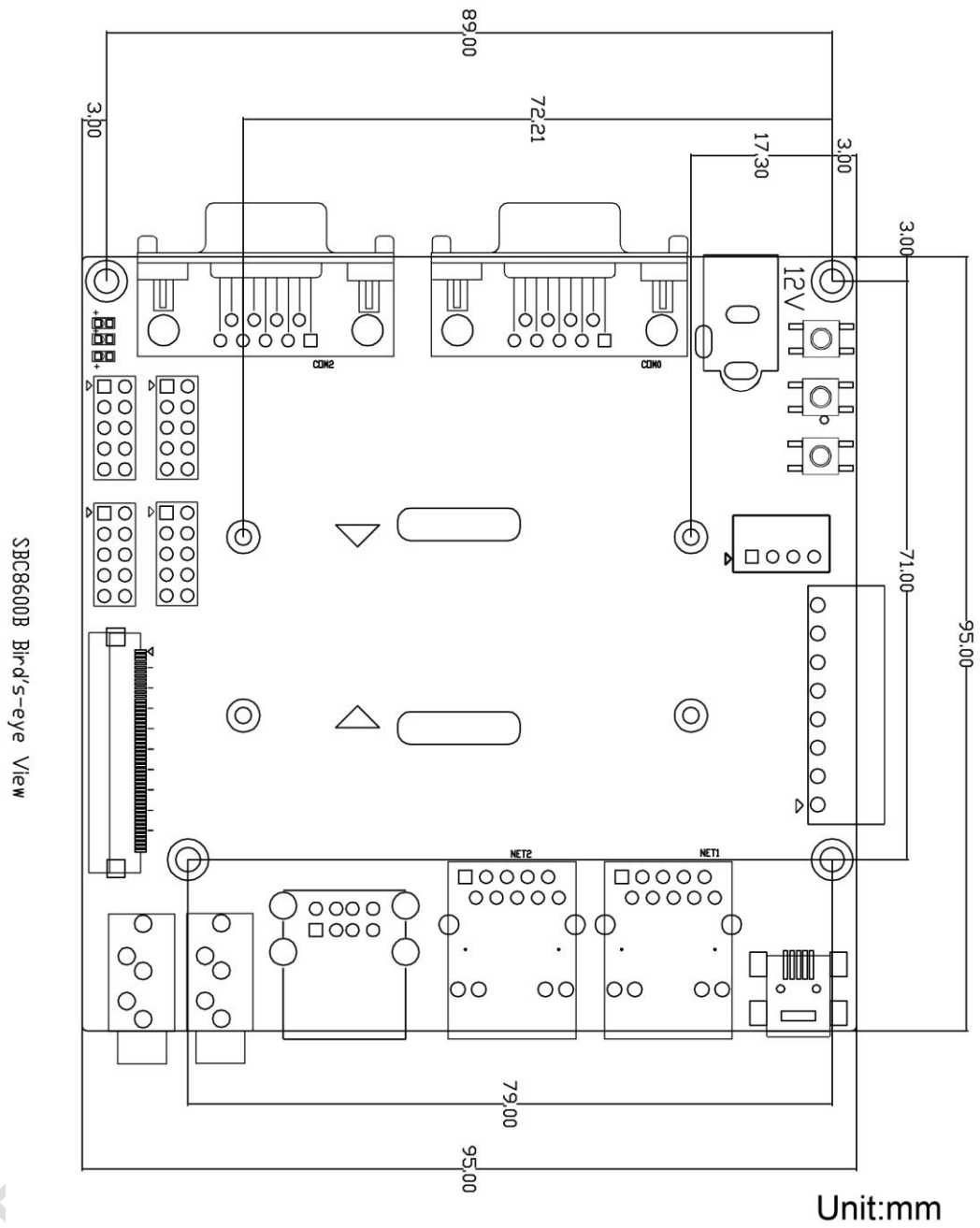
# Appendix

## Appendix I Hardware Dimension



**Figure 1** Mini8600B hardware dimension





**Figure 2** SBC8600B hardware dimension

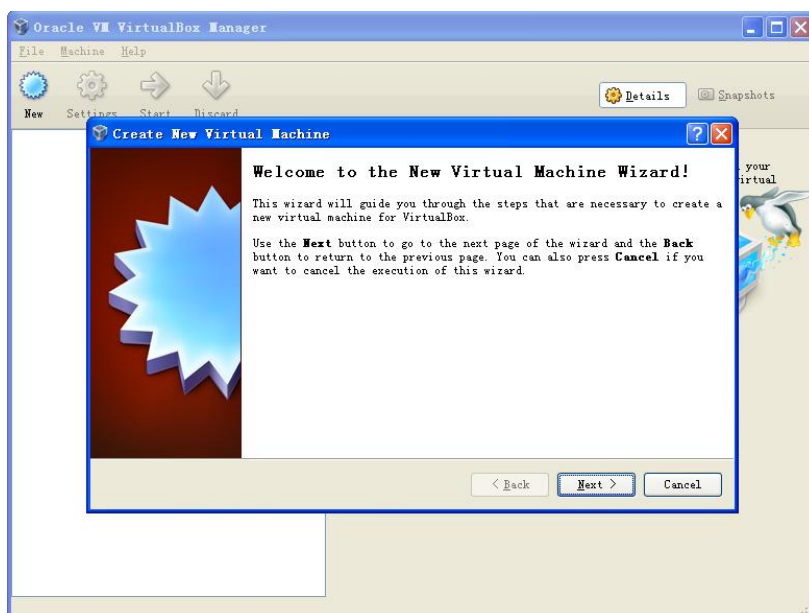
## Appendix II Installation of Ubuntu

As we all know, an appropriate development environment is required for software development. The CD-ROM attached with product has contained a development environment which needs to be installed under Linux system. If you are working on a PC running Windows, you have to create a Linux system first, and then you can install the environment. Here we recommend using VirtualBox – a virtual machine software to accommodate Ubuntu Linux system under Windows. The following sections will introduce the installation processes of VirtualBox and Ubuntu system.

### Installing VirtualBox

You can access <http://www.virtualbox.org/wiki/Downloads> to download the latest version of VirtualBox. VirtualBox requires 512MB memory space at least. A PC with memory space of more than 1GB would be preferred.

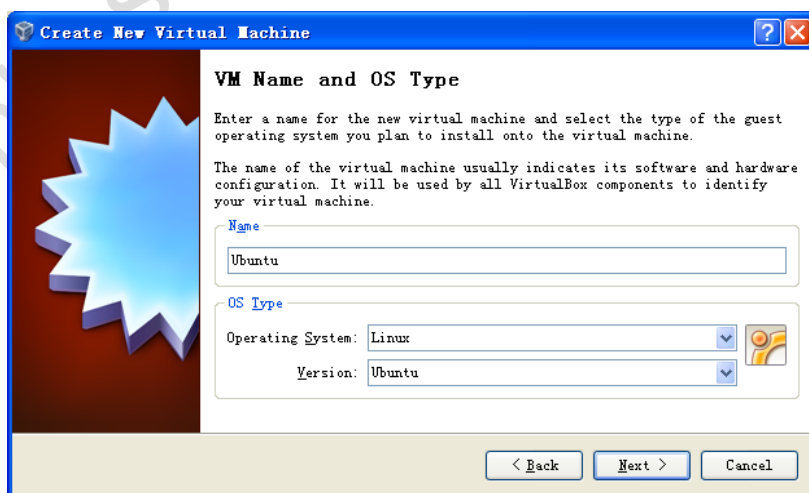
- 1) The installation process is simple and will not be introduced. Please start VirtualBox from the **Start** menu of Windows, and then click **New** in VirtualBox window. A pop-up window **Create New Virtual Machine** will be shown as below;



**Figure 3** Create new virtual machine

Click **Next** to create a new virtual machine.

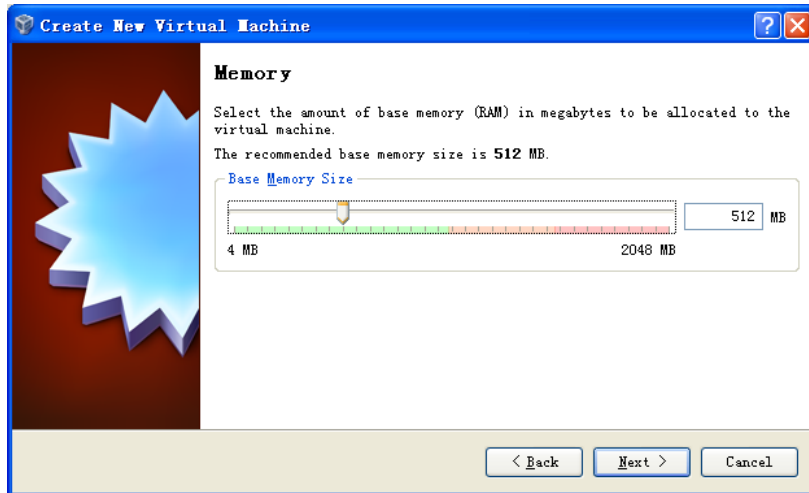
- 2) Enter a name for the new virtual machine and select operating system type as shown below;



**Figure 4** Name and OS type of virtual machine

Enter a name in the **Name** field, e.g. Ubuntu, and select **Linux** in the **Operating System** drop-down menu, and then click **Next**.

- 3) Allocate memory to virtual machine and then click **Next**;

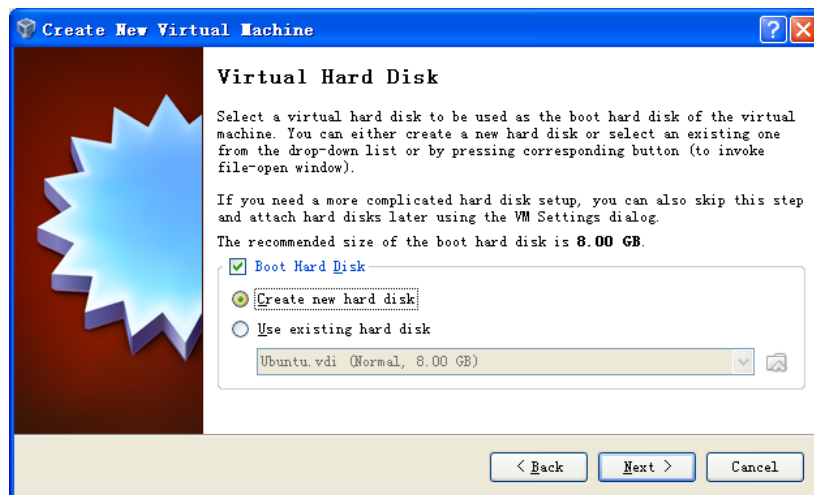


**Figure 5** Memory allocation

**Note:**

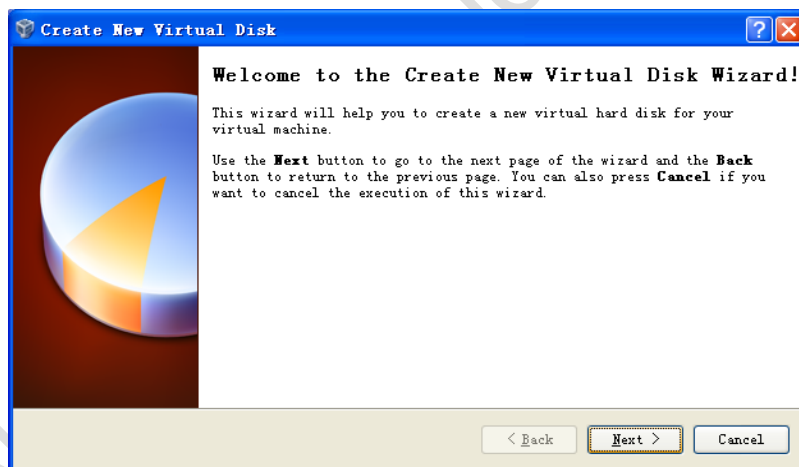
- 📖 If the memory of your PC is only 1GB or lower, please keep the default setting;
- 📖 If the memory of your PC is higher than 1GB, you can allocate 1/4 or fewer to virtual machine, for example, 512MB out of 2GB memory could be allocated to virtual machine.

- 4) If this is the first time you install VirtualBox, please select **Create new hard disk** in the following window, and then click **Next**;



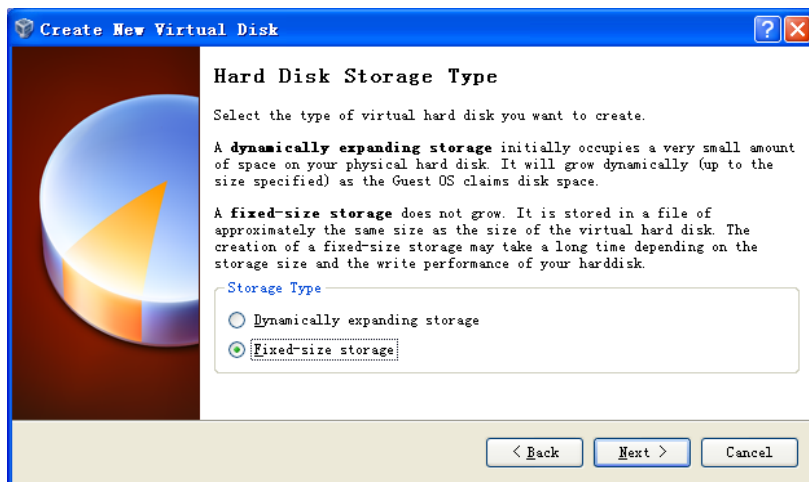
**Figure 6** Create new hard disk

- 5) Click **Next** in the following window;



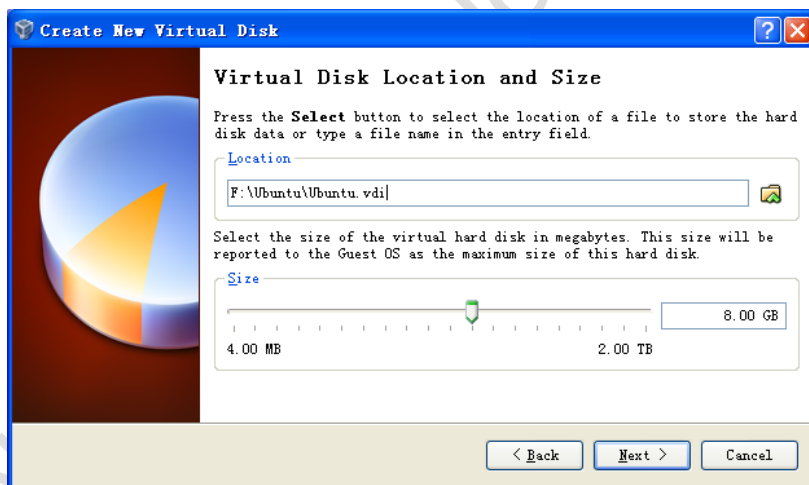
**Figure 7** Wizard of new virtual disk creation

- 6) Selecting **Fixed-size storage** in the following window and click **Next**;



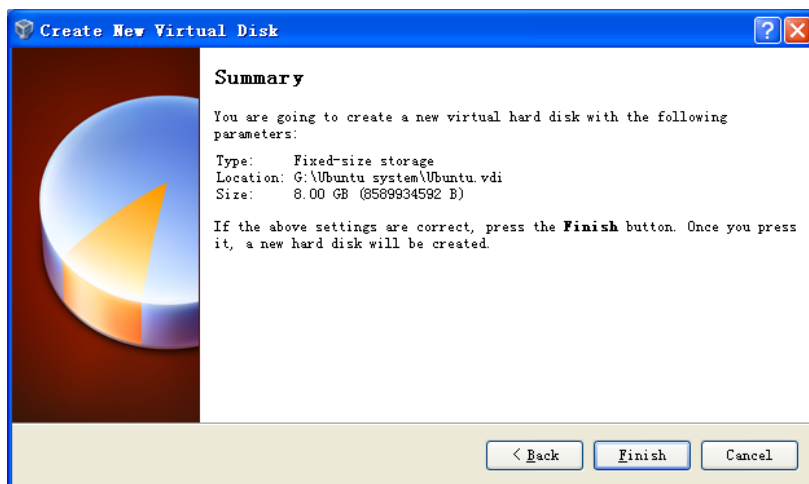
**Figure 8** Select the second option

- 7) Define where the hard disk data is stored and the default space of the virtual disk (8G at least), and then click **Next**;



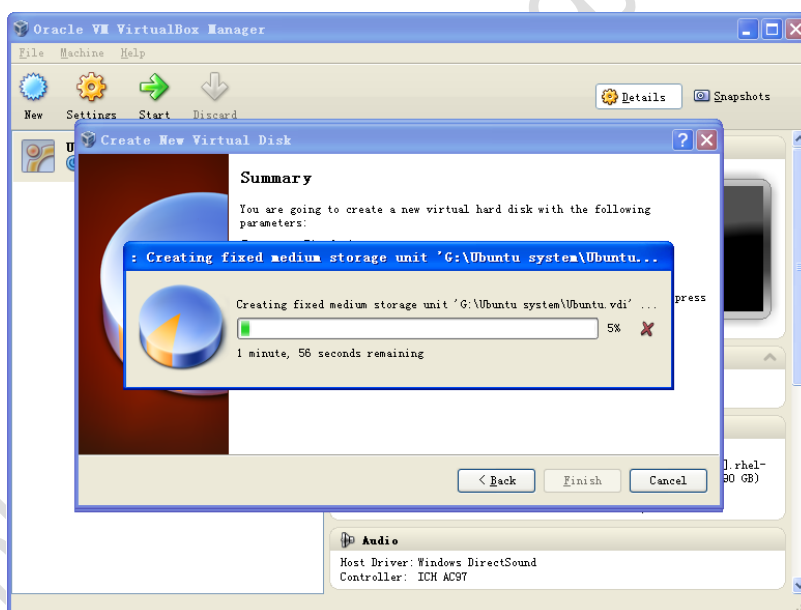
**Figure 9** Virtual disk configuration

- 8) Click Finish in the following window;



**Figure 10** Virtual disk summary

- 9) PC is creating a new virtual disk;



**Figure 11** Virtual disk creation in process

- 10) A window with summary of the newly created virtual machine will be shown as below when the creation process is done. Please click **Finish** to complete the whole process.

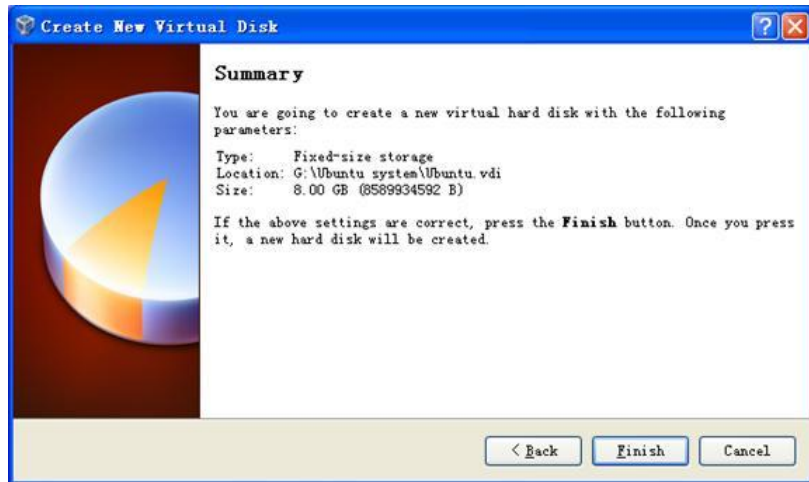


Figure 12 Virtual machine is ready



## Installing Ubuntu Linux System

After virtualBox is installed, we can start the installation of Ubuntu Linux system now. Please access <http://www.Ubuntu.com/download/Ubuntu/download> to download the ISO image file of Ubuntu, and then follow the steps.

- 1) Start VirtualBox from the **Start** menu and click **Setting** on the VirtualBox window. A **Settings** window will be shown as below;

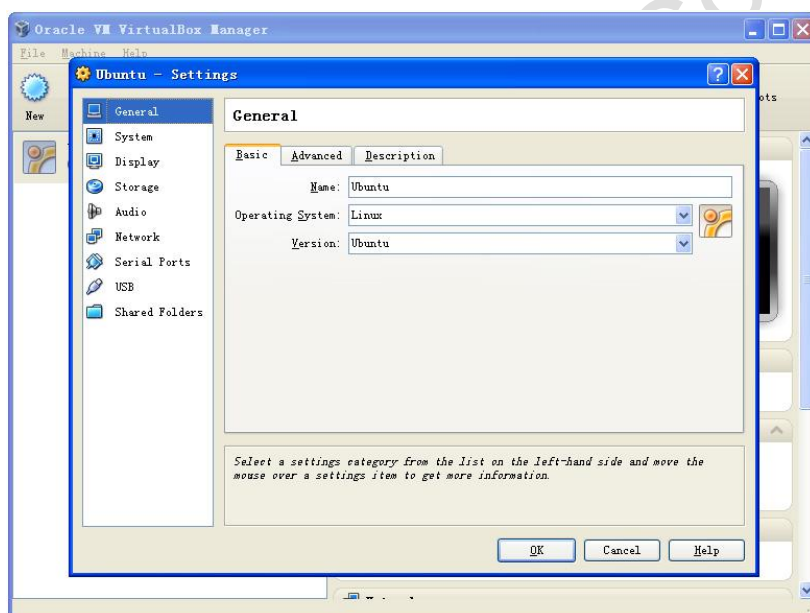
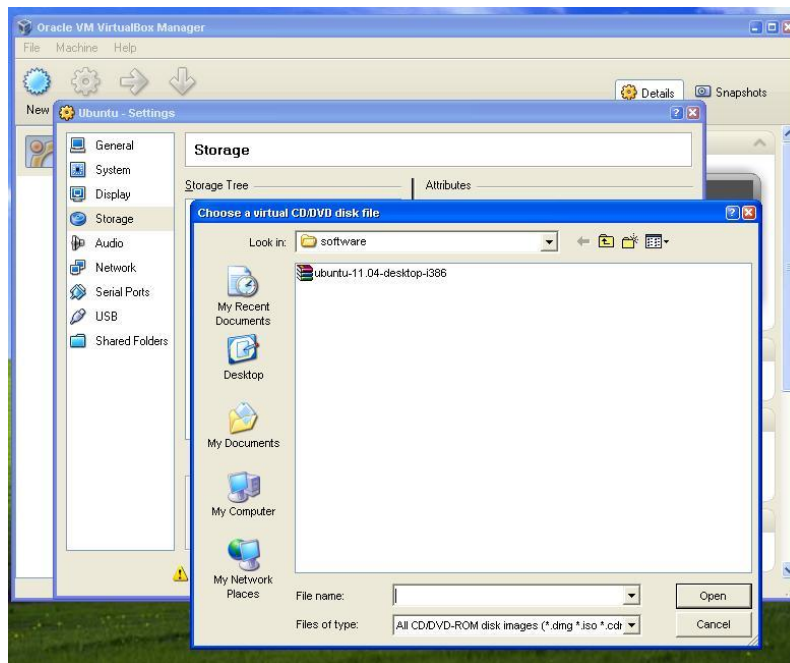


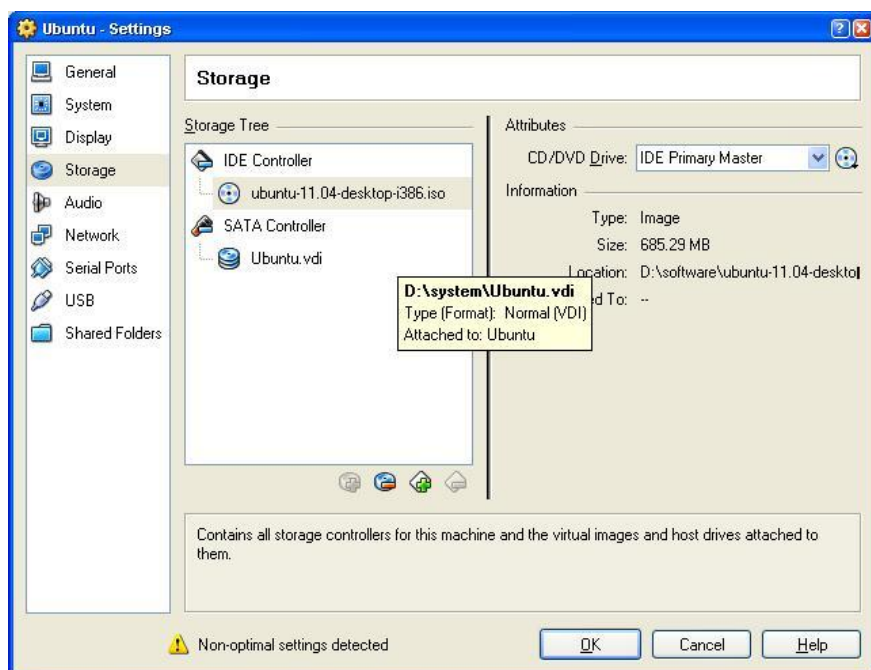
Figure 13 Setting window

- 2) Select **Storage** on the left in the **Setting** window and click the CD-like icon next to the option **Empty** under IDC controller in the right part of the window, and then find the ISO file you downloaded;



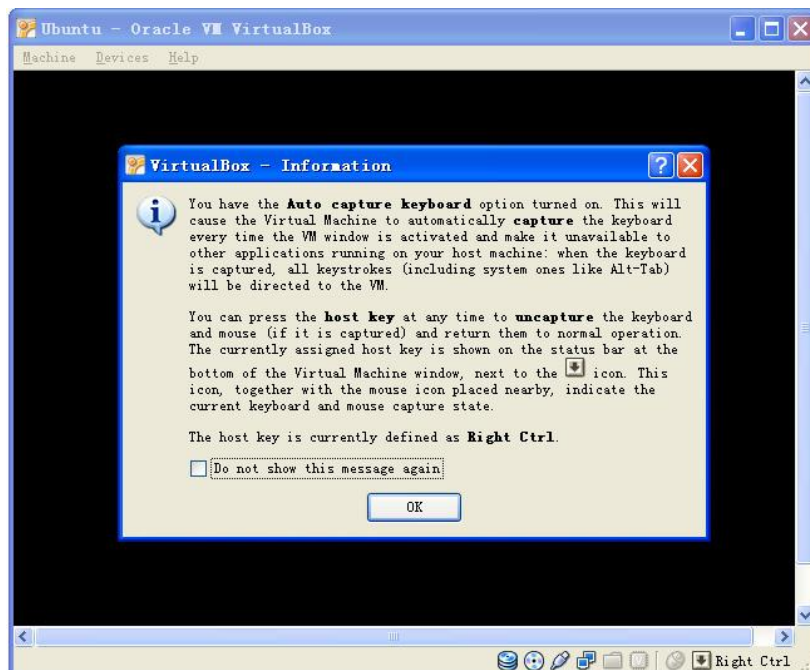
**Figure 14** Find ISO file

- 3) Select the ISO file you added in and click **OK** as shown below;



**Figure 15** Select ISO file

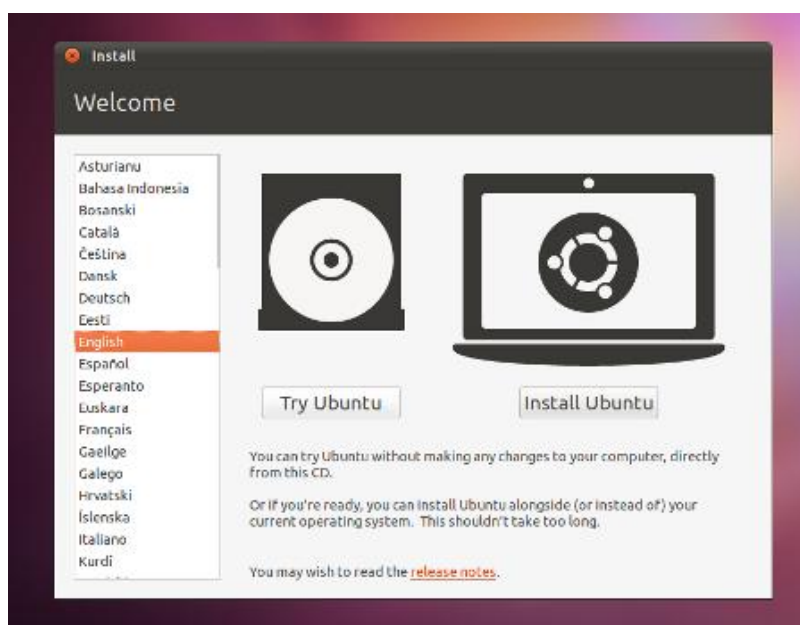
- 4) Click **Start** on the VirtualBox window, the installation program of Ubuntu will be initiating as shown below;



**Figure 16** Ubuntu initiating window

Some prompt windows will interrupt in during the initiating process. You just need to click **OK** all the way to the end of the process.

- 5) Click **Install Ubuntu** to start installation when the following window appears;



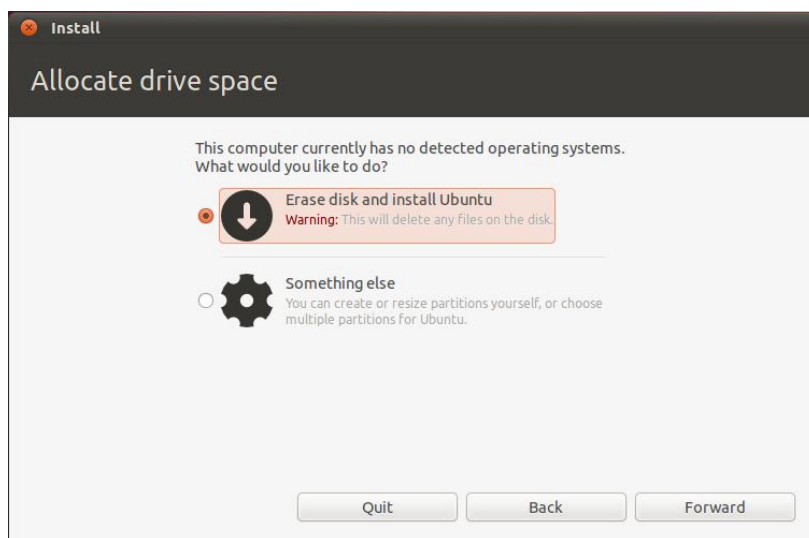
**Figure 17** Ubuntu installation window

- 6) Click **Forward** to continue the process;



**Figure 18** Information before installation

- 7) Select Erase disk and install Ubuntu and click Forward;

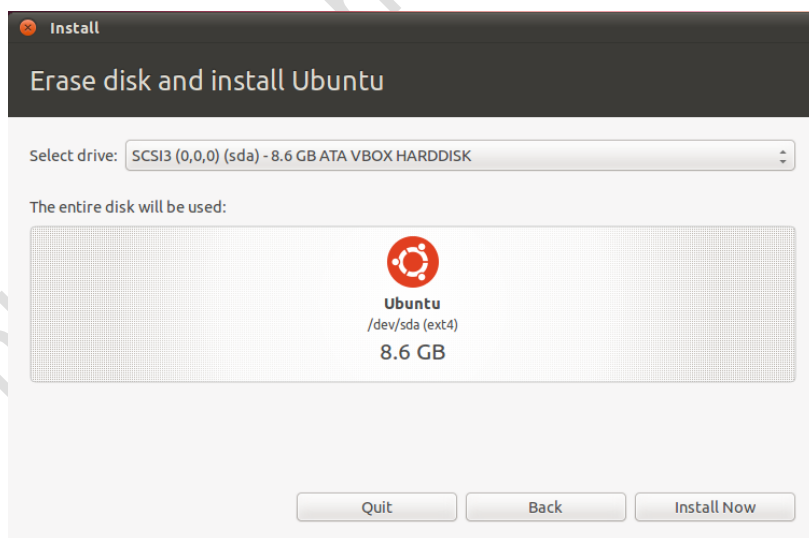


**Figure 19** Options before installation

**Note:**

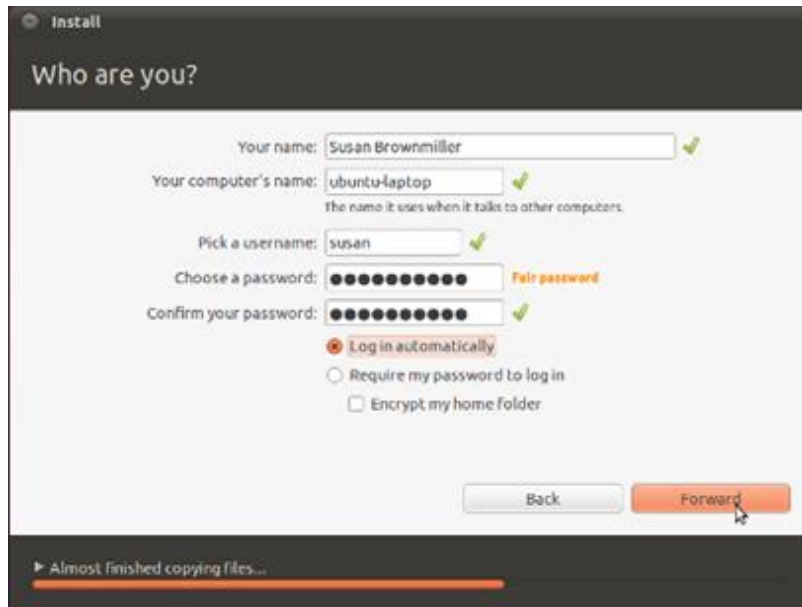
Selecting this option will not lead to any content loss on your hard drive.

- 8) Click **Install Now** in the following window to start installation;



**Figure 20** Confirm installation

- 9) Some simple questions need to be answered during the installation process. Please enter appropriate information and click **Forward**. The following window is the last question that will appear during the process;

The image shows a screenshot of the Ubuntu installer window titled "Who are you?". It contains several input fields: "Your name:" with the value "Susan Brownmiller", "Your computer's name:" with the value "ubuntu-laptop", "Pick a username:" with the value "susan", "Choose a password:" with a masked password, and "Confirm your password:" with a masked password. There are green checkmarks next to the name, computer name, and username fields. The password field has a "Fair password" indicator. Below the password fields are three radio buttons: "Log in automatically" (selected), "Require my password to log in", and "Encrypt my home folder". At the bottom right are "Back" and "Forward" buttons. A progress bar at the bottom indicates "Almost finished copying files...".

**Figure 21** Enter appropriate information

After all the required information is properly entered in to the fields, select **Log in automatically** and click **Forward**.

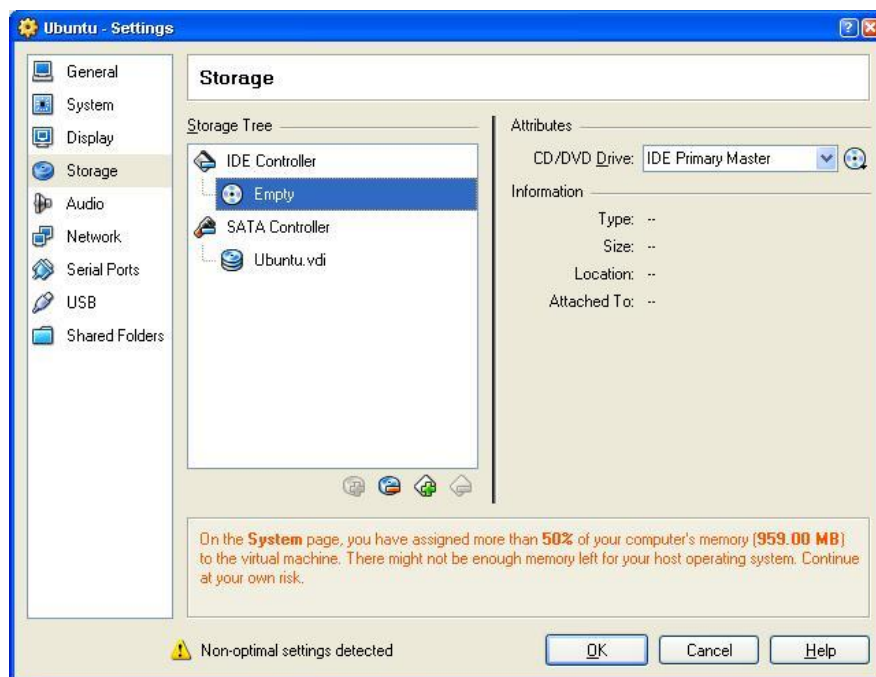
- 10) The installation of Ubuntu may take 15 minutes to about 1 hour depending on your PC's performance. A prompt window will be shown as below after installation is done. Please select **Restart Now** to restart Ubuntu system.



Figure 22 Restart Ubuntu



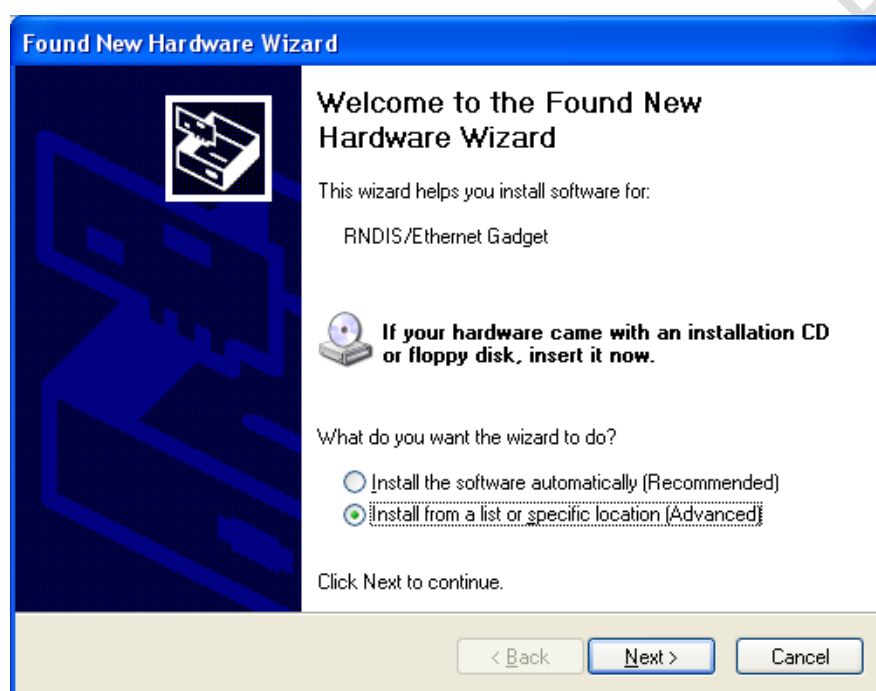
- 11) Ubuntu system is ready for use after restarting. Normally the ISO file shown in Figure 15 will be ejected automatically by VirtualBox after restarting Ubuntu. If it doesn't, you could eject the ISO file manually in the **Setting** window of VirtualBox. The following window shows how it looks after the ISO file is ejected.



**Figure 23** ISO file ejected

## **Appendix III Installation of Linux USB Ethernet/RNDIS Gadget**

- 1) If you don't install driver of Linux USB Ethernet/RNDIS Gadget, PC will find the new hardware and give you a hint on the screen, please select "From list or designated location", then click "Next".



**Figure 24**

- 2) Designate a path for the usb driver, and the usb driver directory is [linux\tools] of the DVD-ROM, then click "Next"

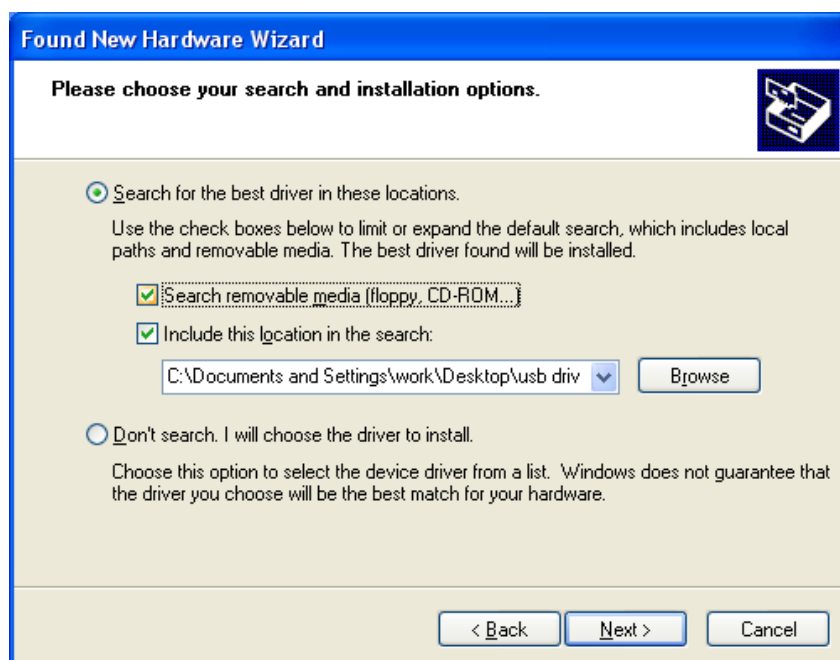


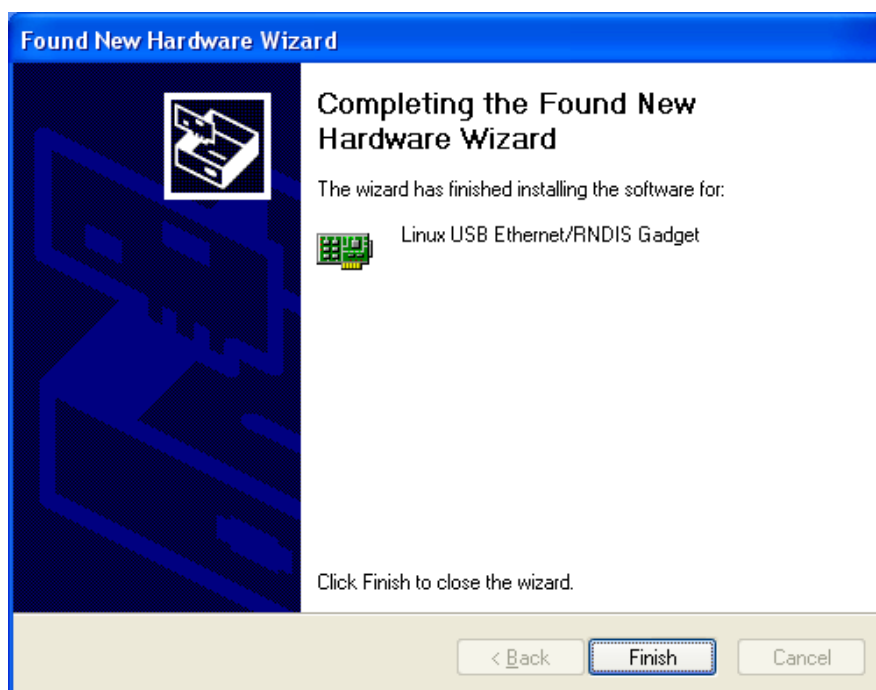
Figure 25

- 3) When the following appears, select "Continue";



Figure 26

- 4) Please wait until the installation is completed;



**Figure 27**

## Appendix IV Formating Linux Boot Disk

How to create a dual-partition card for SBC8600B to boot Linux from first partition and have root file system at second partition.

### 1. Introduction

This guide is meant for those looking to create a **dual-partition** card, booting from a FAT partition that can be read by the OMAP3 ROM bootloader and Linux/Windows, then utilizing an ext3 partition for the Linux root file system.

### 2. Details

**Note:** Text marked with [] shows user input.

#### 1) Determine which device the TF Card Reader is on your system

Plug the TF Card into the TF Card Reader and then plug the TF Card Reader into your system. After doing that, do the following to determine which device it is on your system.

```
$ [dmesg | tail]
...
[ 6854.215650] sd 7:0:0:0: [sd] Mode Sense: 0b 00 00 08
[ 6854.215653] sd 7:0:0:0: [sd] Assuming drive cache: write through
[ 6854.215659] sdc: sdc1
[ 6854.218079] sd 7:0:0:0: [sd] Attached SCSI removable disk
[ 6854.218135] sd 7:0:0:0: Attached scsi generic sg2 type 0
...
```

In this case, it shows up as /dev/sdc (note sdc inside the square brackets above).

#### 2) Check to see if the automounter has mounted the TF card

Note there may be more than one partition (only one shown in the example below).

```
$ [df -h]
Filesystem      Size  Used Avail Use% Mounted on
...
/dev/sdc1       400M   94M  307M  24% /media/disk
...
```

Note the "Mounted on" field in the above and use that name in the umount commands below.

### 3) If so, unmount it

```
$ [umount /media/disk]
```

### 4) Start fdisk

Be sure to choose the whole device (/dev/sdc), not a single partition (/dev/sdc1).

```
$ [sudo fdisk /dev/sdc]
```

### 5) Print the partition record

So you know your starting point. **Make sure to write down the number of bytes on the card (in this example, 2021654528).**

```
Command (m for help): [p]

Disk /dev/sdc: 2021 MB, 2021654528 bytes
255 heads, 63 sectors/track, 245 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sdc1   *           1         246     1974240+    c   W95 FAT32 (LBA)

Partition 1 has different physical/logical endings:
     phys=(244, 254, 63) logical=(245, 200, 19)
```

### 6) Delete any partitions that are there already

```
Command (m for help): [d]
Selected partition 1
```

### 7) Set the Geometry of the TF Card

If the print out above does not show 255 heads, 63 sectors/track, then do the following expert mode steps to redo the TF Card:

#### a) Go into expert mode.

```
Command (m for help): [x]
```

#### b) Set the number of heads to 255.

```
Expert Command (m for help): [h]
Number of heads (1-256, default xxx): [255]
```

**c) Set the number of sectors to 63.**

Expert Command (m for help): **[s]**  
Number of sectors (1-63, default xxx): **[63]**

**d) Now Calculate the number of Cylinders for your TF Card.**

#cylinders = FLOOR (the number of Bytes on the TF Card (from above) / 255 / 63 / 512 )

**e) Set the number of cylinders to the number calculated.**

Expert Command (m for help): **[c]**  
Number of cylinders (1-256, default xxx): **[enter the number you calculated]...**

**f) Return to Normal mode.**

Expert Command (m for help): **[r]**

**8) Print the partition record to check your work**

Command (m for help): **[p]**

Disk /dev/sdc: 2021 MB, 2021654528 bytes  
255 heads, 63 sectors/track, 245 cylinders  
Units = cylinders of 16065 \* 512 = 8225280 bytes

| Device | Boot | Start | End | Blocks | Id | System |
|--------|------|-------|-----|--------|----|--------|
|--------|------|-------|-----|--------|----|--------|

**9) Create the FAT32 partition for booting and transferring files from Windows**

Command (m for help): **[n]**

Command action

**e** extended  
**p** primary partition (1-4)

**[p]**

Partition number (1-4): **[1]**

First cylinder (1-245, default 1): **[(press Enter)]**

Using default value 1

Last cylinder or +size or +sizeM or +sizeK (1-61, default 61): **[+5]**

Command (m for help): **[t]**

Selected partition 1

Hex code (type L to list codes): **[c]**

Changed system type of partition 1 to c (W95 FAT32 (LBA))

## 10) Mark it as bootable

Command (*m* for *help*): **[a]**  
Partition number (1-4): **[1]**

## 11) Create the Linux partition for the root file system

Command (*m* for *help*): **[n]**  
Command action  
*e* extended  
*p* primary partition (1-4)  
**[p]**  
Partition number (1-4): **[2]**  
First cylinder (7-61, default 7): **[(press Enter)]**  
Using default value 52  
Last cylinder or +size or +sizeM or +sizeK (7-61, default 61): **[(press Enter)]**  
Using default value 245

## 12) Print to Check Your Work

Command (*m* for *help*): **[p]**  
  
Disk /dev/sdc: 2021 MB, 2021654528 bytes  
255 heads, 63 sectors/track, 245 cylinders  
Units = cylinders of 16065 \* 512 = 8225280 bytes  
  

| Device    | Boot | Start | End | Blocks  | Id | System          |
|-----------|------|-------|-----|---------|----|-----------------|
| /dev/sdc1 | *    | 1     | 6   | 409626  | c  | W95 FAT32 (LBA) |
| /dev/sdc2 |      | 7     | 61  | 1558305 | 83 | Linux           |

## 13) Save the new partition records on the TF Card

This is an important step. All the work up to now has been temporary.

Command (*m* for *help*): **[w]**  
The partition table has been altered!  
  
Calling ioctl() to re-read partition table.  
  
WARNING: Re-reading the partition table failed with error 16: Device or resource busy.  
The kernel still uses the old table.  
The new table will be used at the next reboot.  
  
WARNING: If you have created or modified any DOS 6.x  
partitions, please see the fdisk manual page for additional  
information.



Syncing disks.

#### 14) Format the partitions


The two partitions are given the volume names LABEL1 and LABEL2 by these commands. You can substitute your own volume labels.

```
$ [sudo mkfs.msdos -F 32 /dev/sdc1 -n LABEL1]
mkfs.msdos 2.11 (12 Mar 2005)

$ [sudo mkfs.ext3 -L LABEL2 /dev/sdc2]
mke2fs 1.40-WIP (14-Nov-2006)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
195072 inodes, 389576 blocks
19478 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=402653184
12 block groups
32768 blocks per group, 32768 fragments per group
16256 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912

Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information:
```

#### Note:

 After formatting and dividing into FAT and EXT3 under Ubuntu system, the FAT needs reformatting under windows system, otherwise, start-up with TF card can be realized.

## Appendix V Setup of TFTP Server

### 1) Installing client

```
$>sudo apt-get install tftp-hpa  
$>sudo apt-get install tftpd-hpa
```

### 2) Installing inet

```
$>sudo apt-get install xinetd  
$>sudo apt-get install netkit-inetd
```

### 3) Configuring server

**Firstly**, create tftpboot under root directory, and set the properties as “any user can write and read”

```
$>cd /  
$>sudo mkdir tftpboot  
$>sudo chmod 777 tftpboot
```

**Secondly**, add a line in /etc/inetd.conf as shown below:

```
$>sudo vi /etc/inetd.conf           //把下面的语句添加的此文件里  
tftpd dgram udp wait root /usr/sbin/in.tftpd /usr/sbin/in.tftpd -s /tftpboot
```

**Then**, reload inetd process:

```
$>sudo /etc/init.d/inetd reload
```

**Finally**, enter directory /etc/xinetd.d/, and create a new file **tftp** and add some lines in it;

```
$>cd /etc/xinetd.d/           //进入目录 /etc/xinetd.d/  
$>sudo touch tftp             //新建文件 tftp  
$>sudo vi tftp                 //编辑文件 tftp,把下面内容加入 tftp 文件中  
service tftp  
{  
    disable = no  
    socket_type = dgram  
    protocol = udp  
    wait = yes  
    user = root  
    server = /usr/sbin/in.tftpd  
    server_args = -s /tftpboot -c  
    per_source = 11
```

```
cps          = 100 2  
}
```

**4) Reboot the server:**

```
$>sudo /etc/init.d/xinetd restart  
$>sudo in.tftpd -l /tftpboot
```

**5) Test the server**

Test the server by creating a new file under /tftpboot

```
$>touch abc
```

Enter another folder

```
$>tftp 192.168.1.15 (192.168.1.15 为本机 IP)  
$>tftp> get abc
```

A successful download indicates that the server is working properly.

## Appendix VI FAQ

Please visit [http://www.elinux.org/SBC8600\\_FAQ](http://www.elinux.org/SBC8600_FAQ)

Embest Technology Co., Ltd

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- Helping customers properly compile and run the source code provided by Embest Technology;
- Providing technical support service if the embedded hardware products do not function properly under the circumstance that customers operate according to the instructions in the documents provided by Embest Technology;
- Helping customers troubleshoot the products.



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  - E. Products malfunction caused by disassembly or alter of components by customers or, products disassembled or repaired by persons or organizations unauthorized by Embest Technology, or altered in factory specifications, or configured or expanded with the components that are not provided or recognized by Embest Technology and the resulted damage in appearance or function;
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