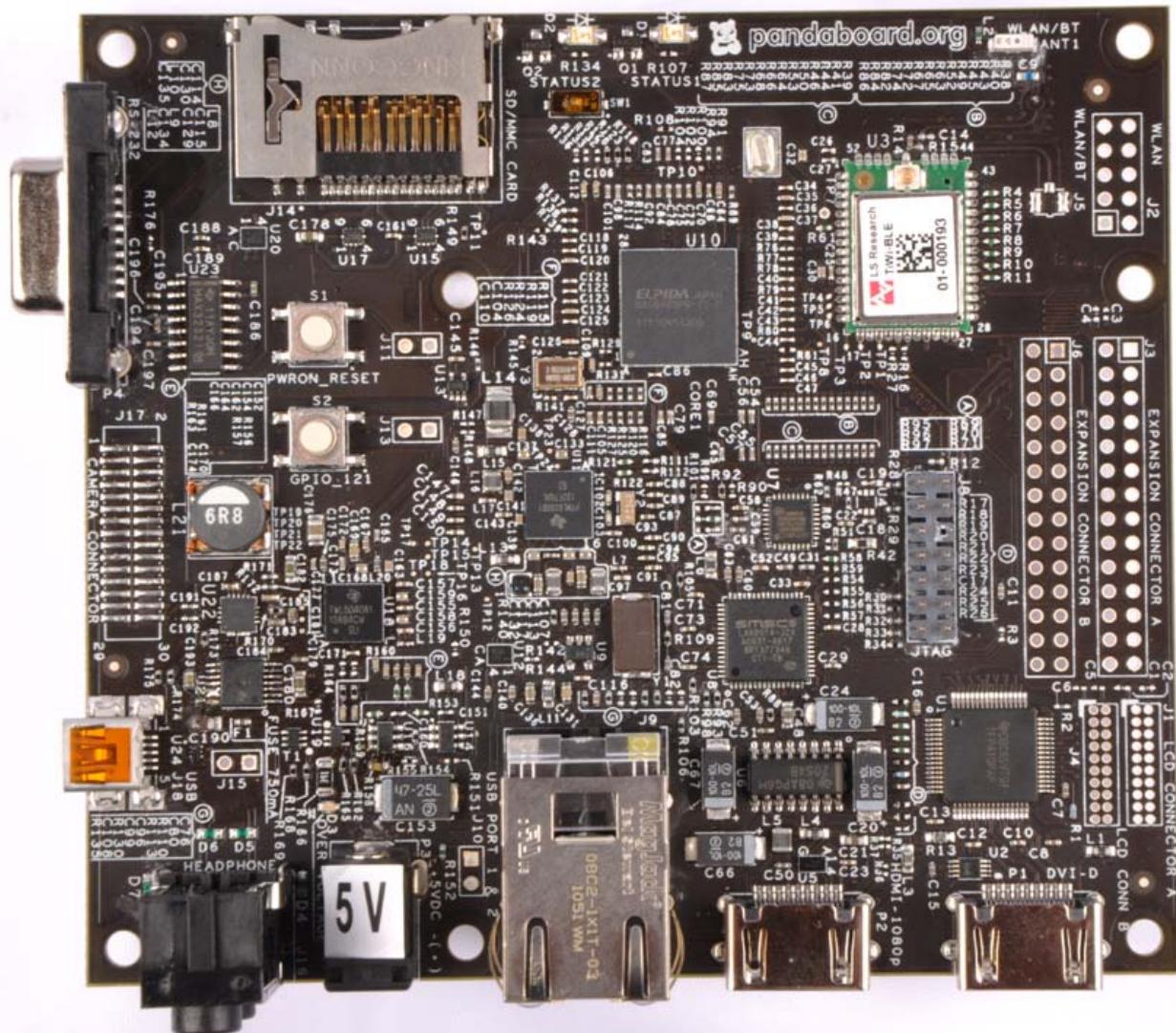




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OMAP4460 Pandaboard ES System Reference Manual





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Preface

Read This First

About This Manual

This manual should be used by software and hardware developers of applications based on the OMAP4460 chipset. This document describes the OMAP4460 Pandaboard ES hardware. This document also gives the user information about the different interfaces on the OMAP4460 Pandaboard ES.

Related Documentation

- OMAP4460 Technical Reference Manual
- OMAP4460 Pandaboard ES Schematic (750-2170-002-SCH)
- OMAP4460 Pandaboard ES Gerber Files (720-2170-004)
- OMAP4460 Pandaboard ES Bill-of-Materials (750-2170-002-EBOM)





Revision History

Revision History

| Rev | Changes | Date |
|-----|---------------------|---------------|
| 0.1 | Preliminary Release | 29 Sept. 2011 |
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1 Introduction

This document is the System Reference Manual for the Pandaboard ES, a low cost OMAP4460 based board supported through <http://Pandaboard.org>. This includes system setup and debugging. This document provides detailed information on the overall design and usage of the Pandaboard ES from the System perspective.

CAUTION: The Pandaboard ES may reach elevated temperatures. Avoid handling the Pandaboard ES while power is applied.





1.1 OMAP4460 Pandaboard ES Overview

Pandaboard ES is an OMAP4460 platform designed to provide access to as many of the powerful features of the OMAP4460 Multimedia Processor as possible, while maintaining a low cost. This will allow the user to develop software to utilize the features of the powerful OMAP4460 processor. In addition, by providing expandability via onboard connectors, the Pandaboard ES supports development of additional capabilities/functionality. See Table 1 for a listing of the Pandaboard ES features.

| Feature | | |
|--|--|--|
| Processor | OMAP4460 | |
| POP Memory | Elpida 8Gb LPDDR2 (EDB8064B1PB-8D-F) | |
| PMIC | TI (TWL6030 Power Management Companion IC) | |
| Debug Support | 14-pin JTAG | GPIO Pins |
| | UART via DB-9 connector | LEDs |
| PCB | 4.5" x 4.0" (114.3 x 101.6 mm) | 8 layers |
| Indicators | 3 LEDs (two user-controlled, one overvoltage indicator) | |
| HS USB 2.0 OTG Port | Mini-AB USB connector, sourced from OMAP USB Transceiver | |
| HS USB Host Port | Four USB HS Ports, up to 500mA current out on each, two to onboard connectors, two to expansion connectors | |
| Audio Connectors | 3.5mm, L+R out | 3.5mm, Stereo In |
| SD/MMC Connector | 6 in 1 SD/MMC/SDIO | 4/8 bit support, Dual voltage |
| User Interface | 1-User defined button | Reset Button |
| | SYSBOOT3 switch | |
| Video | DVI-D or HDMI | Optional user provided plug-in display |
| Power Connector | USB Power | DC Power |
| Camera | Not included, but supported via camera expansion connector | |
| Expansion Connectors (not populated) | See Paragraph 2.17 on page 41 | |
| Parallel LCD Expansion Connectors (not populated) | See Paragraph 2.13.1 on page 32 | |
| DSI LCD Expansion Connector (not populated) | See Paragraph 2.13.2 on page 34 | |

Table 1: Pandaboard ES Features





1.2 Overview of the OMAP4460 Pandaboard ES Kit Contents

The OMAP4460 Pandaboard ES kit contains the following items:

- 1 Pandaboard ES
- Board packing material
- 1 Shipping Box

The following items can be used with the Pandaboard ES, but are NOT included in the kit.

- USB Cable (mini-AB to Type A)
- HDMI Cable (Type A)
- DB-9 Male-to-female cable (straight-through)
- HDMI-A Male to DVI-D Cable
- DC wall supply (+5Vdc, 2.0mm center pin diameter/6.5mm outer hole diameter jack)





2 OMAP4460 Pandaboard ES Architecture

This chapter explains the architecture of the OMAP4460 Pandaboard ES.

2.1 Overview of the Pandaboard ES Architecture

Shown in Figure 1 is the Architectural Block Diagram of the OMAP4460 Pandaboard ES.

Listed below are the major components used on the Pandaboard ES.

- OMAP4460 Processor
- TWL6030 (Phoenix) Power Management Companion Device
- TWL6040 (Phoenix) Audio Companion Device
- TPS62361 Switching Power Supply
- POP Mobile LPDDR2 SDRAM Memory
- HDMI Connector (Type A) – for OMAP4460 HDMI Transmitter output
- HDMI Connector (Type A) – for DVI-D output sourced via OMAP4 parallel display output
- Audio Input & Output Connectors (3.5mm)
- SD/SDIO/MMC Media Card Cage
- UART via RS-232 interface via 9-pin D-Sub Connector
- LS Research Module – 802.11b/g/n, Bluetooth

The Platform also includes connectors that can be used for additional functionality and/or expansion purposes. These connectors are not populated on the platform, but can be installed by the user. They are indicated by the blue blocks in Figure 1, and include:

- Camera Connector (J17)
- Parallel LCD Expansion Connectors (J1 and J4)
- Generic Expansion Connectors (J3 and J6)
- DSI Display Expansion Connector (J7)

See Figure 2 on page 16 for a top side view of the Panda Platform.

The core components of the Pandaboard ES will be discussed in this section of the document. This would include the OMAP4460 Processor and its POP LPDDR2 memory, the input clock circuitry, the TWL6030 Power Companion IC, and the TWL6040 Audio Companion IC. The functional interfaces will be discussed in later sections of the document.



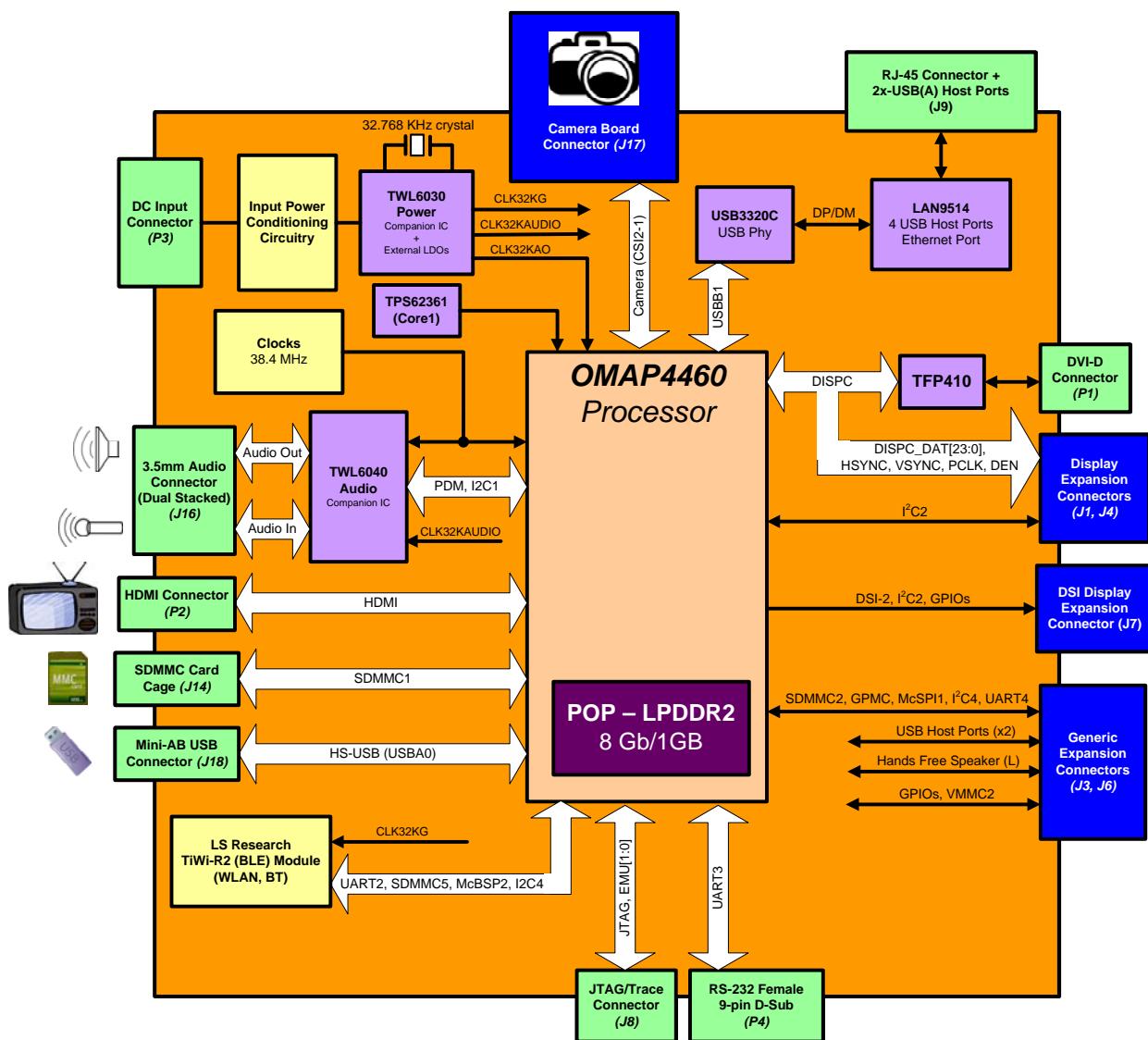


Figure 1 – OMAP4460 Pandaboard ES Architectural Block Diagram



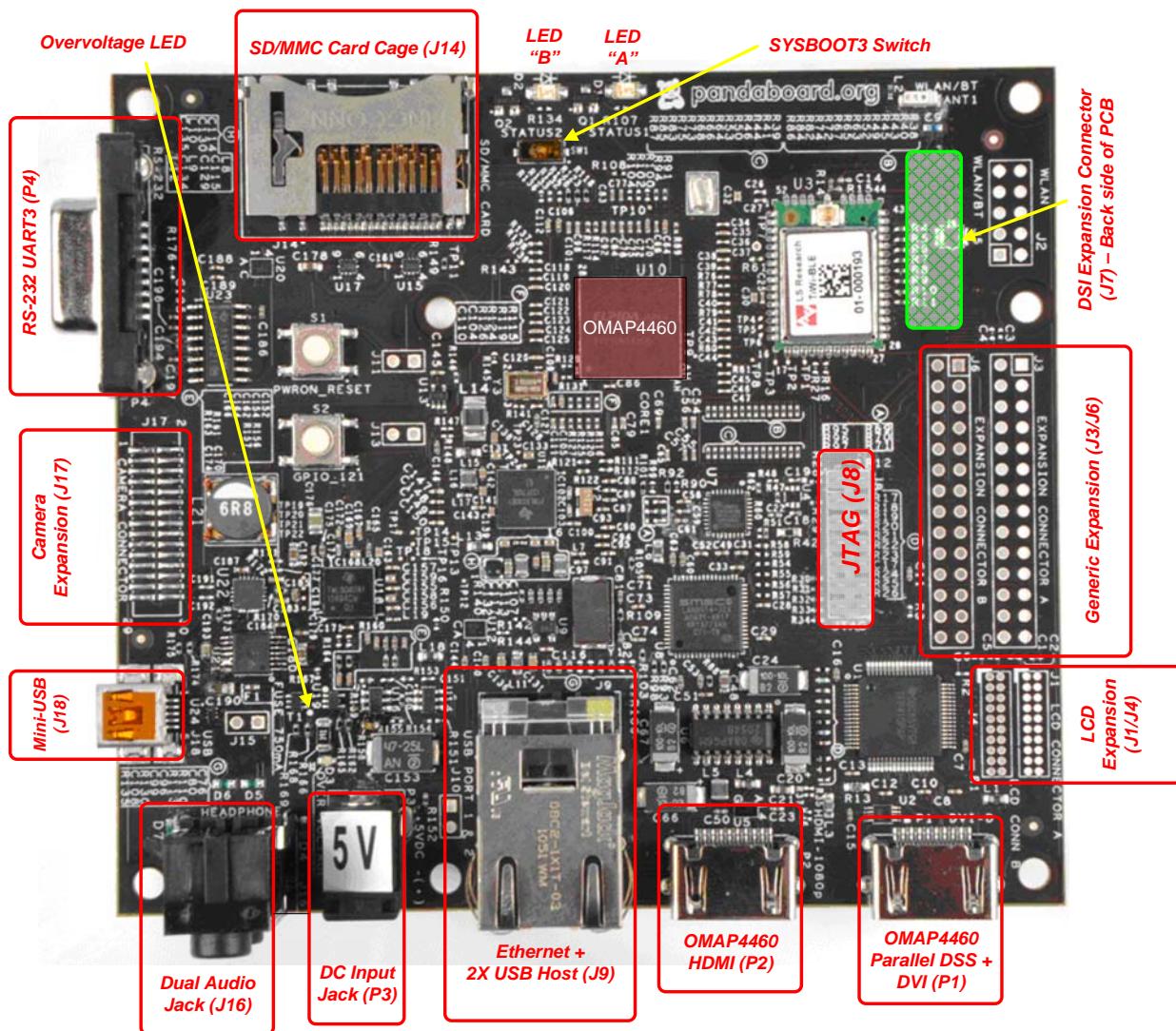


Figure 2 – OMAP4460 Pandaboard ES (Top View)





2.2 System Clock Distribution

The OMAP4460 Pandaboard ES implements a 38.4 MHz 1.8V CMOS square-wave oscillator that directly drives the FREF_SLICER_IN input (ball AG8) of the OMAP4460 processor and the MCLK input to the TWL6040 Audio Companion IC. This clock is used as an input to the PLLs within the OMAP4460 processor so that it can generate all the internal clock frequencies required for system operation.

2.3 OMAP4460 Processor

The heart of Pandaboard ES is the OMAP4460 processor. The OMAP4460 high-performance multimedia application device is based on enhanced OMAP™ architecture and uses 45-nm technology. For more information, refer to the OMAP4460 Technical Reference Manual (TRM). The architecture is designed to provide best-in-class video, image, and graphics processing sufficient to various applications. The device supports the following functions:

- Streaming video up to full high definition (HD) (1920×1080 p, 30 fps)
- 2-dimensional (2D)/3-dimensional (3D) mobile gaming
- Video conferencing
- High-resolution still image (up to 16 Mp)

The device supports high-level operating systems (OSs) such as:

- Windows™ CE, WinMobile™
- Symbian OS™
- Linux®
- Palm OS™

The device is composed of the following subsystems:

- Cortex™-A9 microprocessor unit (MPU) subsystem, including two ARM® Cortex-A9 cores capable of operation at 1.2GHz
- Digital signal processor (DSP) subsystem
- Image and video accelerator high-definition (IVA-HD) subsystem
- Cortex™-M3 MPU subsystem, including two ARM Cortex-M3 microprocessors
- Display subsystem
- Audio back-end (ABE) subsystem
- Imaging subsystem (ISS), consisting of image signal processor (ISP) and still image coprocessor (SIMCOP) block
- 2D/3D graphic accelerator (SGX) subsystem
- Emulation (EMU) subsystem

The device includes state-of-art power-management techniques required for high-performance mobile products. Comprehensive power management is integrated into the device. The device also integrates:

- On-chip memory
- External memory interfaces
- Memory management
- Level 3 (L3) and level 4 (L4) interconnects





- System and connecting peripherals

2.4 TPS62361 External Power Supply (VDD_MPU)

The VDD_MPU balls on the OMAP4460 processor that power the ARM cores are supplied by an external switch mode supply at U25. This device is a Texas Instruments TPS62361 switch mode supply that is controllable via the smart reflex I2C interface of the OMAP4460 processor. Additionally, the VSEL0 ball of the converter is controlled by an OMAP GPIO (GPIO_WK7). This part may be found on sheet 2 of the schematics.

2.5 TWL6030 Power Companion IC

The TWL6030 device is a small (7 x 7 mm, 0.4mm pitch) 256 ball FBGA that provides many functions used on the Platform. Shown below is a feature list of the major functions/interfaces provided by the TWL6030 device that are utilized on the Panda platform. This list below doesn't include all device functionality, just that which is used on the Pandaboard ES.

- A power management system (FSM)
- 1 HS-I2C interface (\leq 2.4Mbits/s) for all Phoenix Power IC GP control commands (CTL-I2C)
- 1 HS-I2C interface (\leq 2.4Mbits/s) for all Smart-Reflex Class 3 control commands (SR-I2C)
- MMC card detection mechanism
- A 24MHz RC oscillator
- A 32kHz RC oscillator for a fast device start-up
- A high-performance crystal oscillator, for 32.768kHz external crystal
- A Real Time Clock (RTC) resource
- Power supply resources:
 - 11 Low Drop Out (LDO) regulators
 - 1 for internal purposes only (VRTC)
 - 1 for internal and platform needs (VANA)
 - 9 for platform needs (VAUX1, VAUX2, VAUX3, VCXIO, VDAC, VMMC, VPP, VUSB, VUSIM)
 - 7 buck SMPS with:
 - DVS capability Smart-Reflex Class 3 compatible (VCORE1, VCORE2, VCORE3)
 - 1 for I/O supply (V1V8), with specific PWMFORCE input control
 - 1 for LDOs pre-regulation (V2V1) and Phoenix Audio features
 - 1 for memory supply (VMEM)
 - 1 for external modem, RF transceiver or I/Os (V1V29)
- 3 general-purpose enables for possible platform upgrades (REGEN1, REGEN2, SYSEN)





2.5.1 TWL6030 Core SMPS Outputs

The TWL6030 implements three Switch Mode Power Supplies (SMPS) that source two of the three main core voltage rails for the OMAP4460 processor. The default voltage of all of these supplies is 0.95V, and each should be adjusted as required by S/W for the desired processor OPP.

VCORE1 is a 1200mA SMPS that is used to power the VDD_CORE balls on the OMAP4460 processor (net name VDD_VCORE3, (34 balls total) and the VDDA_DLLn_LPDDR21 and VDDA_DLLn_LPDDR22 balls, where n=0/1 (4 balls total). VCORE2 is a 600mA SMPS that is used to power the VDD_IVA_AUDIO balls on the processor (net name VDD_VCORE2, 10 balls total). VCORE3 is a 600mA SMPS that is not used on the OMAP4460 Pandaboard ES.

2.5.2 TWL6030 V1V8 SMPS Output

The TWL6030 V1V8 SMPS provides the I/O voltage for the Pandaboard ES (net name VIO_1v8). This is a 1200mA SMPS that provides a 1.8V output that is used to power many balls on the OMAP4460 processor that set the I/O voltage for the device. It also sources onboard peripherals that require an operating voltage referenced to processor I/Os.

2.5.3 TWL6030 V2V1 SMPS Output

The TWL6030 V2V1 SMPS output is used by the TWL6040 Audio Companion IC as an input for some of its internal power supplies (specifically the high side and low side LDOs and the negative charge pump). It is also connected to the TWL6030 as the input voltage to the VCXIO and VDAC LDOs (net name VDD_2V1). It is a 600mA SMPS with a default output value of 2.10V.

2.5.4 TWL6030 VMEM SMPS Output

The TWL6030 VMEM SMPS is not used on the OMAP4460 Pandaboard ES. The LPDDR2 power balls on the OMAP4460 that were previously connected to this rail for the OMAP4430 are connected to the V1V29 SMPS.

2.5.5 TWL6030 V1V29 SMPS Output

The TWL6030 V1V29 output is a 600mA SMPS used to provide the operating voltage for the VDD2 LPDDR2 balls on the OMAP4460 processor (net name VDD_VMEM). These OMAP balls are feed-throughs to the top POP footprint on the OMAP package, where they directly connect to the LPDDR2 VDD2 balls. This SMPS is a 600mA max capacity rail. The Micron LPDDR2 device used is an S4B type device, so VDD2 is required to be 1.2V. This is set in the TWL6030 companion chip by connecting the BOOT1 input to VRTC, which causes V1V29 to be set to a default of 1.225V.

2.5.6 TWL6030 LDO Power Resources

The VAUX2 LDO is a programmable LDO that is only connected to pin 1 of the LCD Expansion Connector J4. Its possible output voltage settings include 1.2V, 1.8V, 2.5V, 2.75V, and 2.8V, and its maximum output current is 200mA. The voltage to be programmed will be dependent on the board plugged into the LCD Expansion connectors, but will most likely be 2.8V.





The VAUX2 LDO is a programmable LDO that is only connected to pin 1 of the LCD Expansion Connector J4. Its possible output voltage settings include 1.2V, 1.8V, 2.5V, 2.75V, and 2.8V, and its maximum output current is 200mA. The voltage to be programmed will be dependent on the board plugged into the LCD Expansion connectors, but will most likely be 2.8V.

The VAUX3 LDO is a programmable LDO that is only connected to pin 30 of the Camera Expansion Connector, J17. Its possible output voltage settings include 1.0V, 1.2V, 1.3V, 1.8V, 2.5V, 2.8V, 3.0V, and its maximum output current is 200mA. The output voltage to be utilized would depend on the implementation of the camera module.

The VCXIO LDO is a fixed 1.8V, 200mA LDO that provides a 1.8V input to certain noise sensitive OMAP4460 balls. The balls powered by this LDO include the VDDA_CSI2 balls (V28 and W28), the VDDA_DPLL balls (G13, P9 and Y16), and on this revision of the Pandaboard ES, the VDDS_DV_BANK7 ball (M28). This LDO also provides power for the onboard 38.4 MHz oscillator.

The VDAC LDO is a fixed 1.8V, 50mA LDO that provides a 1.8V input to certain noise sensitive OMAP4460 balls. The balls powered by this LDO include the VDDA_HDMI_VDAC balls (A11 and G12).

The VMMC LDO is a programmable LDO that provides the voltage to the VDDS_MMC1 balls on the OMAP processor (pins G7 and H7) as well as the SDMMC cardcage. This LDO is off when the board is powered on, but is turned on and set to 1.8V or 3.0V depending on card capabilities detected.

The VRTC LDO is an adjustable LDO that provides internal voltages to the TWL6030 device. Its possible output voltage settings are 1.8V and 2.5V and its maximum output current is 25mA. In normal operation, it should always be set to 1.8V.

The VUSB LDO is a fixed 3.3V, 35mA LDO that provides voltage to the OMAP4460 that it uses for its internal USB transceiver. The only ball powered by this LDO is the VDDA_USBA0OTG_3P3V ball (ball A5).

The VPP LDO is adjustable LDO that powers the VPP_CUST and VPP_STD balls on OMAP (balls J8 and Y22). This LDO is only needed for eFuse operations and can be left disabled for normal Pandaboard ES operation.

2.5.7 TWL6030 Clock Circuitry

The TWL6030 has an 32.768 KHz crystal connected across its OSC32KIN and OSC32KOUT balls. This crystal is used by the TWL6030 to generate three output 32.768 KHz, 1.8V square wave clock outputs. These outputs are:

CLK32KAO: always on clock connected to the SYS32K input of the OMAP4460 processor.

CLK32KAUDIO: clock connected to the CLK32K input of the TWL6040 Audio Companion IC.





CLK32KG: a gated 32.768 clock connected to the SLOW_CLK input of the LS Research module. This clock will be off by default at reset, and must be enabled by software.

2.6 TWL6040 Audio Companion IC

The TWL6040 device is a small (6 x 6 mm, 0.5mm pitch) 120 ball PBGA that provides many functions, primarily audio, used on the Platform. Shown below is a feature list of the major functions/interfaces provided by the TWL6040 device.

- A audio management system
 - PDM Interface for Audio and control
 - Analog Microphone Interface
 - Headset – speaker (32 ohm) and microphone
 - Earpiece Output
 - Aux Output
 - Hands-free 8 ohm driver
 - Dual Vibrator
- Misc Control
 - GPO
 - I2C (high speed)
 - Power on/off
- Power
 - Internal LDOs
 - Internal negative charge pump

2.7 SYSBOOT Configuration

The OMAP4460 Processor has eight SYSBOOT inputs. These inputs are sampled after a board reset, and determine the booting and operating mode of the OMAP4460 Processor. The upper two inputs (SYSBOOT[7:6]) control the clocking modes of the part (i.e. enabling/disabling the internal oscillator to allow using a crystal input or oscillator). They are currently set to “11” and should not be changed.

The lower six inputs, SYSBOOT[5:0] determine the type and order of memory or peripheral booting. SYSBOOT[5] determines whether memory or peripheral booting is preferred. The SYSBOOT definitions may be found in the OMAP4460 TRM, but are included here for convenience. See Table 2 on page 24 for the SYSBOOT definitions for peripheral preferred booting, and Table 3 on page 25 for memory preferred booting SYSBOOT definitions. The shaded row(s) in Table 2 are the default configuration of the Pandaboard ES, depending on the setting of SW1.

If it is desired to change the SYSBOOT configuration, resistors may be added or removed from the SYSBOOT[5:0] lines (except for SYSBOOT3, which may be changed by changing the position of switch SW1). The SYSBOOT[5:0] lines have weak internal pull-down resistors inside the OMAP4460, so removing the onboard resistor will result in the line being sampled as a ‘0’ at reset, and installing a 3.3K





or lower value resistor will result in the line being sampled as a ‘1’ at reset. See Figure 3 on page 23 for the location of the resistors on SYSBOOT[5:0]. These resistors are connected to OMAP4460 as follows:

- SYSBOOT0: R123
- SYSBOOT1: R138
- SYSBOOT2: R128
- SYSBOOT3: N/A (controlled by switch SW1)
- SYSBOOT4: R137
- SYSBOOT5: R139

NOTE: Do not use pull-up resistance values higher than 3.3Kohm on the SYSBOOT lines. This would create a voltage divider with the internal OMAP pulldown, potentially causing an invalid value to be internally latched for SYSBOOT.



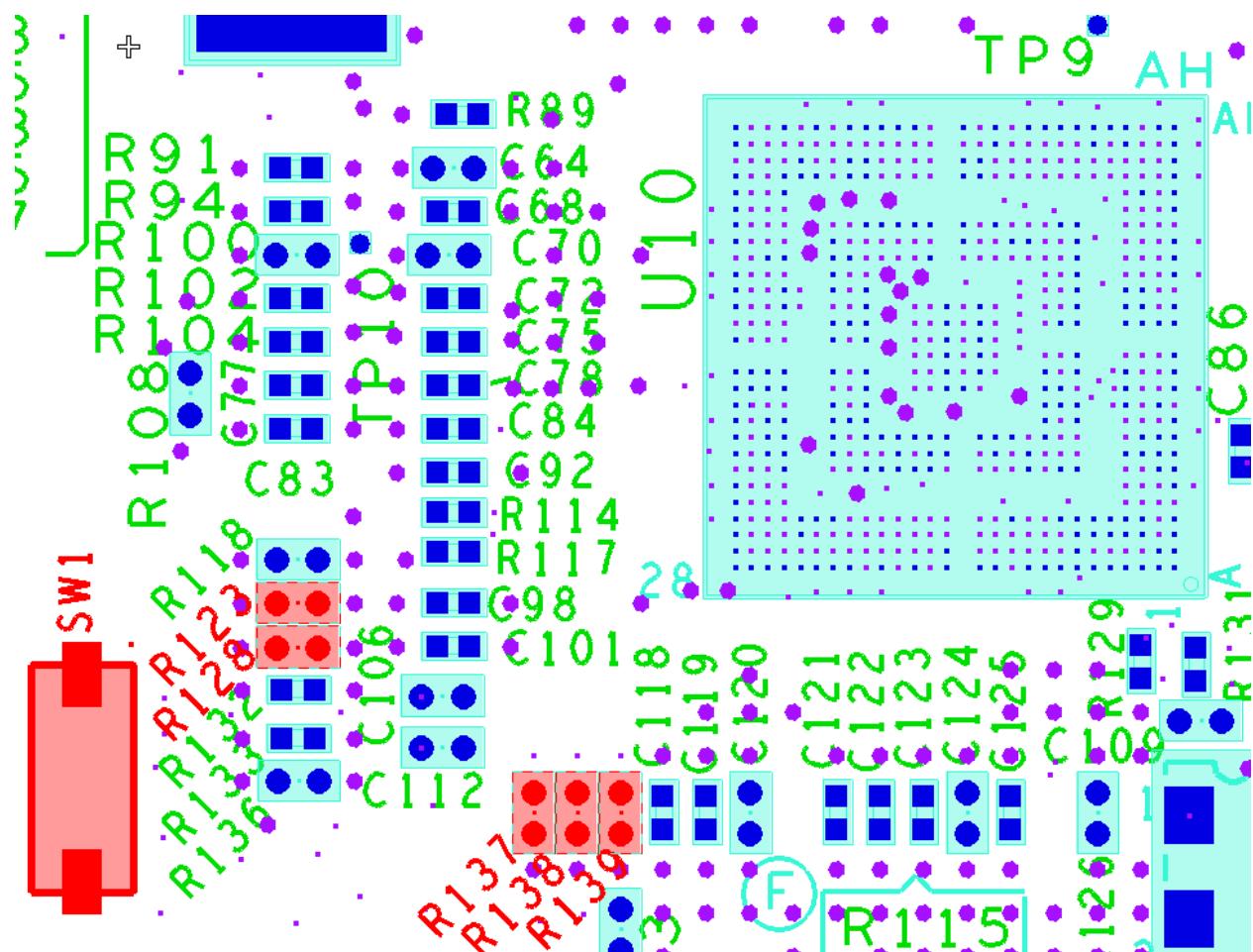


Figure 3 – SYSBOOT[5:0] Resistor Locations + SYSBOOT3 Switch Location





| SYSBOOT[5:0] | Booting Devices Order | | | |
|-----------------------|---------------------------------------|-----------------|-----------------|-----------------|
| | 1 st | 2 nd | 3 rd | 4 th |
| 000000 | USB | MMC2(1) | | |
| 000001 | USB | XIP | | |
| 000010 | USB | XIPWAIT | | |
| 000011 | USB | NAND | | |
| 000100 | USB | EMIF | | |
| 000101 | USB | MMC1 | | |
| 000110 | USB | OneNAND | | |
| 000111 | USB | OneNAND | MMC2(1) | |
| 001000 | UART | MMC2(1) | | |
| 001001 | UART | XIP | | |
| 001010 | UART | XIPWAIT | | |
| 001011 | UART | NAND | | |
| 001100 | UART | EMIF | | |
| 001101 | UART | MMC1 | | |
| 001110 | UART | OneNAND | | |
| 001111 | USB-ULPI | MMC2(1) | | |
| 010000 | USB-ULPI | XIP | | |
| 010001 | USB-ULPI | XIPWAIT | | |
| 010010 | USB-ULPI | NAND | | |
| 010011 | USB-ULPI | EMIF | | |
| 010100 | USB-ULPI | MMC1 | | |
| 010101 | USB-ULPI | OneNAND | | |
| 010110 | USB | UART | MMC1 | MMC2(1) |
| 010111 | USB | UART | MMC1 | XIP |
| 011000 | USB-ULPI | UART | MMC2(2) | |
| 011001 | USB | UART | MMC1 | NAND |
| 011010 | UART | MMC2(2) | | |
| 011011 | USB | UART | MMC1 | |
| 011100 | USB | MMC2(2) | | |
| 011101 | Reserved | | | |
| 011110 | Reserved | | | |
| 011111 ⁽¹⁾ | Fast XIP booting. Wait monitoring off | | USB | UART |

⁽¹⁾ Only on GP devices

Table 2: SYSBOOT[5:0] Definitions – Peripheral Preferred Booting





| SYSBOOT[5:0] | Boot Device Order | | | |
|-----------------------|---------------------------------------|-----------------|-----------------|-----------------|
| | 1 st | 2 nd | 3 rd | 4 th |
| 100000 | MMC2(1) | USB | | |
| 100001 | XIP | USB | | |
| 100010 | XIPWAIT | USB | | |
| 100011 | NAND | USB | | |
| 100100 | EMIF | USB | | |
| 100101 | MMC1 | USB | | |
| 100110 | OneNAND | USB | | |
| 100111 | OneNAND | MMC2(1) | USB | |
| 101000 | MMC2(1) | UART | | |
| 101001 | XIP | UART | | |
| 101010 | XIPWAIT | UART | | |
| 101011 | NAND | UART | | |
| 101100 | EMIF | UART | | |
| 101101 | MMC1 | UART | | |
| 101110 | OneNAND | UART | | |
| 101111 | MMC2(1) | USB-ULPI | | |
| 110000 | XIP | USB-ULPI | | |
| 110001 | XIPWAIT | USB-ULPI | | |
| 110010 | NAND | USB-ULPI | | |
| 110011 | EMIF | USB-ULPI | | |
| 110100 | MMC1 | USB-ULPI | | |
| 110101 | OneNAND | USB-ULPI | | |
| 110110 | MMC2(1) | USB | UART | MMC1 |
| 110111 | XIP | USB | UART | MMC1 |
| 111000 | MMC2(2) | USB-ULPI | UART | |
| 111001 | NAND | USB | UART | MMC1 |
| 111010 | MMC2(2) | UART | | |
| 111011 | MMC1 | USB | UART | |
| 111100 | MMC2(2) | USB | | |
| 111101 | Reserved | | | |
| 111110 | Reserved | | | |
| 111111 ⁽¹⁾ | Fast XIP booting. Wait monitoring off | | USB | UART |

⁽¹⁾ Only on GP devices

Table 3: SYSBOOT[5:0] Definitions – Memory Preferred Booting





2.8 Miscellaneous Power Circuitry

2.8.1 Input Power Circuitry

The input power circuitry may be found on sheet 2 of the board schematic. A block diagram of this circuitry is shown in Figure 4 below. The Pandaboard ES may be run either with or without a DC wall supply plugged into the input power jack at P3.

Without an external power supply plugged in, the 5Vdc input power is supplied from the mini-AB USBOTG connector at J18. This supply is only capable of providing 500mA of output current (1A if operating via a USB cable with a “Y” connection to the host), so board operations will be limited in this mode (e.g. operations could be limited, depending on current requirements). The path of current flow in this mode is designated below by the red arrow. The 5V from VBUS will be routed through the switch at U21, to the TPS54320 switching power supply at U22, which provides a 3.7V “battery” voltage for the TWL6030 and TWL6040 Companion ICs.

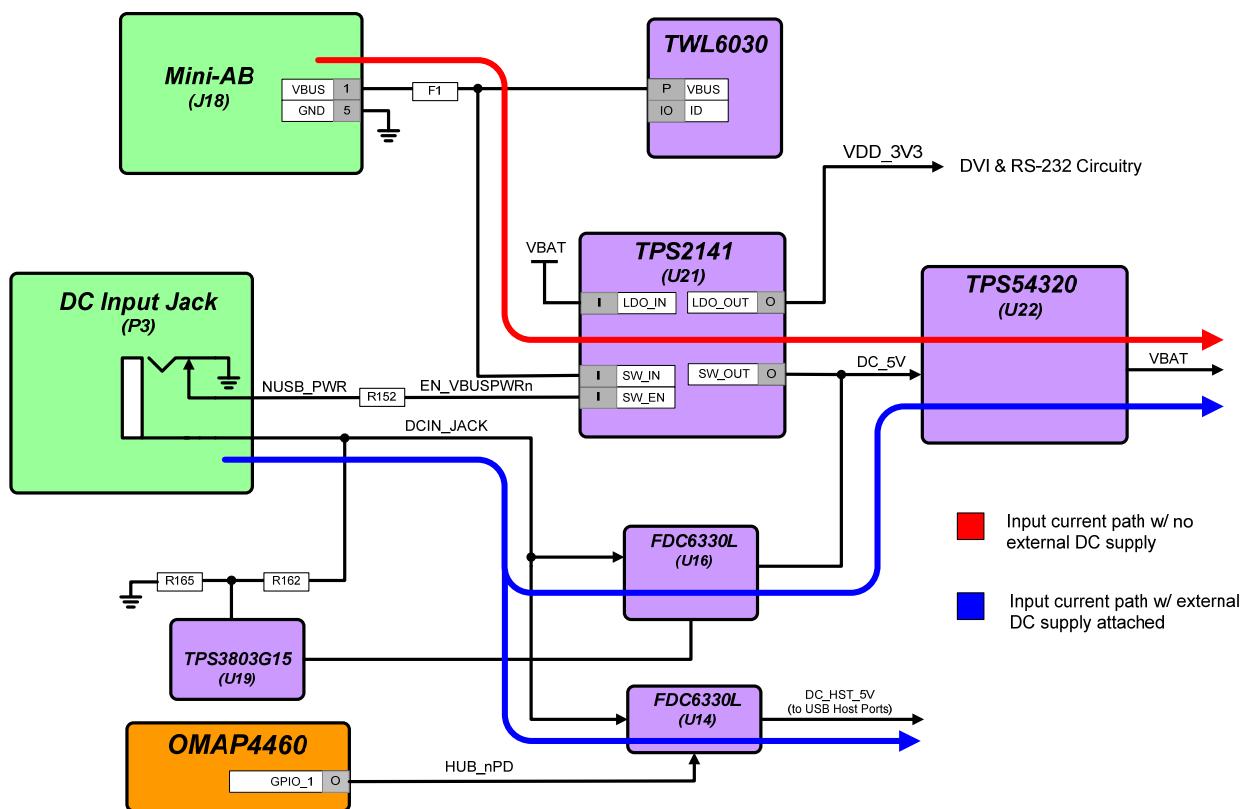


Figure 4 – Pandaboard ES Input Power Circuitry Block Diagram





With an external power supply plugged in, the 5Vdc input power is supplied from the input DC jack at P3. The current capability in this mode is only limited by the particular DC supply being used. The path of current flow in this mode is designated below by the blue arrows. The switch at U21 will be disabled by the insertion of the DC input jack in this mode, and the regulated 5Vdc from the wall supply will be connected to the input of the TPS54320 switching power supply at U22, which provides a 3.7V “battery” voltage for the TWL6030 and TWL6040 Companion ICs.

CAUTION: only use a 5Vdc regulated power supply to power the Pandaboard ES. Connecting a supply with an output higher than +5Vdc could cause possible board damage.

The supervisor IC at U19 has the DC input power tied to its VDD pin through a voltage divider. When the voltage at the VDD input of this IC exceeds 1.40V (i.e. DCIN_JACK \geq 5.64V), the reset output of the supervisor is negated. This will enable the two FETs at T1A and T1B, which will illuminate the red overvoltage indicator, and disable the load switch at U16, which removes input power to the onboard circuitry. The load switch at U14 that provides 5V USB Host power is enabled and disabled manually by writing GPIO_1 to a ‘1’, or a ‘0’, respectively. This load switch powers up disabled.

2.8.2 USB/Ethernet Power Circuitry

There is a fixed 3.3V LDO (U11) that provides power for the LAN9514 Ethernet/USB Hub device. This device is a Texas Instruments TPS73633DBVR device which can provide up to 400mA of output current. This device may be controlled via S/W by writing OMAP4460 GPIO_1. Writing this GPIO high will enable this LDO, while writing it low will disable it (see Table 10 on page 41). This device is shown on sheet 11 of the schematic.

2.9 Standard Volatile Memory

The OMAP4460 processor supports two LPDDR2 channels, accessible only via a POP memory device soldered on the 216-ball, 12x12 mm footprint on top of the OMAP4460 processor. Each channel supports up to two chip-selects, so up to four LPDDR2 memory dies are supported. The two stacked memory packages are directly connected to the two LPDDR2 EMIF4D interfaces of the OMAP4460 die. The base address for the LPDDR2 is 0x8000 0000.

An 8Gb/1GB POP LPDDR2 DRAM device (Elpida P/N EDB8064B1PB-8D-F) is provided on the Pandaboard ES. The memory device has four dies, with each die being a separate 2Gb LPDDR2.





2.10 Debug UART Interface

A single RS-232 port is provided on the Pandaboard ES via 9-pin D-sub female connector at location P4. It provides access to the UART3 interface of the OMAP4460. See Figure 5 for the implementation of the RS232 port.

The TXS0104EZUR device at U20 is a voltage translator that translates between the 1.8V logic levels required by the OMAP4460 processor to the 3.3V logic levels required by the SN75C3232EDR. The SN75C3232EDR @ U23 is an RS-232 transceiver that converts the 3.3V logic signals to/from the voltage translator to the RS-232 signal levels required (-5V to +5V).

The UART port at P4 can be accessed by using Teraterm or other terminal emulation program. To use this UART interface, the serial port settings should be applied as follows:

- BAUD RATE: 115200
- DATA: 8 bit
- PARITY: none
- STOP: 1bit
- FLOW CONTROL: none

This port requires the use of a 9-pin D-sub Male to Female cable.

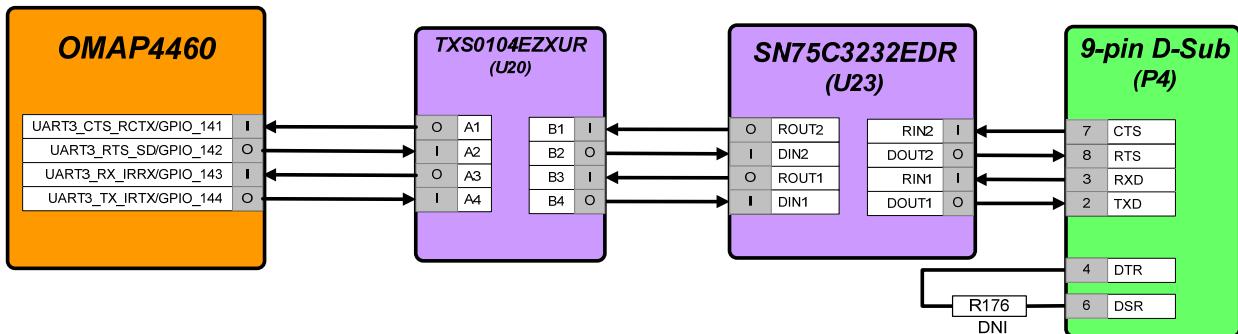


Figure 5 – Panda UART3/RS-232 Block Diagram

2.11 SD/MMC Connector

The OMAP4460 Pandaboard ES supports removable memory storage via onboard SD/MMC card cage. It is an eight-bit card cage that supports 1.8V or 3.0V cards. Card detect functionality is supported via the TWL6030 power companion IC. See Figure 6 for a block diagram of the interface signaling to the card cage. The resistors shown in Figure 6 below are 33 ohm series termination resistors.



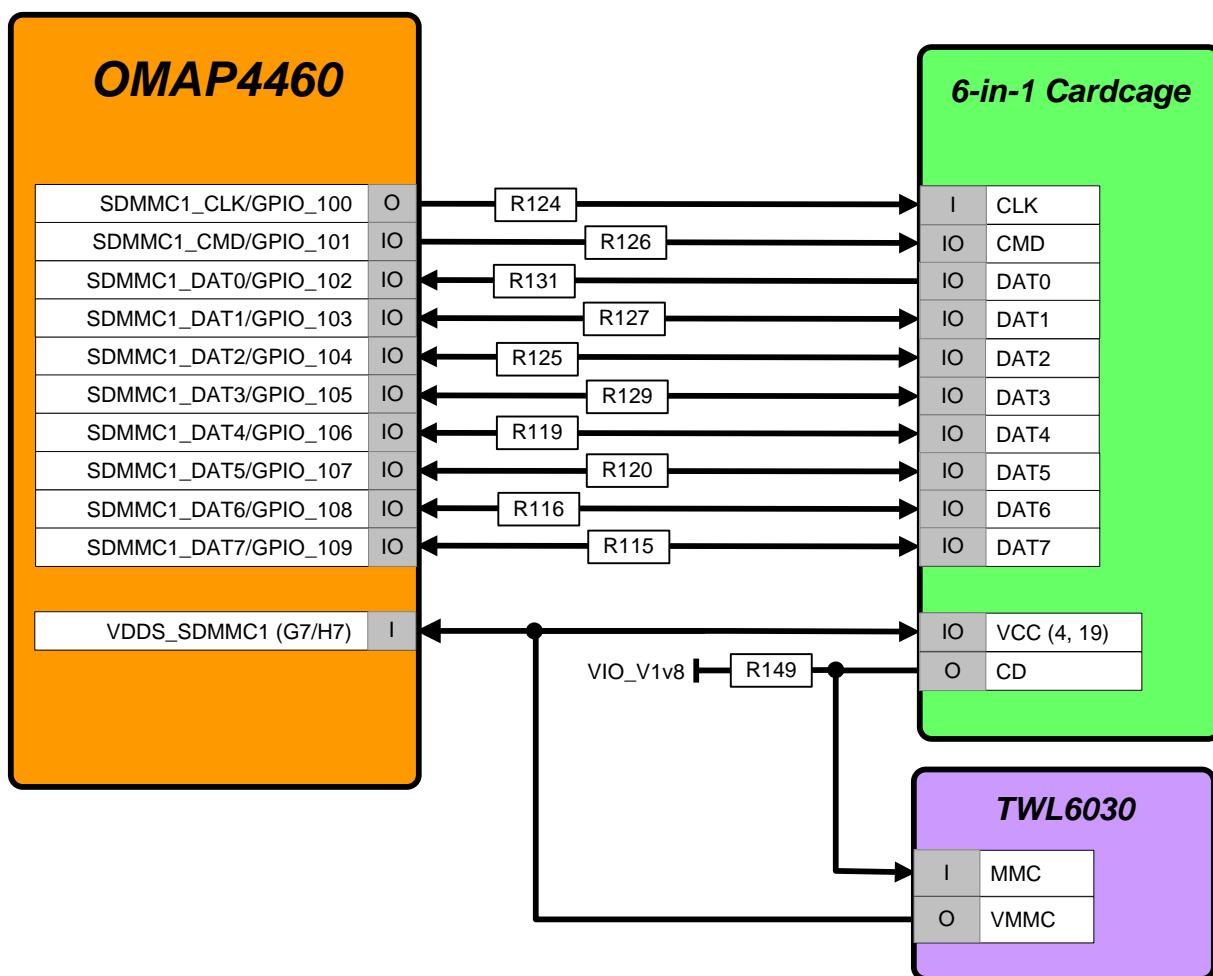


Figure 6 – Panda SDMMC1 Card Cage Block Diagram

2.12 HDMI Interface

The OMAP4460 Pandaboard ES provides a High-Definition Multimedia Interface (HDMI) via an industry-standard Type A connector at location P2. The interface is provided using the internal HDMI module provided by the OMAP4460. See Figure 7 for a block diagram of the Pandaboard ES HDMI circuitry. This interface includes a Texas Instruments TPD12S015A HDMI Port Protection/Interface device. The high-speed differential clock and data lines are connected straight from OMAP to the ESD protection device, to the connector, so that any ESD event experienced at the connector will be absorbed before damaging the OMAP4460 device I/Os.



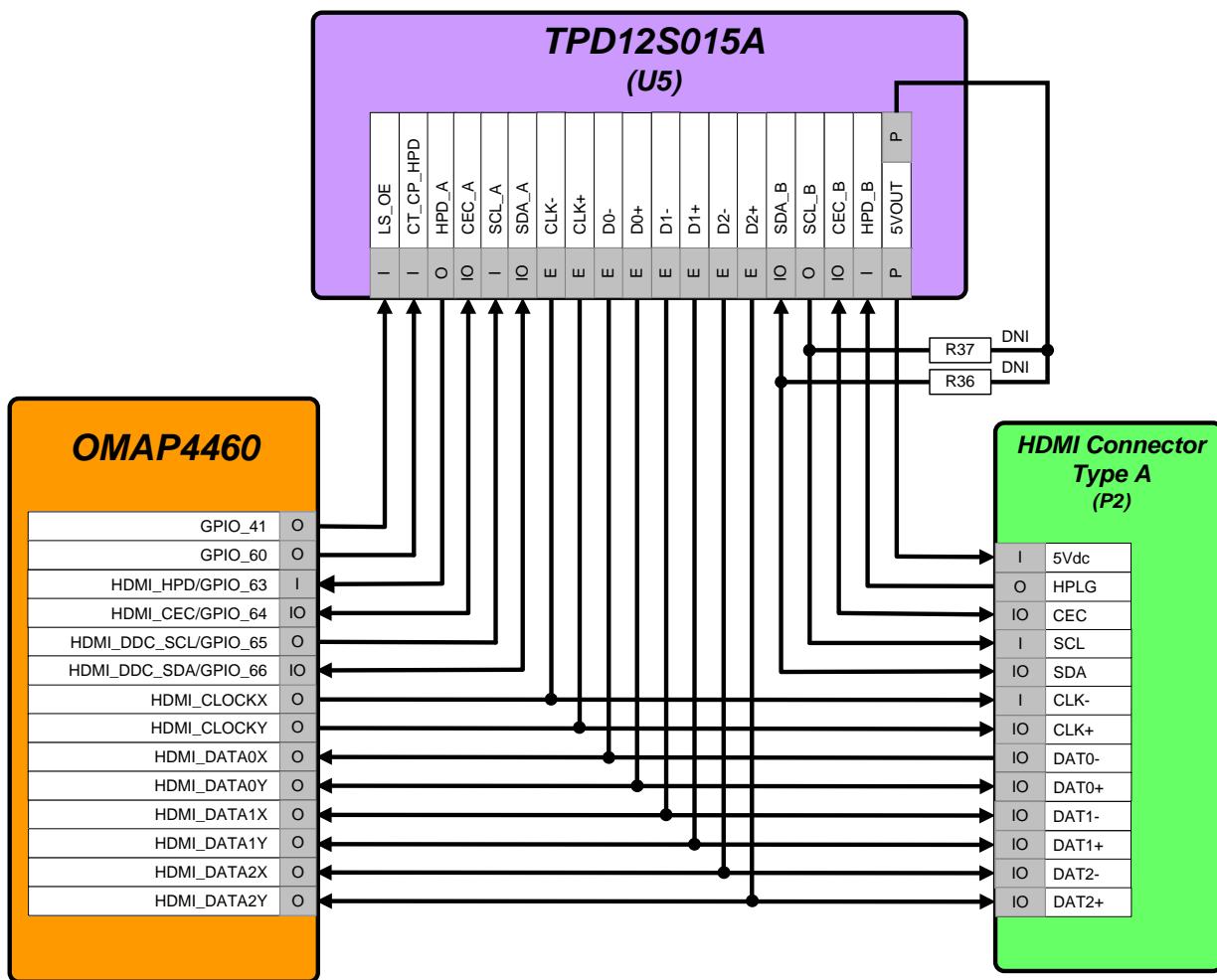


Figure 7 – Panda HDMI Interface Block Diagram

In addition to providing ESD protection on the signals coming from the connector, this device performs voltage translation on the control signals in the HDMI interface (SCL, SDA, CEC, and HPD) from the 1.8V levels of the OMAP4460 to the 5V levels required by a TV set. It also implements a DC/DC boost converter that operates from the “battery” voltage, VBAT, and outputs a 5Vdc output that is capable of sourcing up to 55mA of current. See Table 4 for the GPIOs used on the HDMI interface and a description of their function. The direction column in this table indicates whether this device is an output from OMAP (O) or an input to OMAP (I).



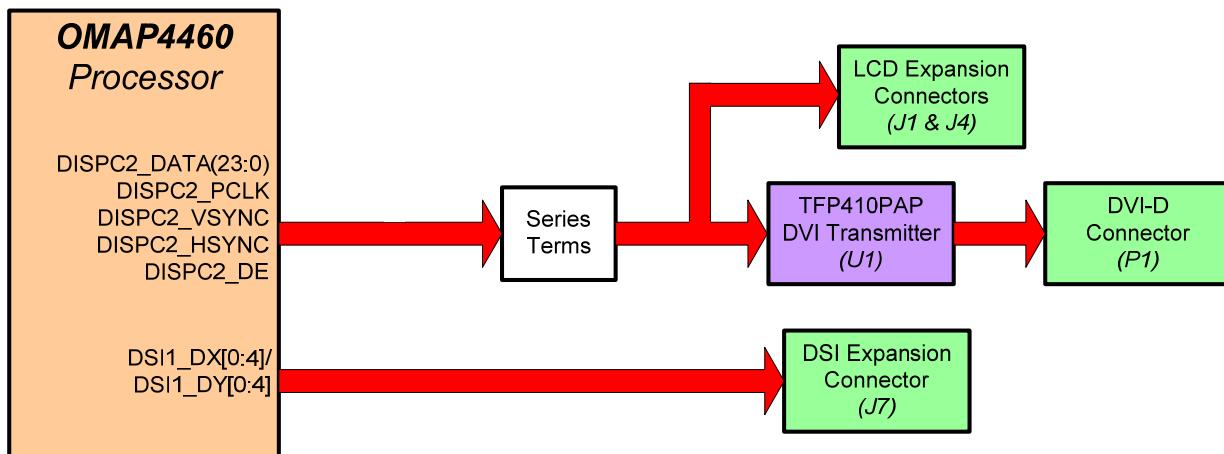


| GPIO | Dir | Signal Name | Description |
|---------|-----|----------------|--|
| GPIO_41 | O | HDMI_LS_OE | TPD12S015A Level Shifter and internal LDO Enable 1 = Enabled, 0 = Disabled |
| GPIO_60 | O | HDMI_CT_CP_HPD | TPD12S015A DC/DC Converter and Hot-Plug Detect Enable 1 = Enabled, 0 = Disabled |

Table 4: HDMI GPIO Definitions

2.13 Display Interface

The Pandaboard ES provides two possible options for the usage of the OMAP4460 parallel display signals. The first option is to use the onboard TFP410 DVI transmitter, whose output feeds an onboard DVI-D connector. The second option is to use a Display Board plugged into a pair of 20-pin LCD expansion connectors (J1 and J4). Both of these possible options are discussed in the following paragraphs. Additionally, a third display option has been added to the OMAP4460 Pandaboard ES. This option is using a DSI Display Board plugged into connector J7 on the back side of the PCB. See Figure 8 for a diagram of the Pandaboard ES Display Interface options.

**Figure 8 – Panda Display Interface Block Diagram**



2.13.1 Parallel Display Interface

See Figure 9 for a detailed block diagram of the OMAP4460 Pandaboard ES parallel display interface. (NOTE: J1/J4 are pin-compatible with the OMAP3530 BeagleBoard, so display boards designed for it may be used with the OMAP4460 Pandaboard ES).

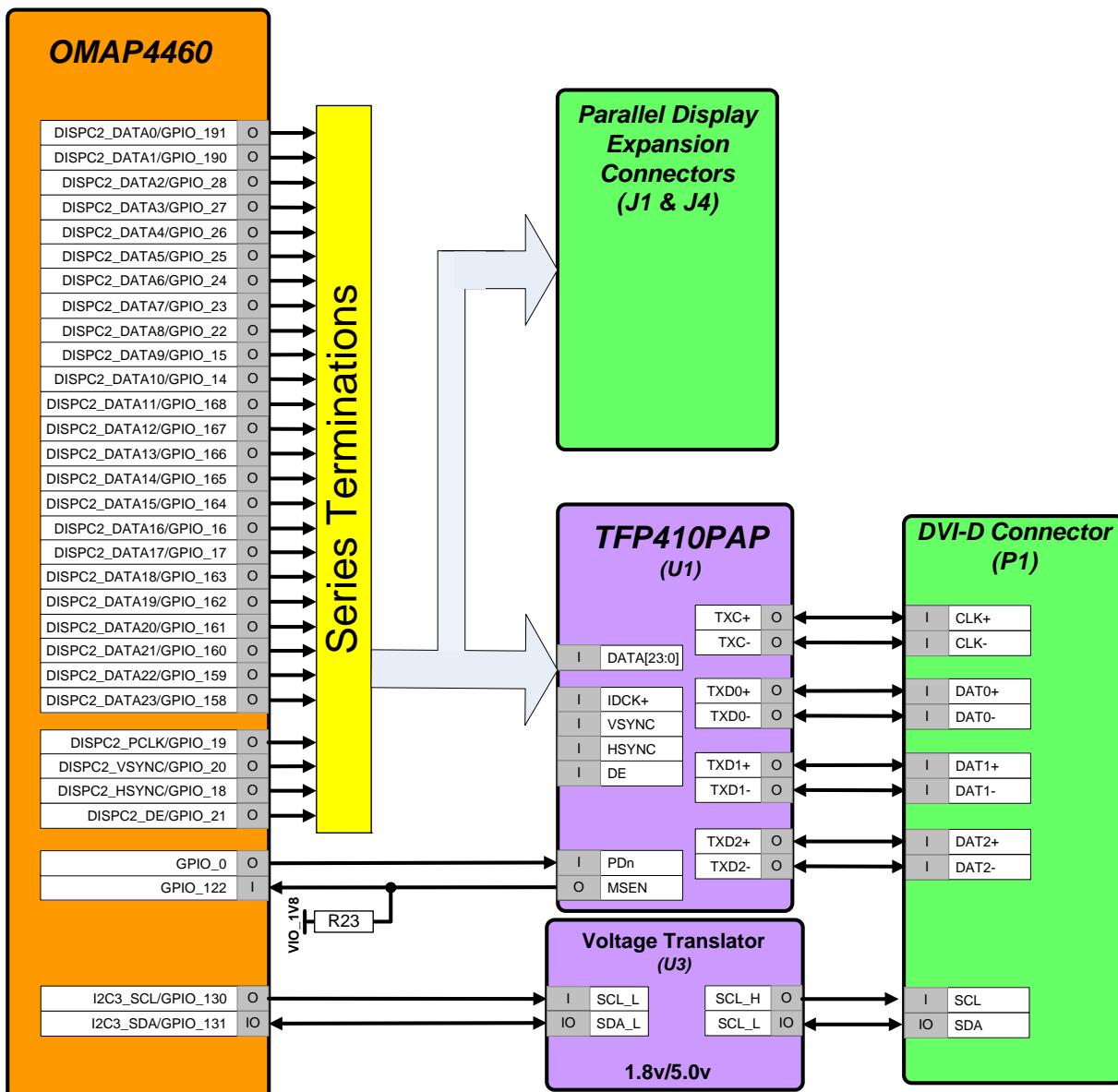


Figure 9 – Pandaboard ES DSS Output Block Diagram





See Table 5 for the GPIOs used on the Parallel display interface and a description of their function. This table does not include the 28 parallel display signals (DATA[23:0], PCLK, VSYNC, HSYNC, and DE).

NOTE: no configuration changes are required to switch between usage of the onboard DVI connector or an external display plugged into the display expansion connectors.

| GPIO | Signal Name | Description |
|----------|-------------------------|--|
| GPIO_0 | H_GPIO_0/ TFP410_NPD | TFP410 Device Power down (<i>note: this GPIO goes through a voltage translator to meet the 3.3V I/O requirement of the TFP410 on this pin</i>) 1 = Normal Operation, 0 = Power Down |
| GPIO_122 | DVI_MSEN | TFP410 Monitor Sense 0 = Powered on receiver sensed at the differential outputs 1 = No powered on receiver detected. (<i>note: this output from the TFP410 is open-drain and has a pull-up to 1.8V, so it is connected directly to OMAP</i>) |

Table 5: DVI-D Display GPIO Definitions

See Table 6 and Table 7 for the pinout of the display expansion connectors.

| Pin# | Signal | I/O | Description |
|------|-------------|-----|---------------------------------|
| 1 | DCIN JACK | PWR | DC rail from the Main DC supply |
| 2 | DCIN JACK | PWR | DC rail from the Main DC supply |
| 3 | h_DSS_DAT1 | I | LCD Pixel Data bit 1 |
| 4 | h_DSS_DAT0 | I | LCD Pixel Data bit 0 |
| 5 | h_DSS_DAT3 | I | LCD Pixel Data bit 3 |
| 6 | h_DSS_DAT2 | I | LCD Pixel Data bit 2 |
| 7 | h_DSS_DAT5 | I | LCD Pixel Data bit 5 |
| 8 | h_DSS_DAT4 | I | LCD Pixel Data bit 4 |
| 9 | h_DSS_DAT12 | I | LCD Pixel Data bit 12 |
| 10 | h_DSS_DAT10 | I | LCD Pixel Data bit 10 |
| 11 | h_DSS_DAT23 | I | LCD Pixel Data bit 23 |
| 12 | h_DSS_DAT14 | I | LCD Pixel Data bit 14 |
| 13 | h_DSS_DAT19 | I | LCD Pixel Data bit 19 |
| 14 | h_DSS_DAT22 | I | LCD Pixel Data bit 22 |
| 15 | H_I2C2_SDA | I/O | I2C2 Serial Data |
| 16 | h_DSS_DAT11 | I | LCD Pixel Data bit 11 |
| 17 | h_DSS_VSYNC | I | LCD Vertical Sync Signal |
| 18 | H_DPM_EMU2 | I | DPM EMU2/GPIO_13 |
| 19 | GND | PWR | Ground bus |
| 20 | GND | PWR | Ground bus |

Table 6: LCD Expansion Connector “A” Pin Definitions (J1)





| Pin# | Signal | I/O | Description |
|------|-------------|-----|---|
| 1 | VDD_VAUX2 | PWR | Power rail (adjustable from 1.2V to 2.8V) |
| 2 | VIO_1V8 | PWR | 1.8V system I/O voltage |
| 3 | h_DSS_DAT20 | I | LCD Pixel Data bit 20 |
| 4 | h_DSS_DAT21 | I | LCD Pixel Data bit 21 |
| 5 | h_DSS_DAT17 | I | LCD Pixel Data bit 17 |
| 6 | h_DSS_DAT18 | I | LCD Pixel Data bit 18 |
| 7 | h_DSS_DAT15 | I | LCD Pixel Data bit 15 |
| 8 | h_DSS_DAT16 | I | LCD Pixel Data bit 16 |
| 9 | h_DSS_DAT7 | I | LCD Pixel Data bit 7 |
| 10 | h_DSS_DAT13 | I | LCD Pixel Data bit 13 |
| 11 | h_DSS_DAT8 | I | LCD Pixel Data bit 8 |
| 12 | NUSB_PWR | O | Input Power Enable |
| 13 | h_DSS_DAT9 | I | LCD Pixel Data bit 9 |
| 14 | H_I2C2_SCL | I | I2C2 Serial Clock |
| 15 | h_DSS_DAT6 | I | LCD Pixel Data bit 6 |
| 16 | h_DSS_PCLK | I | LCD Pixel Clock |
| 17 | h_DSS_DEN | I | LCD Data Enable |
| 18 | h_DSS_HSYNC | I | LCD Horizontal Sync |
| 19 | GND | PWR | Ground bus |
| 20 | GND | PWR | Ground bus |

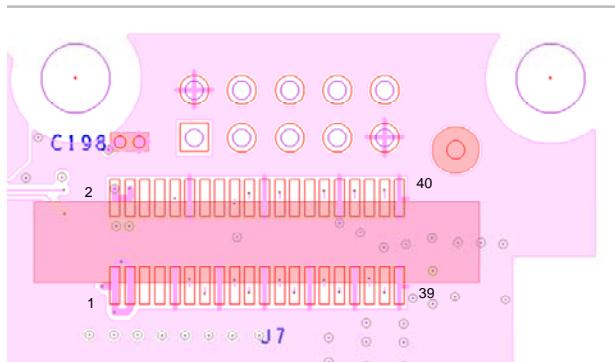
Table 7: LCD Expansion Connector “B” Pin Definitions (J4)

2.13.2 DSI Display Expansion Connector Interface

A third display option for the Pandaboard ES is to plug an external display module into the DSI display expansion connector J7. This connector is a 40-pin, 0.8mm pitch connector (Hirose P/N FX6A-40P-0.8SV91), and is mounted on the back side of the Pandaboard ES PCB. See Figure 10 below for the orientation/pin numbering of this connector as viewed from the back side of the PCB.

A block diagram of the Pandaboard ES Display Expansion interface is shown in Figure 11 on page 36.



**Figure 10 – Panda DSI Display Connector Orientation**

See Table 8 for the pinout of J7 and a description of the signals on the connector. Any pin not shown in Table 8 is not connected.

| J7 Pin # | OMAP Ball # | Signal Name | Signal Description |
|----------|-------------|-----------------|---|
| 1,3 | --- | VIO_1V8 | VIO from TWL6030 |
| 2,4 | --- | VBAT | Battery input voltage |
| Multiple | --- | DGND | Signal Ground (connected on pins 9, 12, 15, 21, 22, 27, 32, 33, 39, and 40) |
| 10 | --- | PHO_PWM1 | PWM1 output of TWL6030 device |
| 11 | P3 | DSI1_DX0 | DSI Signal Lane 0 Data X |
| 13 | P4 | DSI1_DY0 | DSI Signal Lane 0 Data Y |
| 17 | N3 | DSI1_DX1 | DSI Signal Lane 1 Data X |
| 18 | C26 | h_I2C2_SCL | I ² C Clock In |
| 19 | N4 | DSI1_DY1 | DSI Signal Lane 1 Data Y |
| 20 | D26 | h_I2C2_SDA | I ² C Data I/O |
| 23 | M3 | DSI1_DX2 | DSI Signal Lane 2 Data X |
| 24 | D21 | TSC_nINT | Touchscreen Interrupt Out (GPIO_52) |
| 25 | M4 | DSI1_DY2 | DSI Signal Lane 2 Data Y |
| 29 | L3 | DSI1_DX3 | DSI Signal Lane 3 Data X |
| 30 | AG24 | h_DMTIMER11_PWM | Display PWM (GPIO_121) |
| 31 | L4 | DSI1_DY3 | DSI Signal Lane 3 Data Y |
| 34 | B24 | h_GPIO_102 | LCD Reset (GPIO_102) |
| 35 | K3 | DSI1_DX4 | DSI Signal Lane 4 Data X |
| 37 | K4 | DSI1_DY4 | DSI Signal Lane 4 Data Y |
| 38 | A24 | H_DSI1_TE0 | Display Tearing Effect (GPIO_101) |

Table 8: DSI Display Expansion Connector Pin Definitions (J7)

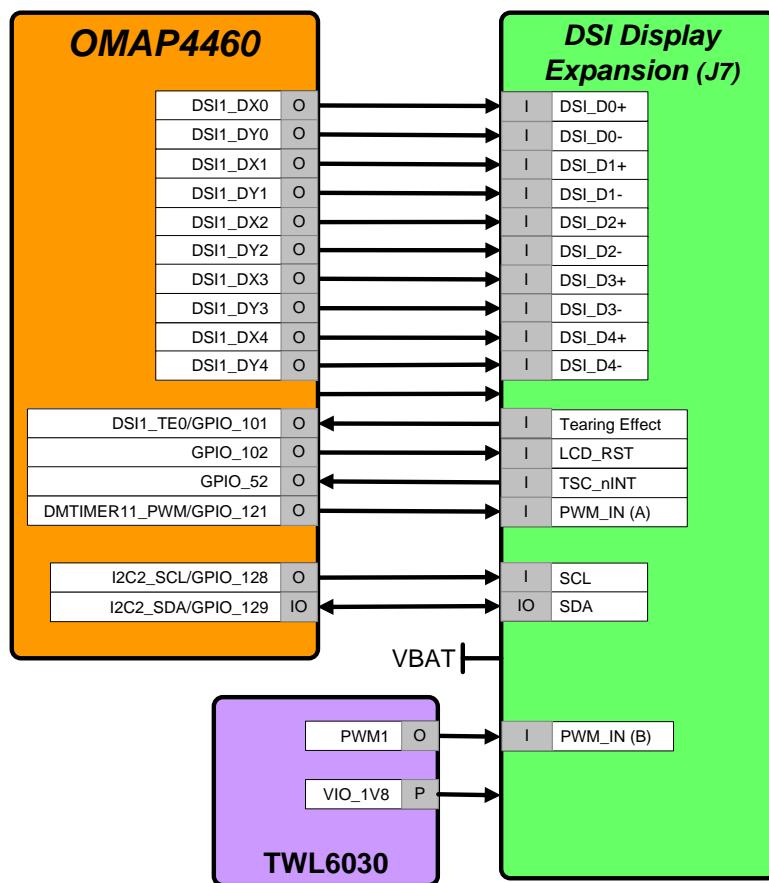


Figure 11 – Panda DSI Display Expansion Block Diagram

2.14 Bluetooth/WLAN Interfaces

The Pandaboard ES provides a module (LS Research Inc. P/N TiWi-BLE) that provides a Bluetooth interface, and a 2.4 GHz 802.11b/g/n interface. This module may be found on sheet 14 of the schematics (reference designator U3). It uses Texas Instruments' WiLink™ 6.0 solution. Information for this module may be found at: <http://www.lsr.com>.

See Figure 12 for a diagram of the Pandaboard ES connectivity to this module. See Table 9 on page 38 for a description of the GPIOs used to interface to the module and their function.





The OMAP4460 interfaces are connected to the LS Research WiLink™ module as follows:

- SDMMC5: WLAN SDIO interface
- UART2: Bluetooth Host Control Interface
- McBSP1: Audio Digital PCM Path

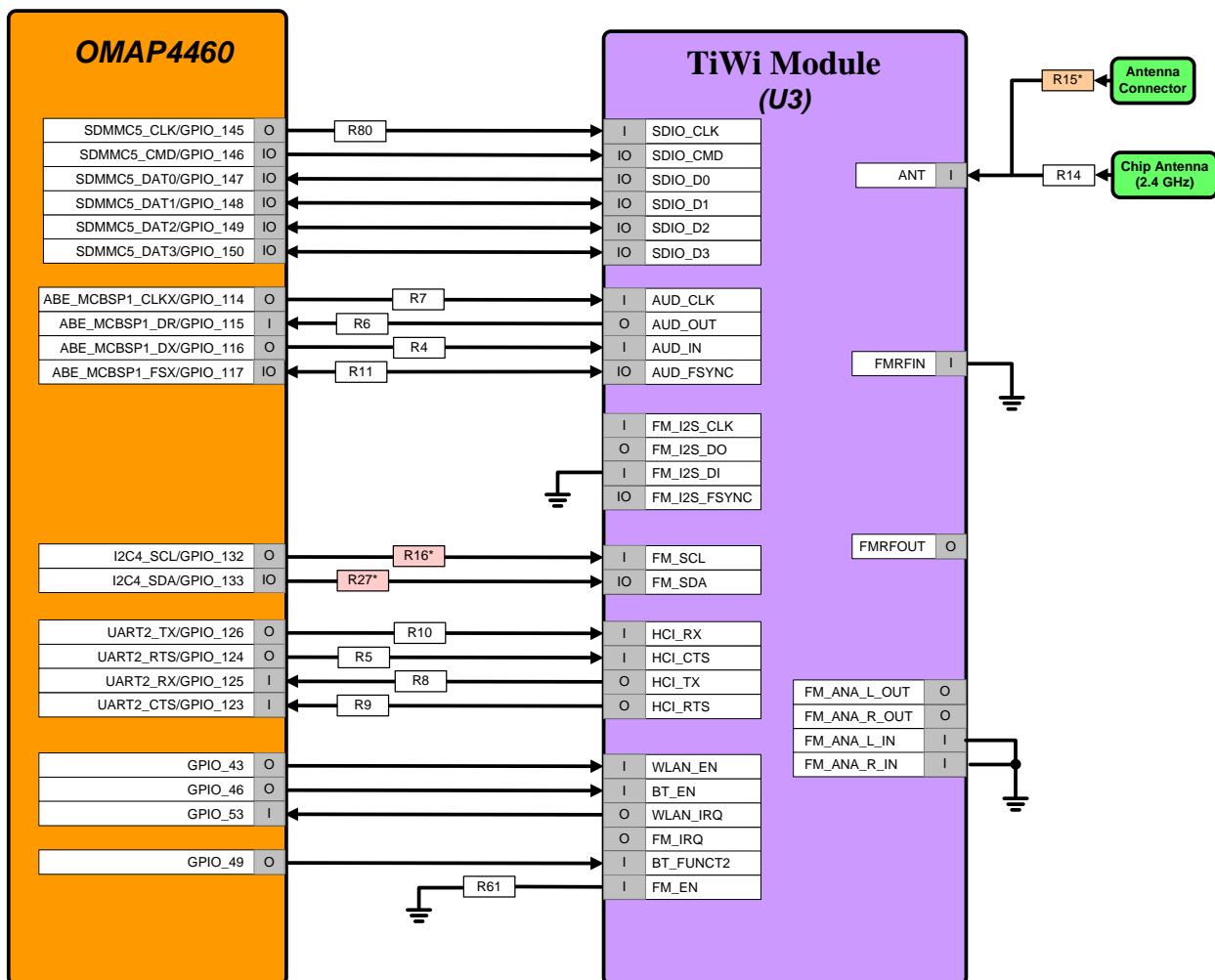


Figure 12 – Pandaboard ES WLAN/Bluetooth Interface Block Diagram





| GPIO | Dir. | Signal Name | Description |
|---------|------|-------------|---|
| GPIO_43 | O | WLAN_EN | 802.11b/g Enable 1 = Enabled, 0 = Disabled |
| GPIO_46 | O | BT_EN | Bluetooth Enable 1 = Enabled, 0 = Disabled |
| GPIO_49 | I | BT_WAKEUP | Bluetooth Wakeup |
| GPIO_53 | I | WLAN_nIRQ | WLAN Interrupt Input |

Table 9: WLAN/Bluetooth Module GPIO Definitions

2.15 Audio Interfaces

See Figure 13 for a block diagram of the audio connectivity on the OMAP4460 Pandaboard ES. In this block diagram, the signals with a red background in the box specifying their direction are analog I/Os while all others are 1.8V digital I/Os.

The OMAP4460 Pandaboard ES provides a stacked audio connector, which provides two 3.5mm audio jack connections. The upper jack on this stacked connector (J16A in Figure 13 below), is connected to FM Audio Left and Right inputs of the TWL6040 Audio Companion IC (AFML/AFMR). The lower jack on this stacked connector (J16B in Figure 13 below) is connected to the Headset Right and Left outputs of the TWL6040. Additionally, there is a 2nd possible connection to the TWL6040 Auxiliary outputs (AUXLP/AUXRP). To enable this alternate path, resistors R181 and R182 would need to be removed, and zero ohm, 0402 resistors should be installed at locations R160 and R164.

The digital path for this audio back to the OMAP4460 processor is through the PDM interface. For expansion purposes, the left Hands-Free speaker outputs of the TWL6040 are connected to the Expansion Connector J6 (see Paragraph 2.17 on page 41 for further details).

The Pandaboard ES also provisions a digital PCM path for Bluetooth audio from the module to OMAP4460 via McBSP1.



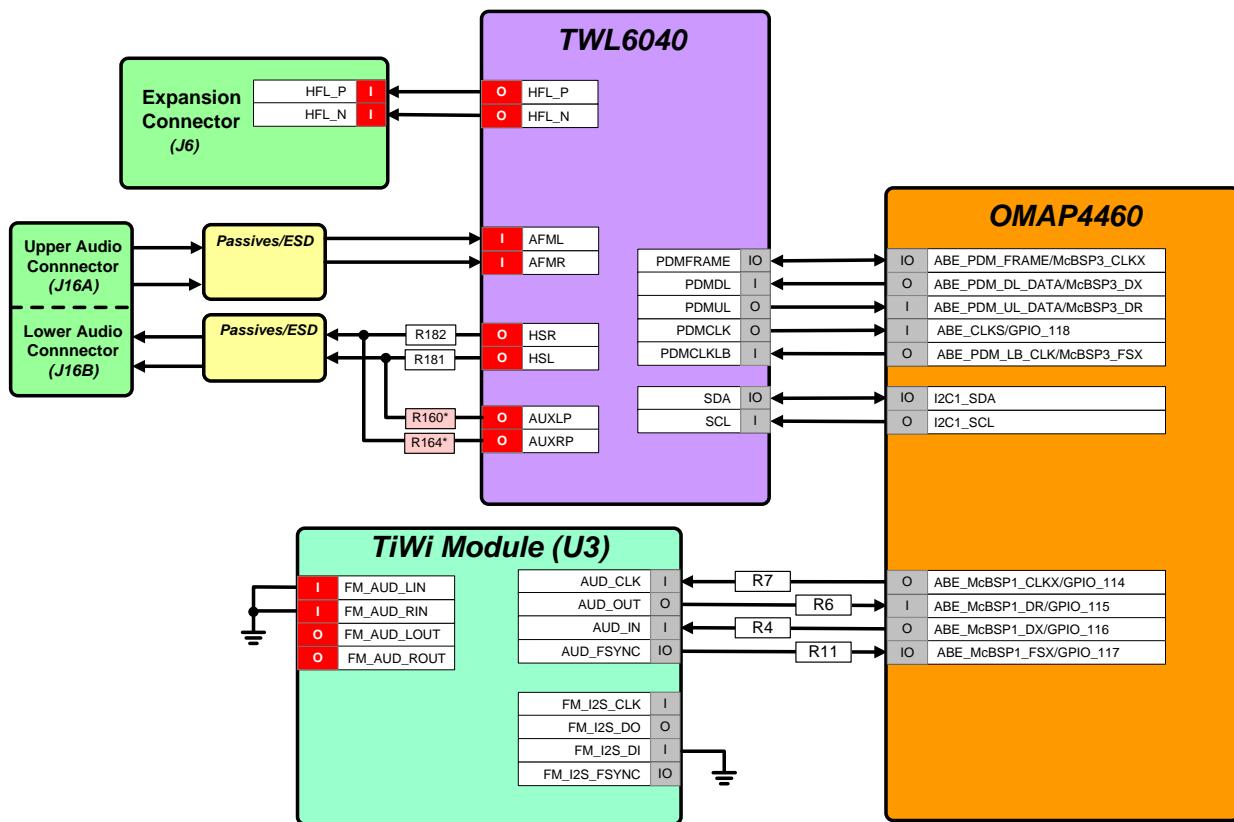


Figure 13 – Panda Audio Interface Block Diagram

2.16 USB Interfaces

The Pandaboard ES utilizes two USB interfaces. The first is a DP/DM interface from the internal transceiver within OMAP to the mini-AB connector J18. The second interface utilizes the 12-wire ULPI interface (USBB1) to an onboard USB phy, whose DP/DM I/Os are interfaced to a Hub IC which provides four downstream USB Host ports, and an Ethernet interface. Each of these interfaces will be discussed in more detail in the following paragraphs.

2.16.1 USBOTG Interface

The Pandaboard ES uses the USB OTG transceiver within the OMAP4460 that is connected to an industry-standard mini-AB connector (J18) as shown in Figure 14. The VBUS from the connector is connected to the TWL6030 companion Power IC, which can provide up to 100mA in host mode (i.e. when a client device is connected). The Pandaboard ES may only be used in host mode if a +5Vdc power supply is installed in power jack P3.



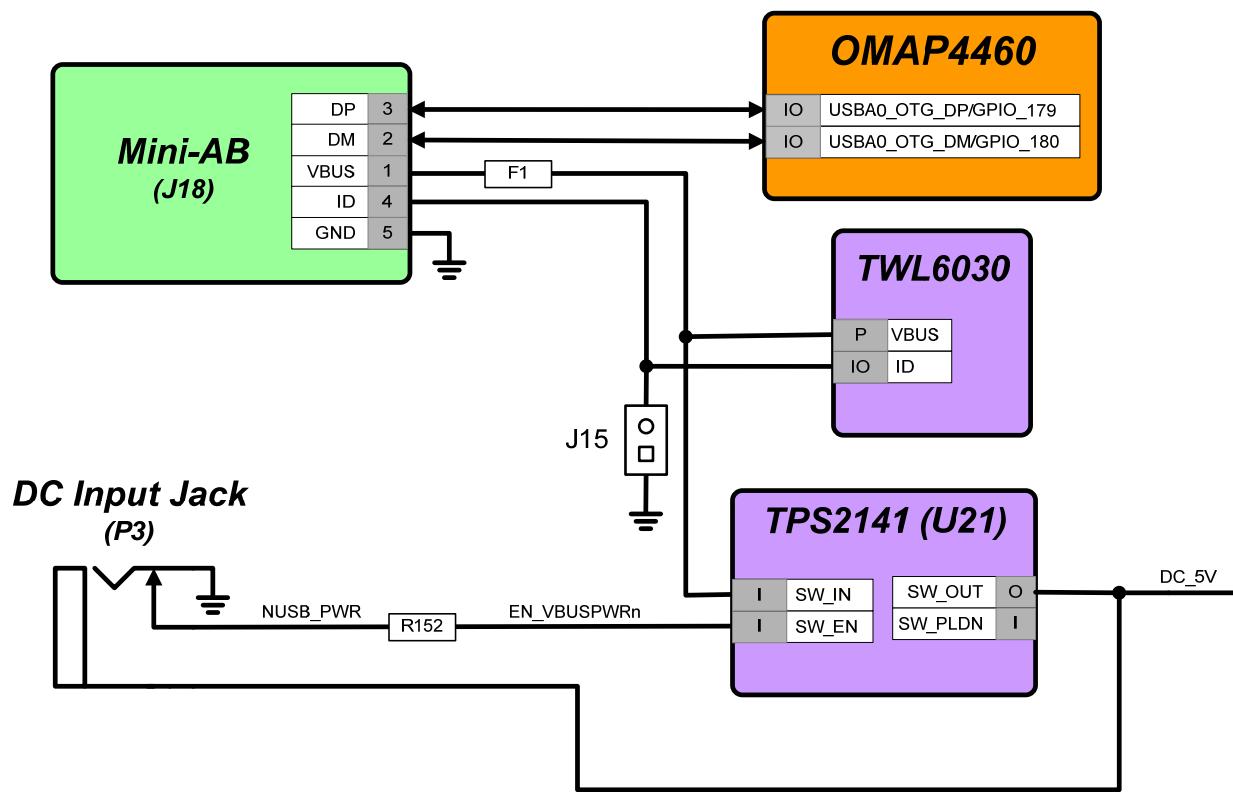


Figure 14 – Panda USBOTG Interface Block Diagram

2.16.2 USBB1 Phy Interface

The Pandaboard ES uses the 12-wire OMAP4460 USBB1 ULPI interface connected to an SMSC USB3320C-EZK phy. This Phy converts the 12-wire ULPI interface to a DP/DM pair that is used as the upstream USB interface to the LAN9514 USB/Ethernet Hub IC. The Hub IC provides four downstream Host USB ports, and an Ethernet interface. Two of the USB Host Ports are available via the combo connector J9, while the other two ports are available via Expansion Connector J6. The Ethernet interface is available via a tab-up RJ-45 connector at J9. See Figure 15 for a block diagram of the Pandaboard ES USBB1 interface connectivity.

- Note that the reference clock to the USB3320C is sourced from the FREF_CLK3_OUT output of OMAP4460, and this OMAP output must be programmed for a clock frequency of 19.2 MHz for proper operation



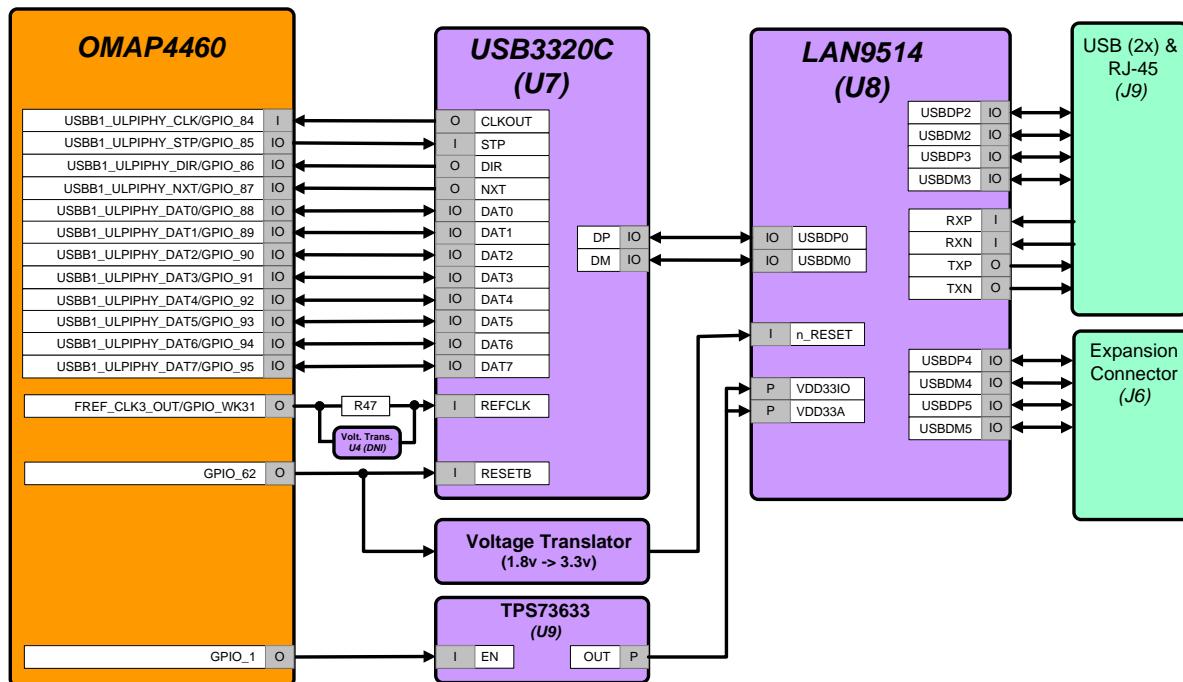


Figure 15 – Panda USBB1 Interface Block Diagram

See Table 10 for the definition of the GPIOs used to provide USB Host Port/Ethernet functions.

| GPIO | Dir. | Signal Name | Description |
|-----------|------|-------------------------------|--|
| GPIO_1 | O | HUB_NPD/ HUB_LDO_EN | Enable to the Hub 3.3V LDO @ U9 (note: this GPIO goes through a voltage translator to provide adequate V_{ih} margin on the LDO enable input). 1 = Enable Hub LDO 0 = Power Down Hub LDO |
| GPIO_62 | O | HUB_NRESET/ HUB_NRESET_3V3 | USB/Ethernet Hub Reset 0 = Hub & Phy held in reset 1 = Normal operation. |
| GPIO_WK31 | O | USBB1_PHY_REFCLK | This pin needs to be used as FREF_CLK3_OUT, and programmed to output 19.2 MHz |

Table 10: USB Host Port/Ethernet GPIO Definitions

2.17 Expansion Connectors (J3 & J6)





The Pandaboard ES provides locations for two 28-pin, 0.1" through-hole expansion connectors, J3 and J6, to support platform expansion (these connectors are not mounted on the current Pandaboard ES). The placement of these connectors on the Panda PCB is shown below. On both connectors, the top left pin is pin 1 and odd numbered pins are on the top row of the connector, and even numbered pins are on the bottom row. See Figure 16 for the placement and orientation of these two connectors on the Pandaboard ES. The distance between pin 1 of the two connectors is 300 mils or 7.62mm. Note that since these are through-hole connectors, boards can be designed to plug into the Pandaboard ES from either top or bottom, depending on user preference.

See Table 11 for the pinout of expansion connector "A" and Table 12 for the pinout of expansion connector "B". These tables show the primary function that is available on the connector pin, along with the alternate function that can be selected by changing the OMAP4460 pin multiplexing. Some of the OMAP I/Os have more than two possible functions, see Table 22 on page 55 for a complete list of the functions available.

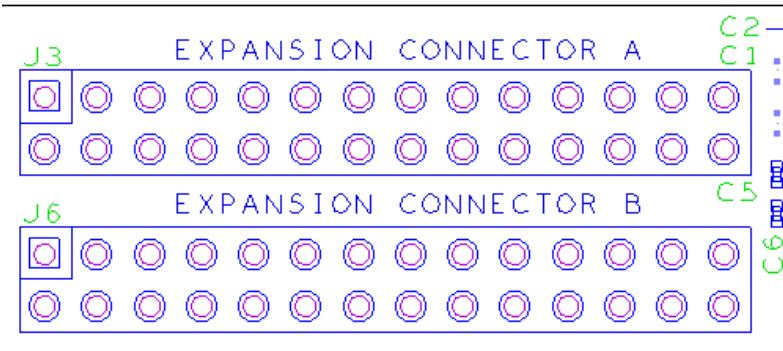


Figure 16 – Expansion Connector PCB Placement/Orientation





| J3 Pin # | OMAP Ball # | Primary Function | Secondary Function | Description of Pandaboard ES Usage |
|----------|-------------|------------------|--------------------|-------------------------------------|
| 1 | --- | VIO_1V8 | --- | 1.8V I/O Power |
| 2 | --- | DCIN JACK | --- | 5Vdc Input Power |
| 3 | B16 | GPMC AD7 | SDMMC2 DAT7 | GPMC Address/Data Bit 7 |
| 4 | AH23 | MCSPI1_CS3 | GPIO_140 | SPI1 Chip Select 3 (also UART1_RTS) |
| 5 | A16 | GPMC AD6 | SDMMC2 DAT6 | GPMC Address/Data Bit 6 |
| 6 | AH19 | UART4_TX | GPIO_156 | UART4 Transmit Data |
| 7 | D15 | GPMC AD5 | SDMMC2 DAT5 | GPMC Address/Data Bit 5 |
| 8 | AG20 | UART4_RX | GPIO_155 | UART4 Receive Data |
| 9 | C15 | GPMC AD4 | SDMMC2 DAT4 | GPMC Address/Data Bit 4 |
| 10 | AF23 | MCSPI1_CS1 | GPIO_138 | SPI1 Chip Select 1 (also UART1_RX) |
| 11 | D13 | GPMC AD3 | SDMMC2 DAT3 | GPMC Address/Data Bit 3 |
| 12 | AG22 | MCSPI1_SIMO | GPIO_136 | SPI1 Slave In Master Out |
| 13 | C13 | GPMC AD2 | SDMMC2 DAT2 | GPMC Address/Data Bit 2 |
| 14 | AG23 | MCSPI1_CS2 | GPIO_139 | SPI1 Chip Select 2 (also UART1_CTS) |
| 15 | D12 | GPMC AD1 | SDMMC2 DAT1 | GPMC Address/Data Bit 1 |
| 16 | AE23 | MCSPI1_CS0 | GPIO_137 | SPI1 Chip Select 0 |
| 17 | C12 | GPMC AD0 | SDMMC2 DAT0 | GPMC Address/Data Bit 0 |
| 18 | AE22 | MCSPI1_SOMI | GPIO_135 | SPI1 Slave Out Master In |
| 19 | B12 | GPMC_NWE | SDMMC2_CMD | GPMC Write Enable |
| 20 | AF22 | MCSPI1_CLK | GPIO_134 | SPI1 Clock Out |
| 21 | B11 | GPMC_NOE | SDMMC2_CLK | GPMC Output Enable |
| 22 | D19 | GPMC_AD15 | GPIO_39 | GPMC Address/Data Bit 15 |
| 23 | AH22 | I2C4_SDA | GPIO_133 | I2C4 Serial Data |
| 24 | AG21 | I2C4_SCL | GPIO_132 | I2C4 Serial Clock |
| 25 | --- | REGEN1 | --- | TWL6030 REGEN1 |
| 26 | E7 | SYS_NRESPWRON | --- | Power On Reset |
| 27 | --- | DGND | --- | Digital Ground |
| 28 | --- | DGND | --- | Digital Ground |

Table 11: Expansion Connector “A” Pin Definitions (J3)





| J6 Pin # | OMAP Ball # | Primary Function | Secondary Function | Description of Pandaboard ES Usage |
|----------|-------------|------------------|--------------------|--|
| 1 | --- | VBUS_3 | --- | VBUS out from USB Host Port #3 |
| 2 | --- | VBUS_4 | --- | VBUS out from USB Host Port #4 |
| 3 | --- | USBH3_DM | --- | USB Host Port #3 Data Minus |
| 4 | --- | USBH4_DM | --- | USB Host Port #4 Data Minus |
| 5 | --- | USBH3_DP | --- | USB Host Port #3 Data Plus |
| 6 | --- | USBH4_DP | --- | USB Host Port #4 Data Plus |
| 7 | --- | DGND | --- | Digital Ground |
| 8 | --- | DGND | --- | Digital Ground |
| 9 | C19 | GPMC_AD14 | GPIO_38 | GPMC Address/Data Bit 14 |
| 10 | D18 | GPMC_AD13 | GPIO_37 | GPMC Address/Data Bit 13 |
| 11 | AF7 | SYS_NRESWARM | --- | Warm Reset |
| 12 | --- | PB_POWER_ON | --- | Power on input to TWL6030 (ref. to VBAT) |
| 13 | --- | HFL_P | --- | Hands Free Left Speaker Out (+) |
| 14 | AG24 | H_DMTIMER11_PWM | GPIO_121 | Display PWM Control |
| 15 | --- | HFL_N | --- | Hands Free Left Speaker Out (-) |
| 16 | --- | VDD_VAUX1 | --- | VAUX1 from TWL6030 |
| 17 | C18 | GPMC_AD12 | GPIO_36 | GPMC Address/Data Bit 13 |
| 18 | C16 | GPMC_AD8 | GPIO_32 | GPMC Address/Data Bit 8 |
| 19 | B26 | GPMC_WAIT0 | GPIO_61 | GPMC Wait input 0 |
| 20 | D16 | GPMC_AD9 | GPIO_33 | GPMC Address/Data Bit 9 |
| 21 | C25 | GPMC_NWP | GPIO_54 | GPMC Write Protect |
| 22 | C17 | GPMC_AD10 | GPIO_34 | GPMC Address/Data Bit 10 |
| 23 | B22 | GPMC_CLK | GPIO_55 | GPMC Clock Out |
| 24 | D17 | GPMC_AD11 | GPIO_35 | GPMC Address/Data Bit 11 |
| 25 | B25 | GPMC_NCS0 | GPIO_50 | GPMC Chip Select 0 |
| 26 | D25 | GPMC_NADV_ALE | GPIO_56 | GPMC Address Valid/Address Latch Enable |
| 27 | C21 | GPMC_NCS1 | GPIO_51 | GPMC Chip Select 1 |
| 28 | C23 | GPMC_NBE0_CLE | GPIO_59 | GPMC Byte Enable 0/Command Latch Enable |

Table 12: Expansion Connector “B” Pin Definitions (J6)

2.18 Camera Expansion Connector (J17)

The Pandaboard ES does not provide an onboard camera sensor, but does provision for a 30-pin camera connector. This camera connector receives the five CSI-2 lanes of the OMAP4460 CSI21 camera interface as well as GPIOs for use on a plug-in camera module.

See Table 13 below for the pinout of the camera expansion connector.

NOTE: the GPIOs listed below don't have specific functions defined yet, as there has been no camera module designed. These GPIOs will be user-definable per the camera module implementation.





| J17 Pin # | OMAP Ball # | Signal Name | Signal Description |
|--------------|----------------|-----------------|--|
| 1 | --- | DGND | Signal Ground |
| 2 | --- | DGND | Signal Ground |
| 3 | R26 | CSI21_DX0 | CSI Signal Lane 0 Data X |
| 4 | V26 | CSI21_DX3 | CSI Signal Lane 3 Data X |
| 5 | R25 | CSI21_DY0 | CSI Signal Lane 0 Data Y |
| 6 | V25 | CSI21_DY3 | CSI Signal Lane 3 Data Y |
| 7 | --- | DGND | Signal Ground |
| 8 | --- | DGND | Signal Ground |
| 9 | T26 | CSI21_DX1 | CSI Signal Lane 1 Data X |
| 10 | W26 | CSI21_DX4 | CSI Signal Lane 4 Data X |
| 11 | T25 | CSI21_DY1 | CSI Signal Lane 1 Data Y |
| 12 | W25 | CSI21_DY4 | CSI Signal Lane 4 Data Y |
| 13 | --- | DGND | Signal Ground |
| 14 | --- | DGND | Signal Ground |
| 15 | U26 | CSI21_DX2 | CSI Signal Lane 2 Data X |
| 16 | B17 | H_GPIO_40 | OMAP GPIO_40 |
| 17 | U25 | CSI21_DY2 | CSI Signal Lane 2 Data Y |
| 18 | B20 | H_GPIO_45 | OMAP GPIO_45 |
| 19 | --- | DGND | Signal Ground |
| 20 | V27 | H_CAM_GLB_RESET | Camera Global Reset or GPIO_83 |
| 21 | W27 | H_I2C3_SCL | I2C3 Serial Clock |
| 22 | T27 | H_CAM_SHUTTER | Camera Shutter or GPIO_81 |
| 23 | Y27 | H_I2C3_SDA | I2C3 Serial Data |
| 24 | U27 | H_CAM_STROBE | Camera Strobe or GPIO_82 |
| 25 | B21 | H_GPIO_47 | OMAP GPIO_47 |
| 26 | B19 | H_GPIO_44 | OMAP GPIO_44 |
| 27 | AA28 | H_FREF_CLK1_OUT | OMAP Camera Clock In |
| 28 | B18 | H_GPIO_42 | OMAP GPIO_42 |
| 29 | --- | VBAT | Battery Voltage In |
| 30 | --- | VDD_VAUX3 | TWL6030 VAUX3 LDO (adjustable from 1.0V to 3.0V) |

Table 13: Camera Expansion Connector Pin Definitions (J17)

2.19 JTAG Connector (J8)

The Pandaboard ES provides a 14-pin 0.1" (2.54mm) pitch through-hole connector at J8 as shown in Figure 17 below. In the figure below, pin 1 is the lower left pin and pin 2 is directly above it. Odd number pins are on the bottom side of the connector, and even numbered pins are along the top. Pin 6 is removed to comply with the keying on the JTAG pods.



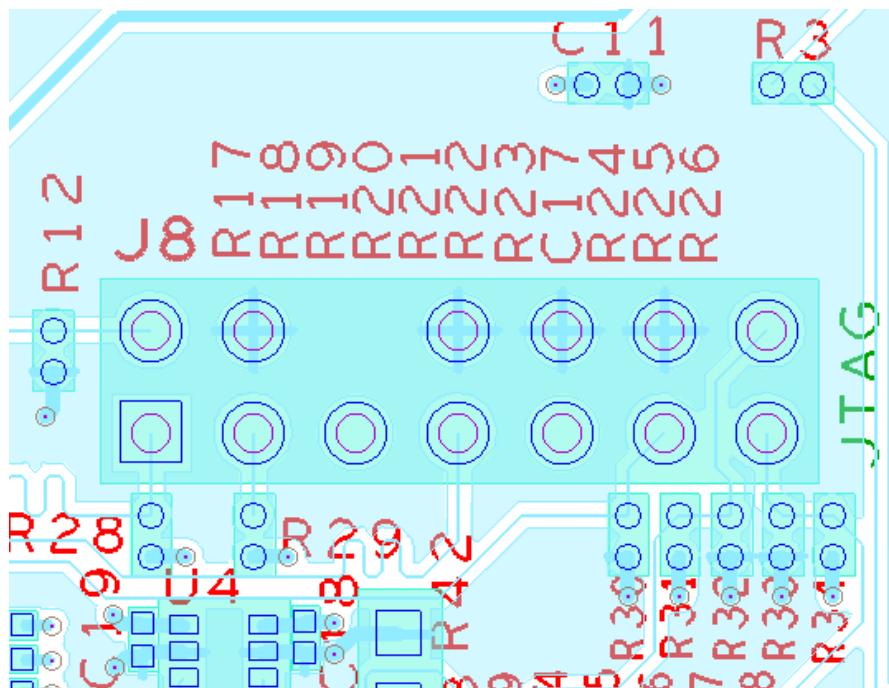


Figure 17 – 14-pin JTAG Connector (J8)

See Table 14 for a description of the pins their connectivity to OMAP4460, and their function on this connector.

| J8 Pin # | OMAP Ball # | Signal Name | Signal Description |
|-----------|-------------|--------------|------------------------------|
| 1 | AH1 | H JTAG TMS | JTAG Test Mode Select |
| 2 | AH2 | H JTAG NTRST | JTAG Test Reset (Active low) |
| 3 | AE1 | H JTAG TDI | JTAG Test Data In |
| 4,8,10,12 | ---- | DGND | Signal Ground |
| 5 | --- | VIO_1V8 | 1.8V JTAG Power |
| 6 | --- | ---- | N/A |
| 7 | AE2 | H JTAG TDO | JTAG Test Data Out |
| 9 | AE3 | H JTAG RTCK | JTAG Return Clock Out |
| 11 | AG1 | H JTAG TCK | JTAG Clock In |
| 13 | M2 | H DPM_EMU0 | Emulator I/O 0 |
| 14 | N2 | H DPM_EMU1 | Emulator I/O 1 |

Table 14: JTAG Connector Pinout (J8)





2.20 LED Indicators

The Pandaboard ES provides three LED indicators. See Figure 18 for the location of these three LEDs on the Panda PCB.

LEDs D1 and D2 are green LEDs. D1 is controlled via OMAP4460 GPIO_110 (ball AD27), while D2 is controlled via OMAP4460 GPIO_WK8 (ball AC3). For both of these LEDs, writing the GPIO high will turn on the LED, while writing it low will turn off the LED.

LED D3 is a red LED that is controlled automatically via onboard circuitry. This LED being illuminated indicates an overvoltage condition on the input DC supply (i.e. a supply of greater than 5V has been plugged into P3). The supervisor IC at U19 on sheet 2 of the schematics monitors the voltage from the DC input jack (through a voltage divider to set the appropriate threshold). If a DC supply of more than 5V is plugged into the Pandaboard ES, the U19 output reset will be negated, which will turn on the red LED at D3 and disable load switch U16 on sheet 2 of the schematic, which will remove 5V power to the remainder of the Pandaboard ES circuitry. This is intended to prevent damage to onboard circuitry.

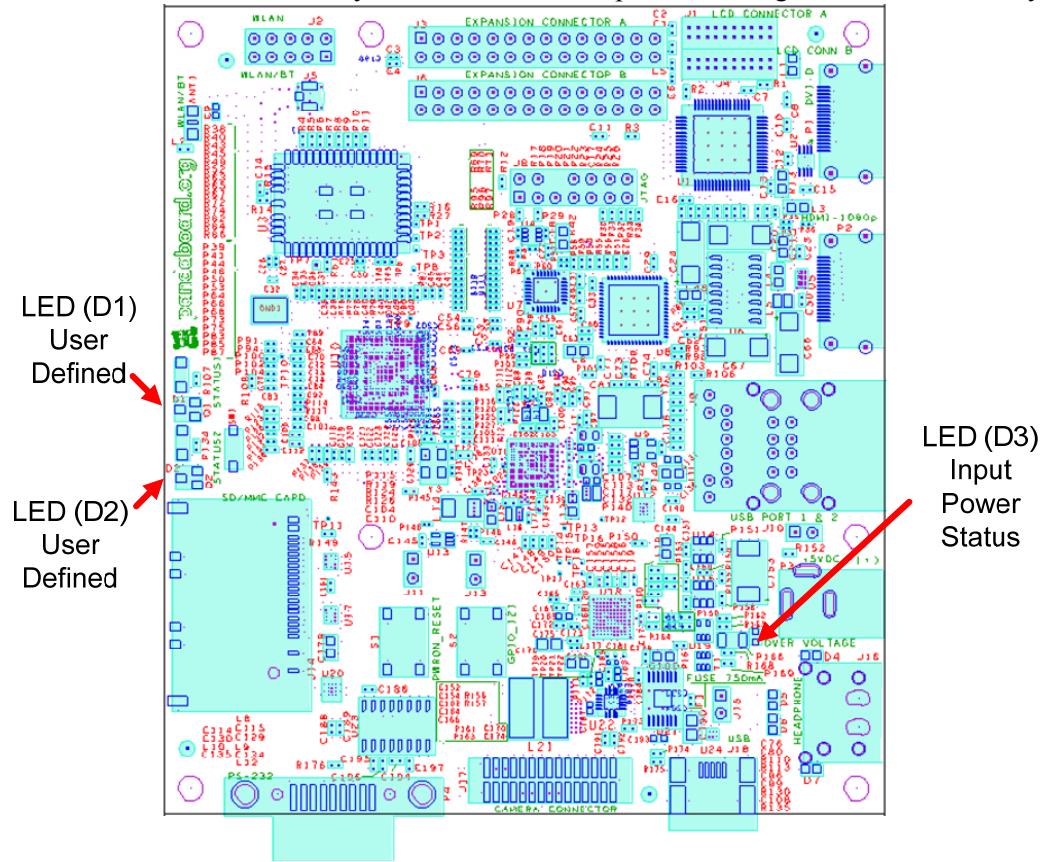


Figure 18 – Pandaboard ES LED Locations





2.21 User Interface Features

Described below are the user features that are incorporated in the OMAP4460 Pandaboard ES.

2.21.1 S1 – Push Button Switch

S1 is a momentary push-button switch that may be depressed to initiate a power-on reset of the Pandaboard ES. The normal power-on output from the TWL6030 is driven through an open-collector driver, and the output of this switch is tied to the output of the open-collector gate.

2.21.2 S2 - Push Button Switch

S2 is a momentary push-button switch whose output is tied to GPIO_113 on the Pandaboard ES. Depressing this switch will momentarily ground GPIO_113. For proper operation of this switch, the internal pull on this signal must be enabled, and it must be set to a pull-up NOT a pull-down.

2.21.3 SW1 – Dip/Slide Switch

SW1 is slide switch that is used to provide the Pandaboard ES user with the desired value on the SYSBOOT3 input into the OMAP4460. Having this switch in the open position will cause SYSBOOT3 to be sampled as a logic ‘1’ at reset, while having it in the closed position will cause SYSBOOT3 to be sampled low at reset.

2.22 I²C Device Mapping

The OMAP4460 Pandaboard ES contains four different I²C busses that are provided by the OMAP4460 (I²C1, I²C2, I²C3, and I²C4). The paragraphs below detail the seven bit I²C addresses for each device on the different I²C busses. The write and read addresses are derived by adding a ‘0’ or ‘1’ respectively, to the LSB of the address given below.

2.22.1 OMAP I²C1

| Device | Function | I2C Address |
|---------|------------------|------------------|
| TWL6030 | Phoenix Power IC | 0x48, 0x49, 0x4A |
| TWL6040 | Phoenix Audio IC | 0x4B |

Table 15: OMAP I²C1 Device Addresses





2.22.2 OMAP I²C2

| <i>Device</i> | <i>Function</i> | <i>I2C Address</i> |
|-------------------------------------|---|--------------------|
| Display Expansion Connector (J1/J4) | External LCD Control (e.g. touchscreen) | TBD |
| DSI Expansion Connector (J7) | DSI Connector Touchscreen I/F Control | TBD |

Table 16: OMAP I²C2 Device Addresses

2.22.3 OMAP I²C3

| <i>Device</i> | <i>Function</i> | <i>I2C Address</i> |
|----------------------------------|--|--------------------|
| DVI-D connector (P1) | Control of television set connected via P1 | TBD |
| Camera Expansion connector (J17) | Camera Module Control | TBD |

Table 17: OMAP I²C3 Device Addresses

2.22.4 OMAP I²C4

| <i>Device</i> | <i>Function</i> | <i>I2C Address</i> |
|---------------------------|------------------|--------------------|
| Expansion Connectors (J6) | Future expansion | TBD |

Table 18: OMAP I²C4 Device Addresses





3 Pandaboard ES S/W Interface

This chapter provides details of interest regarding the SW interface of the Pandaboard ES implementation.

3.1 Readable Board Revision

The OMAP4460 Panda Board provides a readable PCB revision that may be read by Software to determine what board is being used. These board ID bits are shown below for the OMAP4460 and OMAP4430 Pandaboard ESs. BOARD_ID2 and BOARD_ID0 stayed on the same GPIOs (GPIO_171 and GPIO_182, respectively), but BOARD_ID1 changed from GPIO_101 on the 4430 Pandaboard ES to GPIO_48 on the OMAP4460 Pandaboard ES. This was necessary because GPIO_101 was utilized as the tearing effect signal to the new DSI Display Expansion connector at J7. Values are as shown in Table 19 below.

| BOARD_ID4 | BOARD_ID3 | BOARD_ID2 | BOARD_ID1 | BOARD_ID0 |
|-------------------------------|------------------|-----------|-----------|-----------|
| OMAP4460 Pandaboard ES | | | | |
| GPIO_2 | GPIO_3 | GPIO_171 | GPIO_48 | GPIO_182 |
| 0 | 0 | 0 | 1 | 1 |
| OMAP4430 Pandaboard ES | | | | |
| N/A ¹ | N/A ¹ | GPIO_171 | GPIO_101 | GPIO_182 |
| 1 | 1 | 0 | 1 | 1 |

Table 19: Board ID Read Values

¹ – GPIO_2 and GPIO_3 are unused on the OMAP4430 Pandaboard ES, and if read, will both be read back as ‘1’

3.2 Pandaboard ES Pin Multiplexing

3.2.1 Panda Base Platform Pin Multiplexing

See Table 20 for a listing of the OMAP pin multiplexing required for the OMAP4460 processor on the Pandaboard ES. This table only includes the GPIOs that are connected and required for operation of the as-shipped configuration of the Pandaboard ES. Unused pins are not included here as well as any GPIOs that go to the onboard connectors. GPIOs that are connected to the Camera Expansion connector at J17 are listed in Table 21 on page 54, while the signals connected to the Generic Expansion connectors at J3 and J6 may be found in Table 22 on page 55.

| GPIO | OMAP Ball # | Mux Mode | Signal Name | Description of Pandaboard ES Usage |
|------|-------------|----------|-------------|---------------------------------------|
| 0 | J27 | 3 | H_GPIO_0 | DVI-D Transmitter (TFP410) Power Down |





| GPIO | OMAP Ball # | Mux Mode | Signal Name | Description of Pandaboard ES Usage |
|------|-------------|----------|---------------|--|
| 1 | H27 | 3 | HUB_NPD | Ethernet/USB Hub LDO Power Enable |
| 2 | L27 | 3 | GPIO_2 | Board ID Bit 4 |
| 3 | K27 | 3 | GPIO_3 | Board ID Bit 3 |
| 11 | M2 | 0 | DPM_EMU0 | JTAG Emulator 0 I/O |
| 12 | N2 | 0 | DPM_EMU1 | JTAG Emulator 1 I/O |
| 14 | V1 | 5 | DISPC2_DATA10 | Parallel Display Data Bit 10 |
| 15 | V2 | 5 | DISPC2_DATA9 | Parallel Display Data Bit 9 |
| 16 | W1 | 5 | DISPC2_DATA16 | Parallel Display Data Bit 16 |
| 17 | W2 | 5 | DISPC2_DATA17 | Parallel Display Data Bit 17 |
| 18 | W3 | 5 | DISPC2_HSYNC | Parallel Display Horizontal Sync |
| 19 | W4 | 5 | DISPC2_PCLK | Parallel Display Pixel Clock |
| 20 | Y2 | 5 | DISPC2_VSYNC | Parallel Display Vertical Sync |
| 21 | Y3 | 5 | DISPC2_DE | Parallel Display Data Enable |
| 22 | Y4 | 5 | DISPC2_DATA8 | Parallel Display Data Bit 8 |
| 23 | AA1 | 5 | DISPC2_DATA7 | Parallel Display Data Bit 7 |
| 24 | AA2 | 5 | DISPC2_DATA6 | Parallel Display Data Bit 6 |
| 25 | AA3 | 5 | DISPC2_DATA5 | Parallel Display Data Bit 5 |
| 26 | AA4 | 5 | DISPC2_DATA4 | Parallel Display Data Bit 4 |
| 27 | AB2 | 5 | DISPC2_DATA3 | Parallel Display Data Bit 3 |
| 28 | AB3 | 5 | DISPC2_DATA2 | Parallel Display Data Bit 2 |
| 41 | A18 | 3 | GPIO_41 | HDMI Transceiver Level Shifter Output Enable |
| 43 | A19 | 3 | GPIO_43 | Wireless LAN Enable |
| 46 | A21 | 3 | GPIO_46 | Bluetooth Enable |
| 48 | C20 | 3 | GPIO_48 | Board ID Bit 1 |
| 49 | D20 | 3 | GPIO_49 | Bluetooth Wakeup |
| 53 | C22 | 3 | GPIO_53 | WLAN Interrupt In |
| 60 | D22 | 3 | GPIO_60 | HDMI DC/DC-Hot Plug Enable |
| 62 | B23 | 3 | GPIO_62 | Ethernet/USB Hub Reset |
| 63 | B9 | 0 | HDMI_HPD | HDMI Hot Plug Detect |
| 64 | B10 | 0 | HDMI_CEC | HDMI Consumer Electronic Control |
| 65 | A8 | 0 | HDMI_DDC_SCL | Display Data Channel Serial Clock |
| 66 | B8 | 0 | HDMI_DDC_SDA | Display Data Channel Serial Data |
| 84 | AE18 | 4 | ULPIPHY_CLK | USBB1 ULPI Clock (Hub) |
| 85 | AG19 | 4 | ULPIPHY_STP | USBB1 ULPI Stop (Hub) |
| 86 | AF19 | 4 | ULPIPHY_DIR | USBB1 ULPI Direction (Hub) |
| 87 | AE19 | 4 | ULPIPHY_NXT | USBB1 ULPI Next (Hub) |
| 88 | AF18 | 4 | ULPIPHY_DAT0 | USBB1 ULPI Data Bit 0 (Hub) |
| 89 | AG18 | 4 | ULPIPHY_DAT1 | USBB1 ULPI Data Bit 1 (Hub) |
| 90 | AE17 | 4 | ULPIPHY_DAT2 | USBB1 ULPI Data Bit 2 (Hub) |





| GPIO | OMAP Ball # | Mux Mode | Signal Name | Description of Pandaboard ES Usage |
|------|-------------|----------|-------------------|--|
| 91 | AF17 | 4 | ULPIPHY_DAT3 | USBB1 ULPI Data Bit 3 (Hub) |
| 92 | AH17 | 4 | ULPIPHY_DAT4 | USBB1 ULPI Data Bit 4 (Hub) |
| 93 | AE16 | 4 | ULPIPHY_DAT5 | USBB1 ULPI Data Bit 5 (Hub) |
| 94 | AF16 | 4 | ULPIPHY_DAT6 | USBB1 ULPI Data Bit 6 (Hub) |
| 95 | AG16 | 4 | ULPIPHY_DAT7 | USBB1 ULPI Data Bit 7 (Hub) |
| 100 | D2 | 0 | SDMMC1_CLK | SDMMC Card Cage Clock (1.8v/3.0V) |
| 101 | E3 | 0 | SDMMC1_CMD | SDMMC Card Cage Command (1.8v/3.0V) |
| 101 | A24 | 3 | GPIO_101 | Board ID Input Bit 1 |
| 102 | E4 | 0 | SDMMC1_DAT0 | SDMMC Card Cage Data Bit 0 (1.8v/3.0V) |
| 103 | E2 | 0 | SDMMC1_DAT1 | SDMMC Card Cage Data Bit 1 (1.8v/3.0V) |
| 104 | E1 | 0 | SDMMC1_DAT2 | SDMMC Card Cage Data Bit 2 (1.8v/3.0V) |
| 105 | F4 | 0 | SDMMC1_DAT3 | SDMMC Card Cage Data Bit 3 (1.8v/3.0V) |
| 106 | F3 | 0 | SDMMC1_DAT4 | SDMMC Card Cage Data Bit 4 (1.8v/3.0V) |
| 107 | F1 | 0 | SDMMC1_DAT5 | SDMMC Card Cage Data Bit 5 (1.8v/3.0V) |
| 108 | G4 | 0 | SDMMC1_DAT6 | SDMMC Card Cage Data Bit 6 (1.8v/3.0V) |
| 109 | G3 | 0 | SDMMC1_DAT7 | SDMMC Card Cage Data Bit 7 (1.8v/3.0V) |
| 110 | AD27 | 3 | GPIO_110 | LED D1 On/Off Control |
| 113 | AC28 | 3 | GPIO_113 | Input from push-button switch S2 |
| 114 | AC26 | 0 | MCBSP1_CLKX | BT Audio I2S Clock |
| 115 | AC25 | 0 | MCBSP1_DR | BT Audio I2S Data Out |
| 116 | AB25 | 0 | MCBSP1_DX | BT Audio I2S Data In |
| 117 | AC27 | 0 | MCBSP1_FSX | BT Audio I2S Frame Sync |
| 118 | AH26 | 0 | ABE_CLKS | Clock input from TWL6030 Audio Companion IC |
| 121 | AG24 | 5 | DMTIMER11_PWM_EVT | Display Expansion Connector(s) PWM Control |
| 122 | AH24 | 3 | GPIO_122 | DVI-D Monitor Sense Input |
| 123 | AB26 | 0 | UART2_CTS | Bluetooth Host Control Interface Request to Send |
| 124 | AB27 | 0 | UART2_RTS | Bluetooth Host Control Interface Clear to Send |
| 125 | AA25 | 0 | UART2_RX | Bluetooth Host Control Interface Transmit Data |
| 126 | AA26 | 0 | UART2_TX | Bluetooth Host Control Interface Receive Data |
| 127 | AA27 | 3 | GPIO_127 | TWL6040 Audio Power On |
| 128 | C26 | 0 | I2C2_SCL | I2C2 Serial Clock |
| 129 | D26 | 0 | I2C2_SDA | I2C2 Serial Data |
| 130 | W27 | 0 | I2C3_SCL | I2C3 Serial Clock |
| 131 | Y27 | 0 | I2C3_SDA | I2C3 Serial Data |
| 132 | AG21 | 0 | I2C4_SCL | I2C4 Serial Clock |
| 133 | AH22 | 0 | I2C4_SDA | I2C4 Serial Data |
| 141 | F27 | 0 | UART3_CTS | Debug Terminal RS-232 Clear to Send |
| 142 | F28 | 0 | UART3_RTS | Debug Terminal RS-232 Request to Send |
| 143 | G27 | 0 | UART3_RX | Debug Terminal RS-232 Receive Data |





| GPIO | OMAP Ball # | Mux Mode | Signal Name | Description of Pandaboard ES Usage |
|------|-------------|----------|----------------|---|
| 144 | G28 | 0 | UART3_TX | Debug Terminal RS-232 Transmit Data |
| 145 | AE5 | 0 | SDMMC5_CLK | WLAN SDIO Clock Line |
| 146 | AF5 | 0 | SDMMC5_CMD | WLAN SDIO Command Line |
| 147 | AE4 | 0 | SDMMC5_DAT0 | WLAN SDIO Data Bit 0 |
| 148 | AF4 | 0 | SDMMC5_DAT1 | WLAN SDIO Data Bit 1 |
| 149 | AG3 | 0 | SDMMC5_DAT2 | WLAN SDIO Data Bit 2 |
| 150 | AF3 | 0 | SDMMC5_DAT3 | WLAN SDIO Data Bit 3 |
| 158 | AF12 | 5 | DISPC_DATA23 | Parallel Display Data Bit 23 |
| 159 | AE12 | 5 | DISPC_DATA22 | Parallel Display Data Bit 22 |
| 160 | AG13 | 5 | DISPC_DATA21 | Parallel Display Data Bit 21 |
| 161 | AE11 | 5 | DISPC_DATA20 | Parallel Display Data Bit 20 |
| 162 | AF11 | 5 | DISPC_DATA19 | Parallel Display Data Bit 19 |
| 163 | AG11 | 5 | DISPC_DATA18 | Parallel Display Data Bit 18 |
| 164 | AH11 | 5 | DISPC_DATA15 | Parallel Display Data Bit 15 |
| 165 | AE10 | 5 | DISPC_DATA14 | Parallel Display Data Bit 14 |
| 166 | AF10 | 5 | DISPC_DATA13 | Parallel Display Data Bit 13 |
| 167 | AG10 | 5 | DISPC_DATA12 | Parallel Display Data Bit 12 |
| 168 | AE9 | 5 | DISPC_DATA11 | Parallel Display Data Bit 11 |
| 171 | G26 | 3 | GPIO_171 | Board ID Bit 2 |
| 179 | B5 | 0 | USBA0_OTG_DP | Internal USB Transceiver Data Plus |
| 180 | B4 | 0 | USBA0_OTG_DM | Internal USB Transceiver Data Minus |
| 181 | AA28 | 0 | FREF_CLK1_OUT | Camera Expansion Connector |
| 182 | Y28 | 0 | GPIO_182 | Board ID Bit 0 |
| 183 | AF6 | 0 | SYS_NIRQ2 | System Interrupt from TWL6040 Audio IC |
| 184 | F26 | 0 | SYS_BOOT0 | SYSBOOT Input 0 |
| 185 | E27 | 0 | SYS_BOOT1 | SYSBOOT Input 1 |
| 186 | E26 | 0 | SYS_BOOT2 | SYSBOOT Input 2 |
| 187 | E25 | 0 | SYS_BOOT3 | SYSBOOT Input 3 |
| 188 | D28 | 0 | SYS_BOOT4 | SYSBOOT Input 4 |
| 189 | D27 | 0 | SYS_BOOT5 | SYSBOOT Input 5 |
| 190 | AB4 | 5 | DISPC2_DATA1 | Parallel Display Data Bit 1 |
| 191 | AC4 | 5 | DISPC2_DATA0 | Parallel Display Data Bit 0 |
| WK5 | AG8 | 0 | FREF_SLICER_IN | 38.4MHz Clock Input |
| WK6 | AD2 | 2 | GPIO_WK6 | MSECURE output to TWL6030 (RTC related) |
| WK7 | AC2 | 3 | GPIO_WK7 | TPS62361 VSEL0 control |
| WK8 | AC3 | 3 | GPIO_WK8 | LED D2 On/Off Control |
| WK9 | AF8 | 0 | SYS_BOOT6 | SYSBOOT Input 6 |
| WK10 | AE8 | 0 | SYS_BOOT7 | SYSBOOT Input 7 |
| WK31 | AD4 | 0 | FREF_CLK3_OUT | USBB1 Phy Reference Clock (19.2 MHz) |



**Table 20: Pandaboard ES OMAP4460 Pin Multiplexing****3.2.2 Camera Expansion Connector Pin Multiplexing**

See Table 21 for a description of the pin multiplexing possibilities for the camera expansion board signals.

| GPIO | OMAP Ball # | Mux Mode | Signal Name | Description of Pandaboard ES Usage |
|------|-------------|----------|-----------------|-------------------------------------|
| 40 | B17 | 3 | GPIO_40 | Camera Expansion Connector (pin 16) |
| 42 | B18 | 3 | GPIO_42 | Camera Expansion Connector (pin 28) |
| 44 | B19 | 3 | GPIO_44 | Camera Expansion Connector (pin 26) |
| 45 | B20 | 3 | GPIO_45 | Camera Expansion Connector (pin 18) |
| 47 | B21 | 3 | GPIO_47 | Camera Expansion Connector (pin 25) |
| 67 | R26 | 0 | CSI21_DX0 | Camera Expansion Connector (pin 3) |
| 68 | R25 | 0 | CSI21_DY0 | Camera Expansion Connector (pin 5) |
| 69 | T26 | 0 | CSI21_DX1 | Camera Expansion Connector (pin 9) |
| 70 | T25 | 0 | CSI21_DY1 | Camera Expansion Connector (pin 11) |
| 71 | U26 | 0 | CSI21_DX2 | Camera Expansion Connector (pin 15) |
| 72 | U25 | 0 | CSI21_DY2 | Camera Expansion Connector (pin 17) |
| 73 | V26 | 0 | CSI21_DX3 | Camera Expansion Connector (pin 4) |
| 74 | V25 | 0 | CSI21_DY3 | Camera Expansion Connector (pin 6) |
| 75 | W26 | 0 | CSI21_DX4 | Camera Expansion Connector (pin 10) |
| 76 | W25 | 0 | CSI21_DY4 | Camera Expansion Connector (pin 12) |
| 81 | T27 | 0/3 | CAM_SHUTTER | Camera shutter or GPIO_81 (pin 22) |
| 82 | U27 | 0/3 | CAM_STROBE | Camera strobe or GPIO_82 (pin 24) |
| 83 | V27 | 0 | CAM_GLOBALRESET | Camera Expansion Connector (pin 20) |
| 130 | W27 | 0 | I2C3_SCL | I2C3 Serial Clock (pin 21) |
| 131 | Y27 | 0 | I2C3_SDA | I2C3 Serial Data (pin 23) |
| 181 | AA28 | 0 | FREF_CLK1_OUT | Camera Expansion Connector (pin 27) |

Table 21: Camera Expansion Connector (J17) Pin Multiplexing Options**3.2.3 Expansion Connector (J3 & J6) Pin Multiplexing**

See Table 22 below for a listing of the IOs connected to the expansion connectors at J3 and J6. GPIOs with multiple mux modes listed have multiple functions that can be supported, depending on the requirements of the particular expansion board being utilized.





| GPIO | OMAP Ball # | Mux Mode | Function1 | Function2 | Function3 | Function4 |
|------|-------------|----------|---------------|----------------|--------------|-------------|
| 32 | C16 | 0/1/3/5 | GPMC AD8 | KPD ROW0 | GPIO_32 | SDMMC1 DAT0 |
| 33 | D16 | 0/1/3/5 | GPMC AD9 | KPD ROW1 | GPIO_33 | SDMMC1 DAT1 |
| 34 | C17 | 0/1/3/5 | GPMC AD10 | KPD ROW2 | GPIO_34 | SDMMC1 DAT2 |
| 35 | D17 | 0/1/3/5 | GPMC AD11 | KPD ROW3 | GPIO_35 | SDMMC1 DAT3 |
| 36 | C18 | 0/1/3/5 | GPMC AD12 | KPD COL0 | GPIO_36 | SDMMC1 DAT4 |
| 37 | D18 | 0/1/3/5 | GPMC AD13 | KPD COL1 | GPIO_37 | SDMMC1 DAT5 |
| 38 | C19 | 0/1/3/5 | GPMC AD14 | KPD COL2 | GPIO_38 | SDMMC1 DAT6 |
| 39 | D19 | 0/1/3/5 | GPMC AD15 | KPD COL3 | GPIO_39 | SDMMC1 DAT7 |
| 50 | B25 | 0/3 | GPMC_NCS0 | GPIO_50 | --- | --- |
| 51 | C21 | 0/3 | GPMC_NCS1 | GPIO_51 | --- | --- |
| 54 | C25 | 0/3/4 | GPMC_NWP | GPIO_54 | SYS_NDMAREQ1 | --- |
| 55 | B22 | 0/3/4/5 | GPMC_CLK | GPIO_55 | SYS_NDMAREQ2 | SDMMC1_CMD |
| 56 | D25 | 0/3/4/5 | GPMC_NADV_ALE | GPIO_56 | SYS_NDMAREQ3 | SDMMC1_CLK |
| 59 | C23 | 0/3 | GPMC_NBE0_CLE | GPIO_59 | ---- | ---- |
| 61 | B26 | 0/3 | GPMC_WAIT0 | GPIO_61 | ---- | ---- |
| 132 | AG21 | 0/3 | I2C4_SCL | GPIO_132 | ---- | ---- |
| 133 | AH22 | 0/3 | I2C4_SDA | GPIO_133 | ---- | ---- |
| 134 | AF22 | 0/3 | MCSPI1_CLK | GPIO_134 | ---- | ---- |
| 135 | AE22 | 0/3 | MCSPI1_SOMI | GPIO_135 | ---- | ---- |
| 136 | AG22 | 0/3 | MCSPI1_SIMO | GPIO_136 | ---- | ---- |
| 137 | AE23 | 0/3 | MCSPI1_CS0 | GPIO_137 | ---- | ---- |
| 138 | AF23 | 0/3 | MCSPI1_CS1 | GPIO_138 | ---- | ---- |
| 139 | AG23 | 0/2/3 | MCSPI1_CS2 | SLIMBUS2_CLOCK | GPIO_139 | ---- |
| 140 | AH23 | 0/2/3 | MCSPI1_CS3 | SLIMBUS2_DATA | GPIO_140 | ---- |
| 155 | AG20 | 0/2/3 | UART4_RX | KPD_ROW8 | GPIO_155 | ---- |
| 156 | AH19 | 0/2/3 | UART4_TX | KPD_COL8 | GPIO_156 | ---- |
| None | C12 | 0/1 | GPMC_AD0 | SDMMC2_DAT0 | ---- | ---- |
| None | D12 | 0/1 | GPMC_AD1 | SDMMC2_DAT1 | ---- | ---- |
| None | C13 | 0/1 | GPMC_AD2 | SDMMC2_DAT2 | ---- | ---- |
| None | D13 | 0/1 | GPMC_AD3 | SDMMC2_DAT3 | ---- | ---- |
| None | C15 | 0/1 | GPMC_AD4 | SDMMC2_DAT4 | ---- | ---- |
| None | D15 | 0/1 | GPMC_AD5 | SDMMC2_DAT5 | ---- | ---- |
| None | A16 | 0/1 | GPMC_AD6 | SDMMC2_DAT6 | ---- | ---- |
| None | B16 | 0/1 | GPMC_AD7 | SDMMC2_DAT0 | ---- | ---- |
| None | B11 | 0/1 | GPMC_NOE | SDMMC2_CLK | ---- | ---- |
| None | B12 | 0/1 | GPMC_NWE | SDMMC2_CMD | ---- | ---- |

Table 22: Expansion Connector (J3 & J6) Pin Multiplexing Options





3.3 OMAP4460 Pandaboard ES Key Components

See Table 23 for a listing of the manufacturers and manufacturer part numbers for some of the key components used on the OMAP4460 Pandaboard ES.

| Device / Interface | Under NDA? | Manufacture P/N |
|-----------------------------------|------------|---|
| Application Processor | | |
| Processor | Yes | TI OMAP4460 |
| Memories/Storage | | |
| DDR | Yes | Elpida 8Gb (POP, S4B) EDB8064B1PB-8D-F |
| Removable card support | No | KingConn 6-in-One SD/MMC (8 bit Cardcage) SDMM-B0-0016 |
| Removable card ESD protection | No | Texas Instruments TPD6E001RSER |
| Power | | |
| Power Management (U12) | Yes | Texas Instruments TWL6030 |
| DC Input Connector (P3) | No | CUI, Inc. PJ-002A |
| USB Power Switch/LDO (U21) | No | Texas Instruments TPS2141IPWP |
| Input Power SMPS (U22) | No | Texas Instruments TPS54320RHL |
| Input Voltage Supervisor (U19) | No | Texas Instruments TPS3803G15DCKR |
| USB/Ethernet Hub Power (U9) | No | Texas Instruments TPS73633DBVR |
| Clocking | | |
| 38.4 MHz oscillator | No | TXC 7X-38.400MBB-T |
| Video/Display | | |
| HDMI Transceiver + ESD protection | No | Texas Instruments TPD12S015AYFFR |
| HDMI Connector & DVI-D Connector | No | FCI Connectors 10029449-001RLF |





| | | |
|---|-----|---|
| DVI-D Transmitter | No | Texas Instruments TFP410PAP |
| Audio | | |
| Audio Management | Yes | TI TWL6040 |
| Dual Stacked Audio Jack | No | Kycon STX-4235-3/3-N |
| MCS | | |
| Wilink™ 6 Module | No | LS Research, Inc. LS240-WI-01-A20 |
| USB/Ethernet | | |
| Ethernet + 2x USB Host Port Connector | No | Tyco (6620004-1) Belfuse (08C2-1X1T-03) |
| ULPI USB Phy | No | SMSC USB3320C-EZK |
| USB/Ethernet Hub Controller | No | SMSC LAN9514-JZX |
| USB OTG ESD Protection | No | Texas Instruments TPD4S012DRYR |
| Camera Expansion | | |
| 30-pin Camera Expansion Connector | No | Samtec TFM-115-32-S-D-A |
| Display Expansion | | |
| DSI Display Expansion (40 pin SMT, 0.8mm pitch) | No | Hirose FX6A-40P-0.8SV91 |
| Parallel Display Expansion (2x 20 pin TH, 0.050" pitch) | No | Samtec SFMC-110-T1-F-D |
| Generic Expansion | | |
| Generic Expansion (2x 28 pin TH, 0.050" pitch) | No | Major League Electronics LSWSS-114-D-02-T-LF |

Table 23: OMAP4460 Pandaboard ES Key H/W Components





3.4 OMAP4460 Pandaboard ES Key Component Datasheet URLs

Shown below for convenience are links to datasheets for key Pandaboard ES components.

3.4.1 Connector Datasheets

- Combo Ethernet/2x USB Host Port Connector (J9)
 - <http://www.tycoelectronics.com/catalog/products/en?q=6620004-1>
- Power Input Connector (P3)
 - <http://products.cui.com/adtemplate.asp?brand=electronic-components&invky=7106&catky=619701&subcatky1=447353&subcatky2=632366&subcatky3=405514>
- Dual Audio Jack (J16)
 - http://domino2.kycon.com/catalog_PDF/STX4235.pdf
- DVI-D & HDMI Connectors (P1 & P2)
 - http://portal.fciconnect.com/portal/page/portal/FcicntPublic/Product_Type?appname=cat_Landing
- Camera Expansion Connector (J17)
 - http://www.samtec.com/documents/webfiles/pdf/TFM_SM.PDF
- DSI Display Expansion Connector (J7)
 - <http://www.hirose-connectors.com/connectors/H205SeriesGaiyou.aspx?c1=FX6&c3=3>

3.4.2 Key Electronic Component Datasheets

- DVI Transmitter (U1)
 - <http://focus.ti.com/docs/prod/folders/print/tfp410.html>
- HDMI Companion Chip – ESD, Level Translator, Charge Pump (U5)
 - <http://www.ti.com/product/tpd12s015a>
- USB Power Switch w/ Integrated LDO (U21)
 - <http://focus.ti.com/docs/prod/folders/print/tps2141.html>
- Switching Power Supply, 3A (U22)
 - <http://www.ti.com/product/tps54320>





- Single Output LDO, 400mA (U9)
 - <http://www.ti.com/product/tps73633>
- Single Voltage Detector, (U19)
 - <http://www.ti.com/product/tps3803g15>
- USB ULPI Phy (U7)
 - <http://www.smsc.com/index.php?tid=143&pid=211>
- USB/Ethernet Hub Controller (U9)
 - <http://www.smsc.com/index.php?tid=300&pid=135&cid=&tab=5>
- WilinkTM6 Module (U3)
 - http://www.lsr.com/products/radio_modules/802.11_BGN_BT/tiwi.shtml





4 Test/Debug Information

This chapter contains information to allow easier debug access to signals on the OMAP4460 Pandaboard ES.

4.1 Pandaboard ES Clock Signal Access

The following sections show where various clock signals on the Pandaboard ES may be accessed.

4.1.1 H_FREF_ALTCLK_IN_OMAP Probe Point

This signal is the input clock to OMAP and the TWL6040 Audio Companion IC from the onboard 38.4 MHz oscillator. It may be probed at TP9 in the area above OMAP as shown in Figure 19 below.

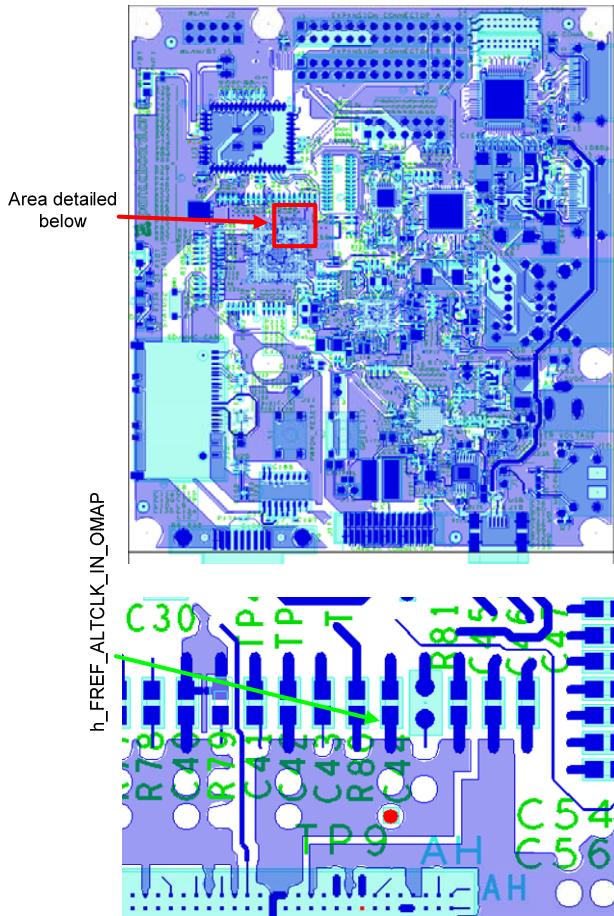




Figure 19 – 38.4 MHz Input Clock Probe Point (h_FREF_ALTCLK_IN_OMAP)

4.1.2 USBB1_PHY_REFCLK Probe Point

The 19.2 MHz reference input clock to the USBB1 Phy device may be probed at R47-1 or U4-4 as shown below in red. These parts are located directly below the 14-pin JTAG connector J8.

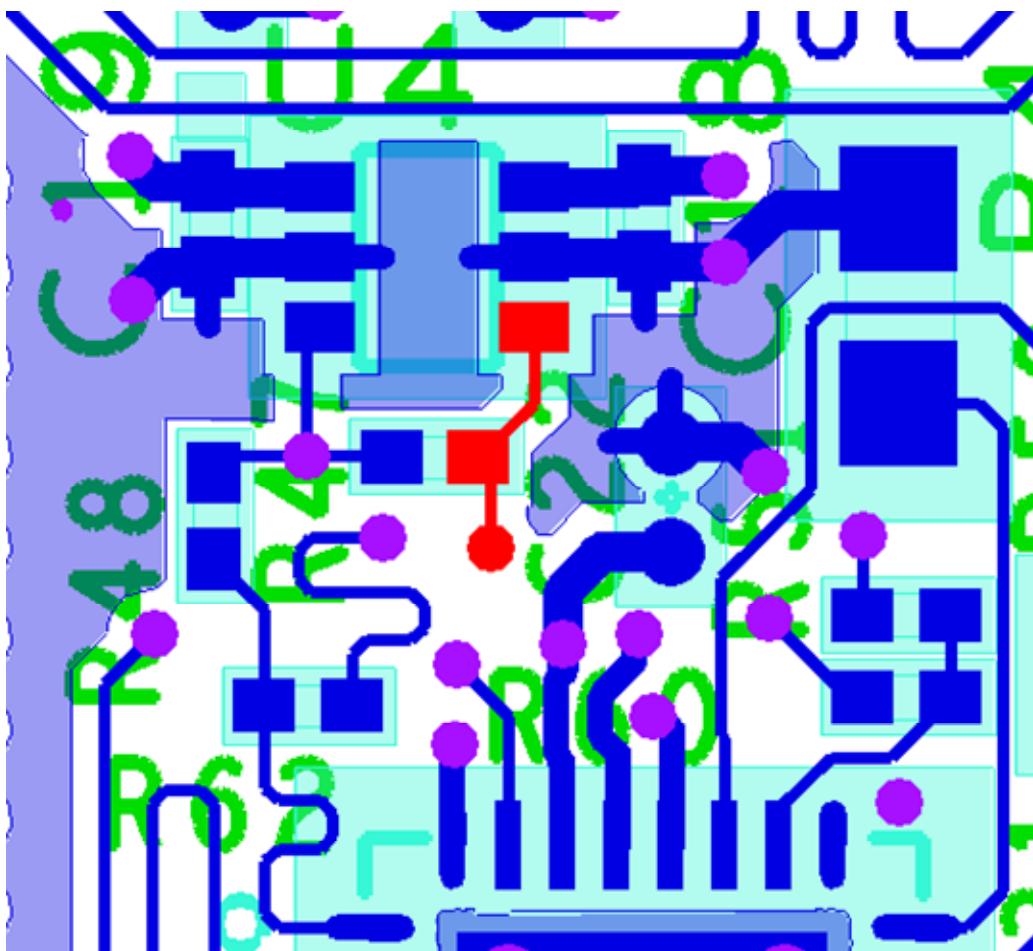


Figure 20 – USB Phy Ref Clock In Probe Point (USBB1_PHY_REFCLK)





4.1.3 CLK32K_AUD Probe Point

The 32.768KHz input clock to the TWL6040 Audio Companion IC may be probed at TP14 as shown in Figure 21. This testpoint may be located between the TWL6040 device at U19 and the TWL6030 Power Companion device at U12.

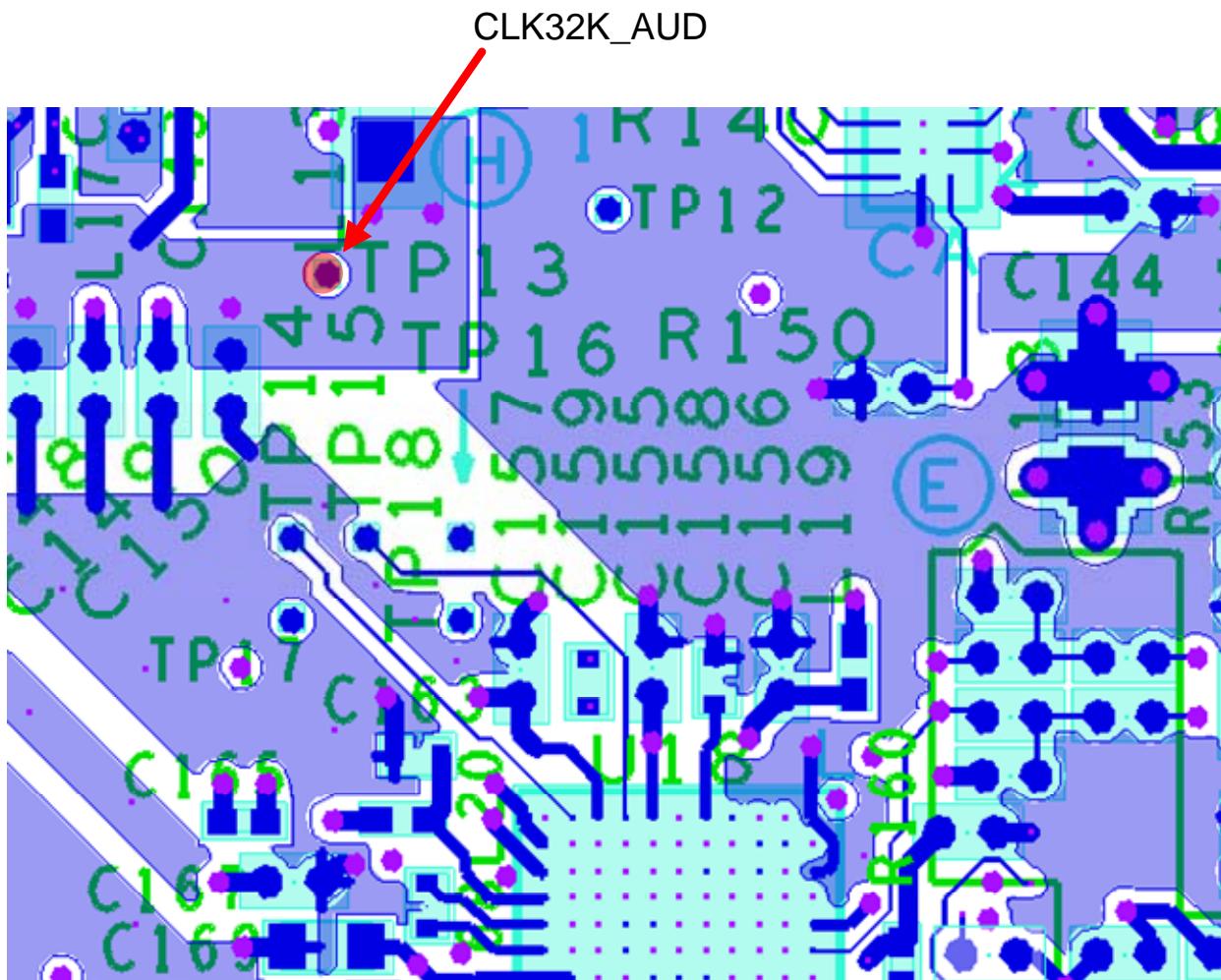


Figure 21 – 32KHz Audio Clock Probe Point (CLK32K_AUD)





4.2 Pandaboard ES Power Rail Signal Access

4.2.1 TWL6030 SMPS Output Probe Points

The outputs of the seven Phoenix SMPS output supplies may be probed around the TWL6030 IC at U11 as shown in Figure 22 below.

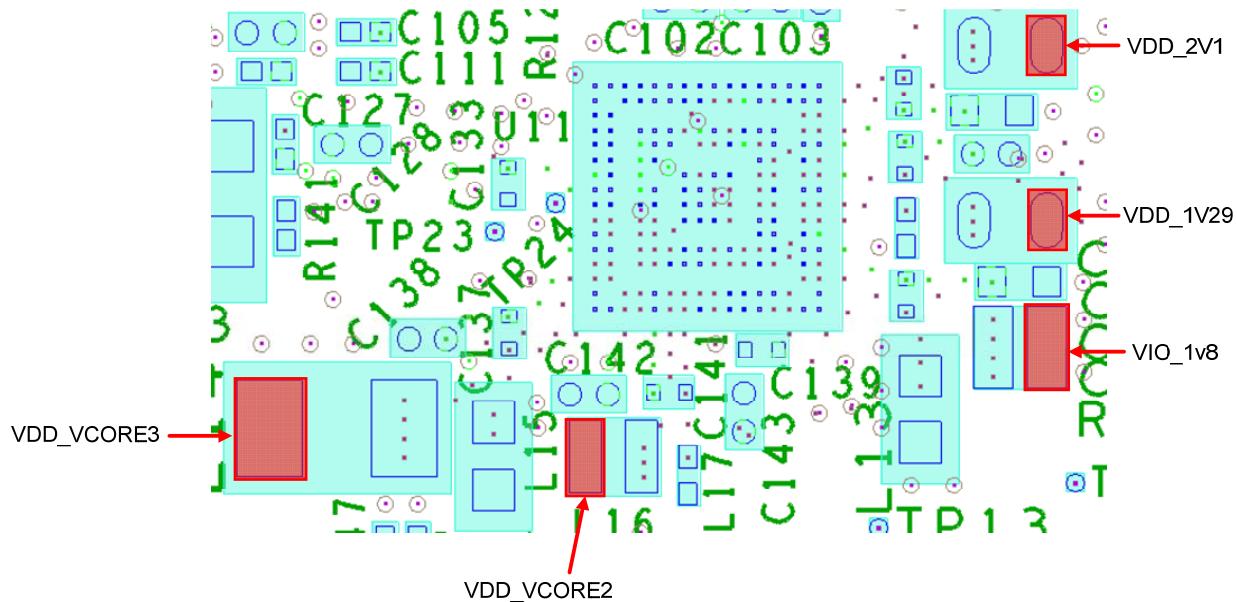


Figure 22 – TWL6030 SMPS Output Probe Points

4.2.2 VDD_CORE1 Output Probe Point

The output of the TPS62361 external supply used to power the VDD_MPU inputs of the OMAP4460 may be probed on the back side of the PCB at L23-1 as shown in Figure 23 below.



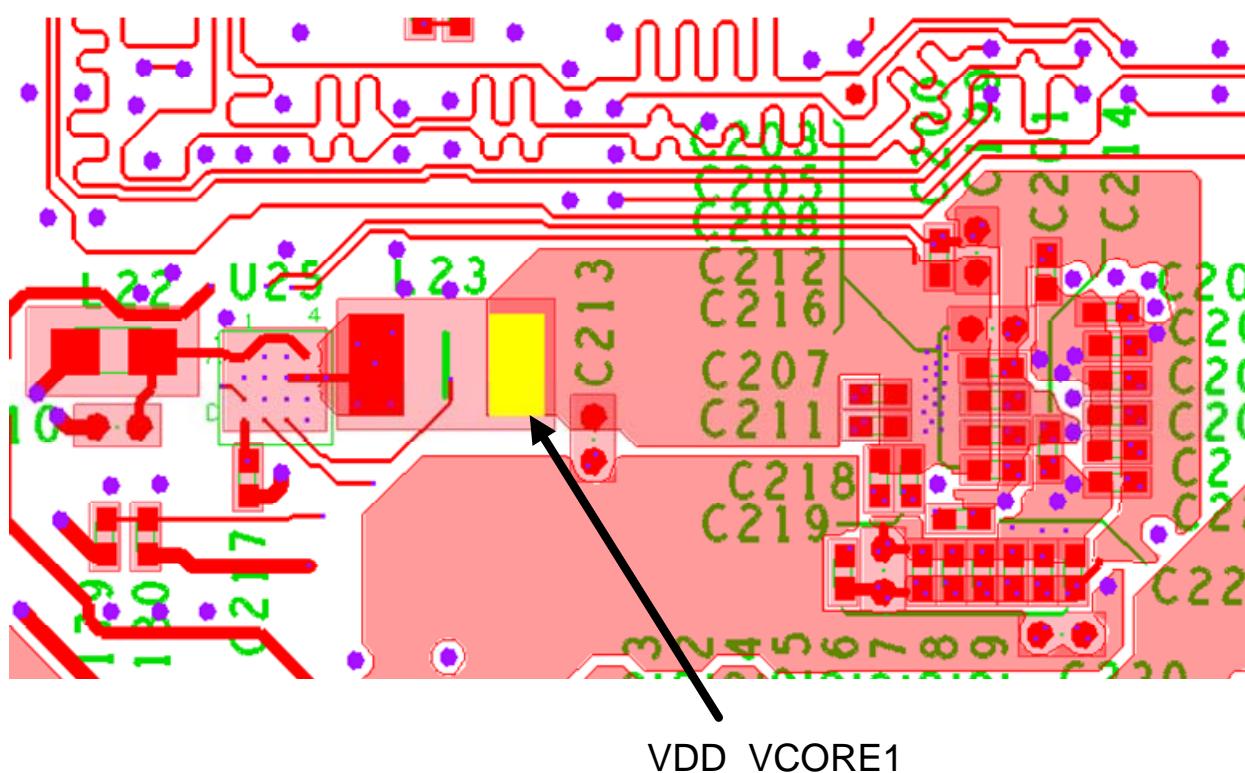


Figure 23 – VDD_CORE1 Output Probe Point

4.2.3 VCXIO LDO Output Probe Point

The outputs of the TWL6030 VCXIO LDO may be probed around the bottom of the OMAP4460 and near the oscillator Y3 as shown in Figure 24 below. The possible probe points are at C123-2, C125-2, R145-1, C109-2, C86-2, C127-2, or C105-2 as shown highlighted in red from left to right in Figure 24.



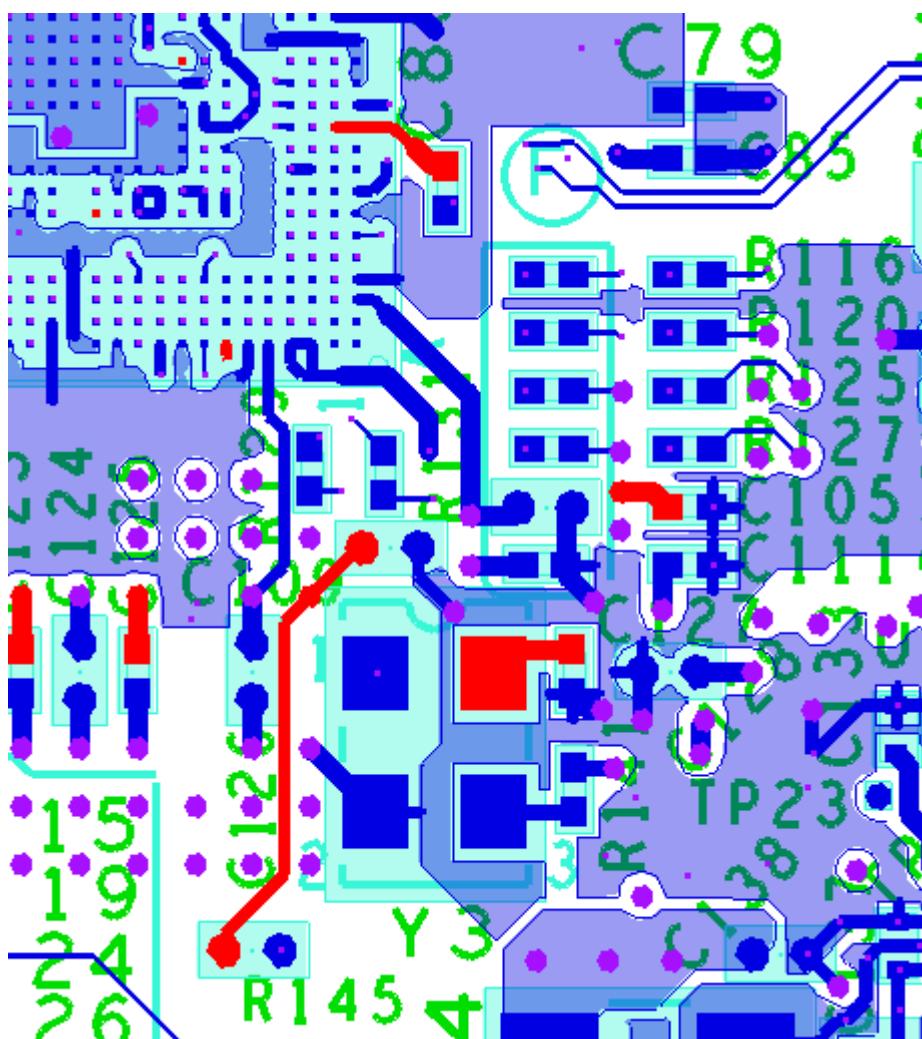


Figure 24 – TWL6030 VCXIO LDO Output Probe Points





4.3 Pandaboard ES Interface Signal Access

4.3.1 TWL6040 PDM Interface Probe Points

The PDM interface which is the digital audio interface between the OMAP4460 and the TWL6040 Audio Companion IC, may be probed at testpoints above the TWL6040 IC at U18 as shown in Figure 25 below.

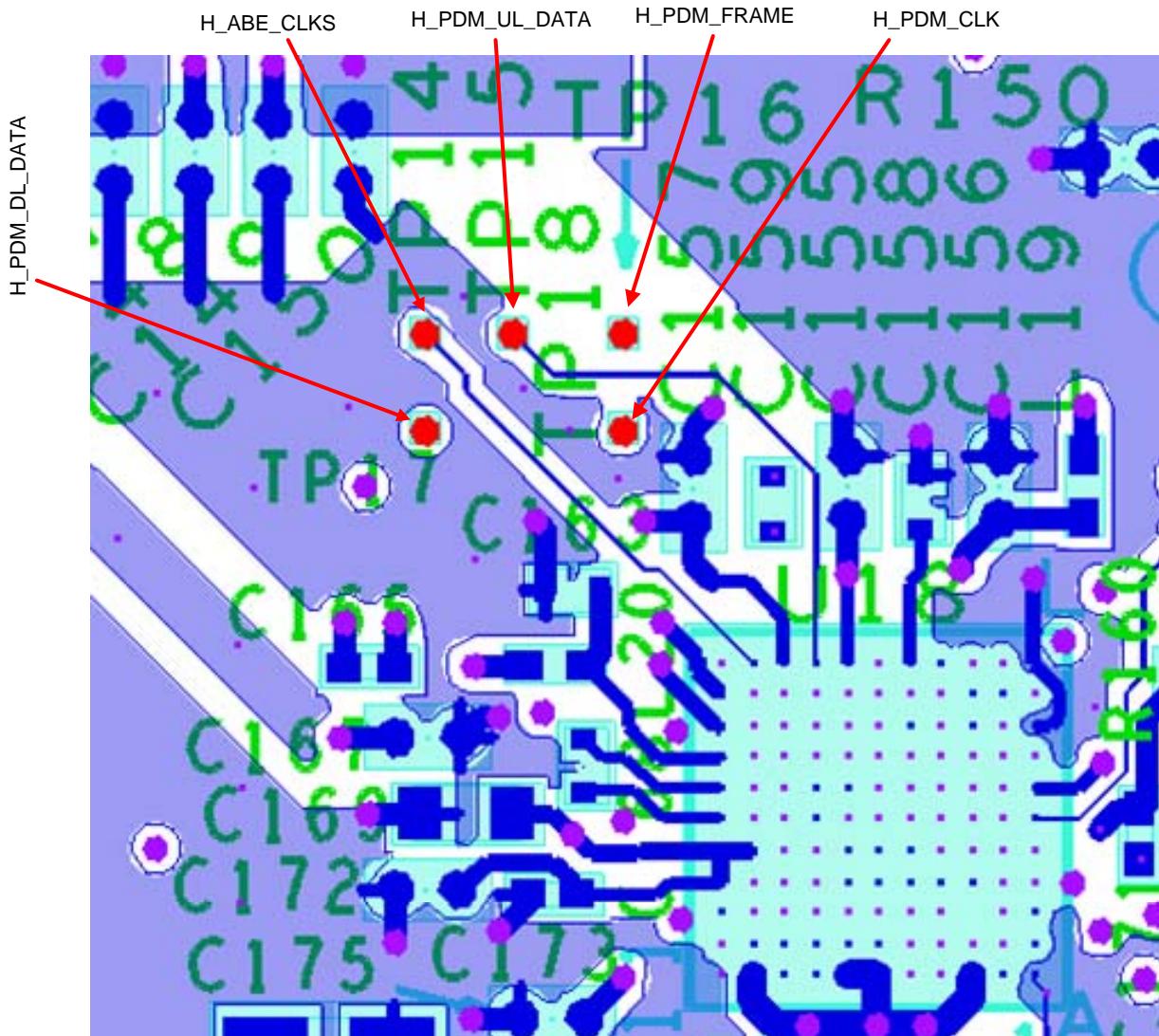


Figure 25 – TWL6040 PDM Interface Probe Points





4.4 Pandaboard ES Schematic

The following pages contain the PDF schematics for the production Pandaboard ES. The schematics are included in this document for convenience, and this manual will be periodically updated, but for the latest information be sure and check on the Pandaboard.org website. OrCAD 16.3 source files are provided for the Pandaboard ES at the following URL:

<http://Pandaboard.org/content/resources/references>

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OMAP4460 Pandaboard ES System Reference Manual

Revision 0.1
September 29, 2011
DOC-21054

| Rev | Date | Notes |
|-----|-----------|---|
| A | 8-29-2011 | Created from 750-2170-001 rev. D schematic (input power and antenna matching component changes). Added resistor on VBAT to allow overall current measurement. |
| | | |
| | | |
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- 3 – Phoenix Power Component
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- 5 – OMAP4460 Symbol A
- 6 – OMAP4460 Symbol B
- 7 – OMAP4460 Symbol C
- 8 – OMAP4460 Debug Interface
- 9 – SD/MMC Card Interface + USB Phy (Hub)
- 10 – DVI & HDMI Connector
- 11 – Debug Ethernet
- 12 – Audio Jack /RS-232 Connection
- 13 – Expansion Connectors
- 14 – WLAN Subsystem



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OMAP4460 Panda Board, 64-Bit

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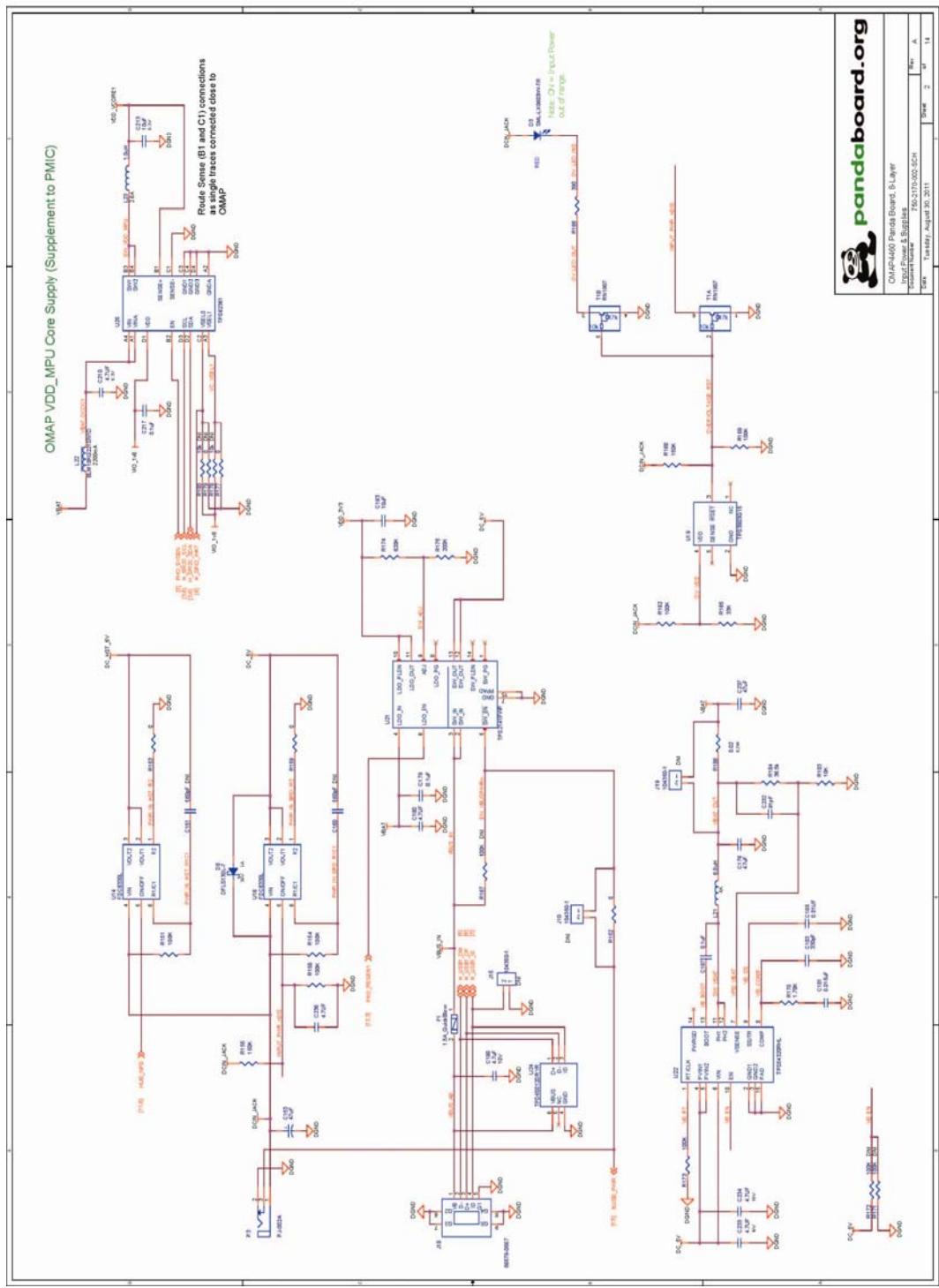
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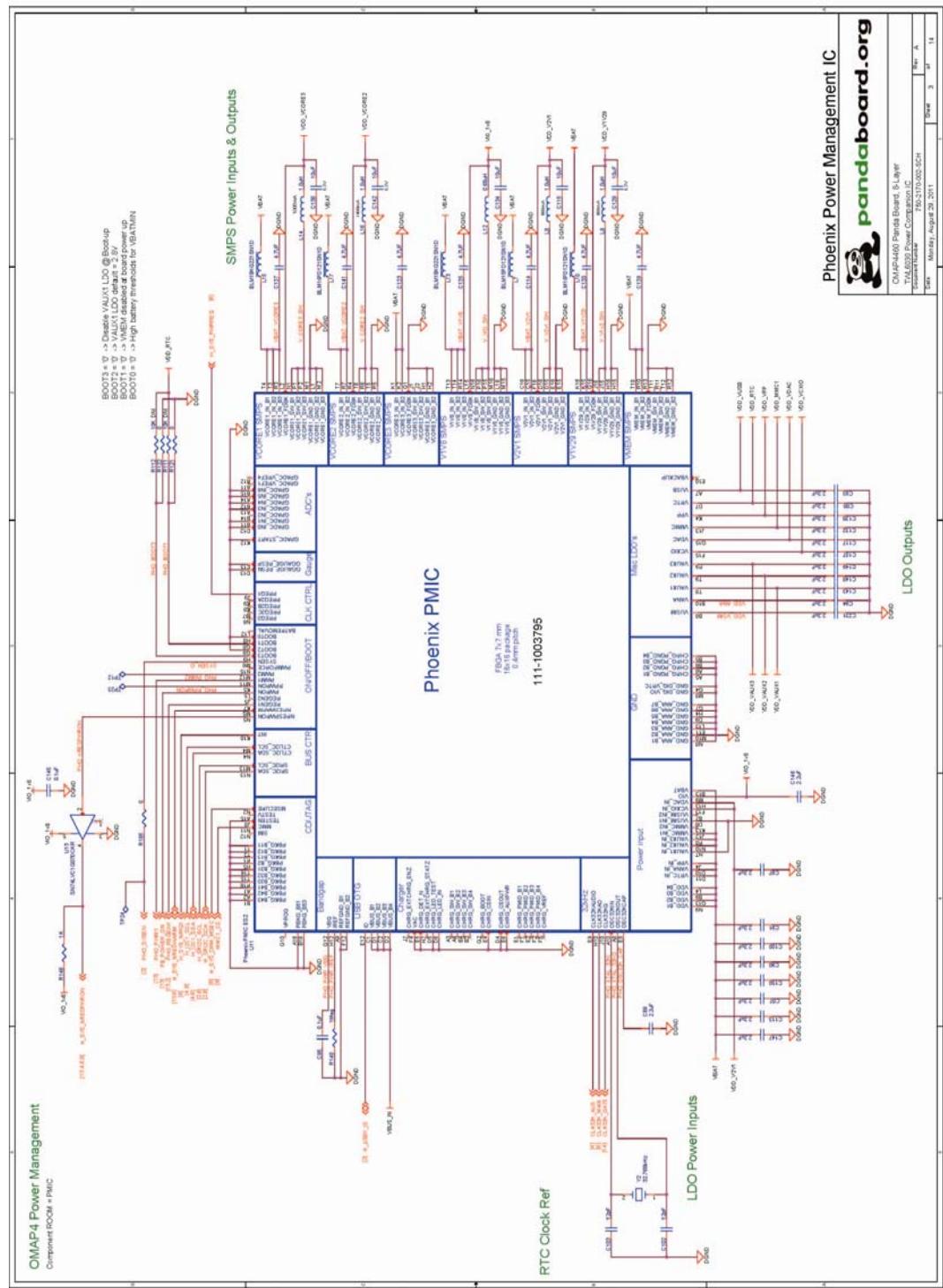
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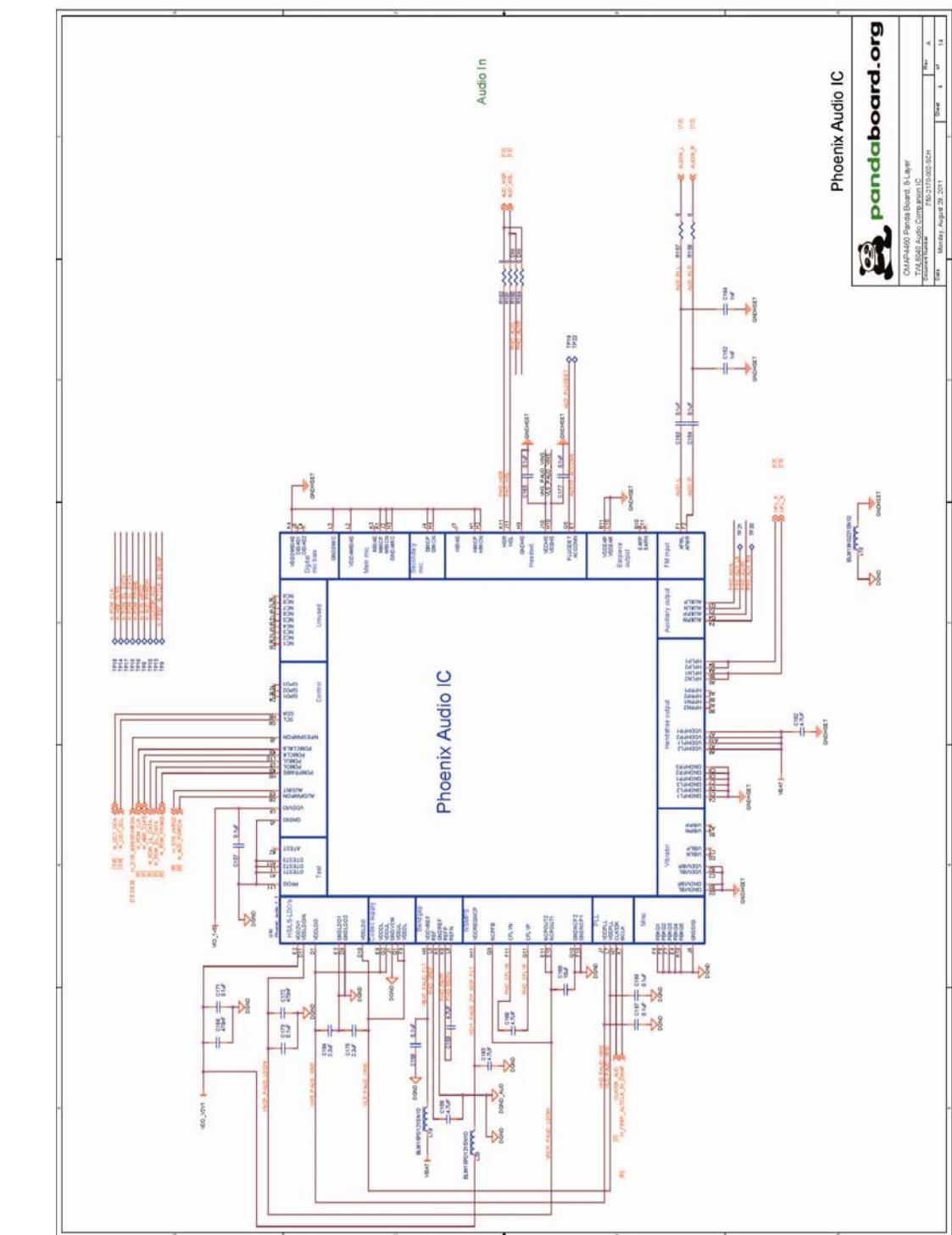
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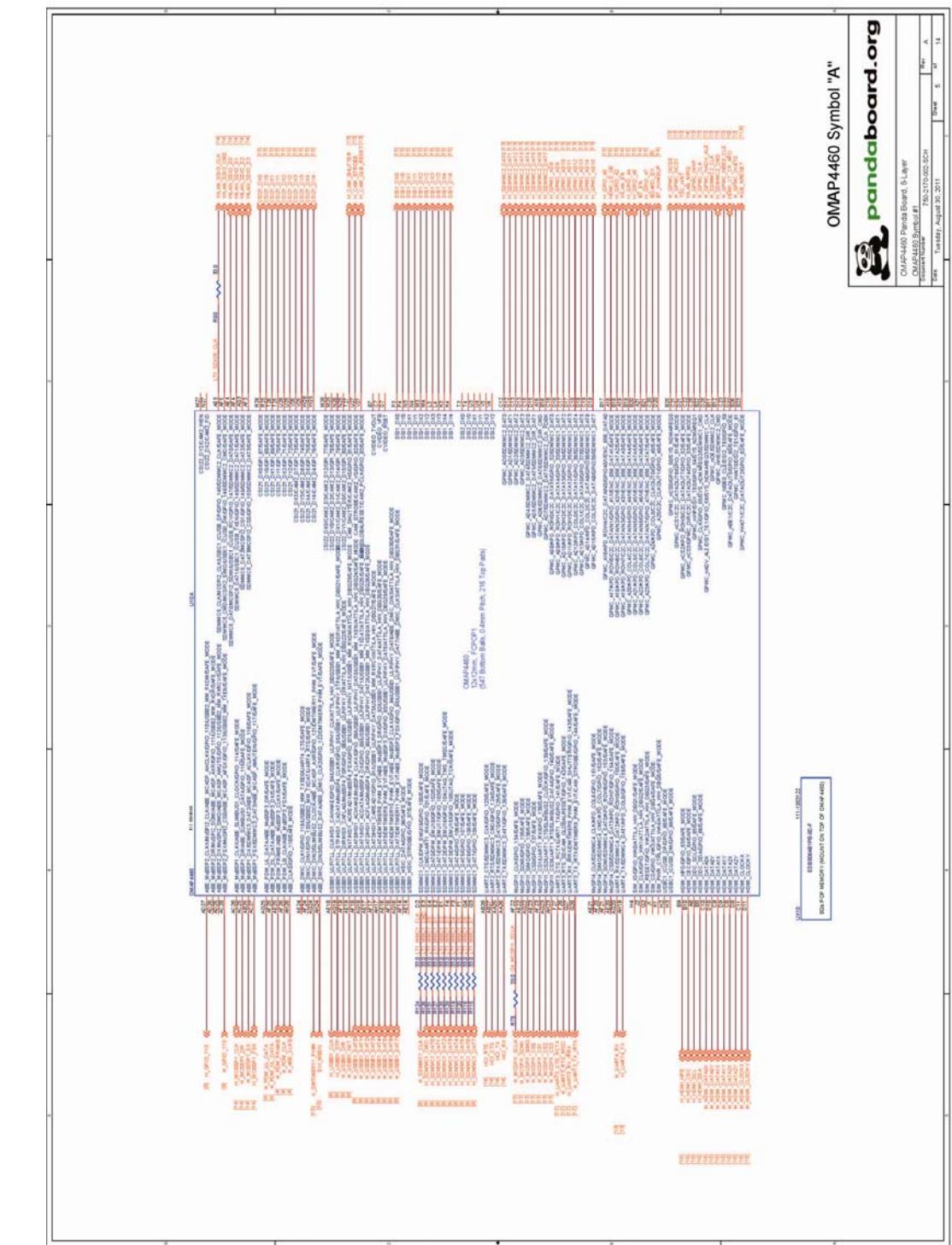




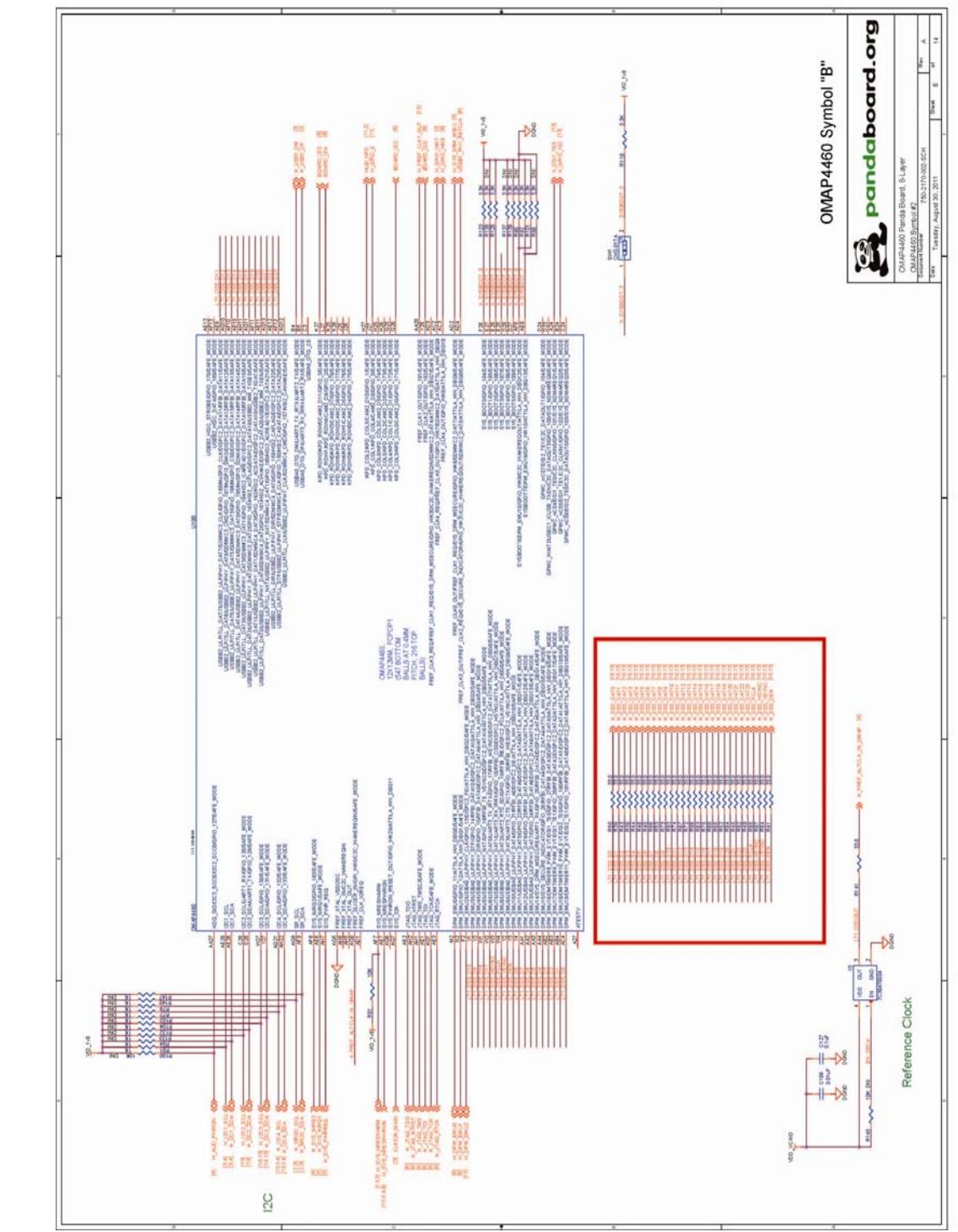
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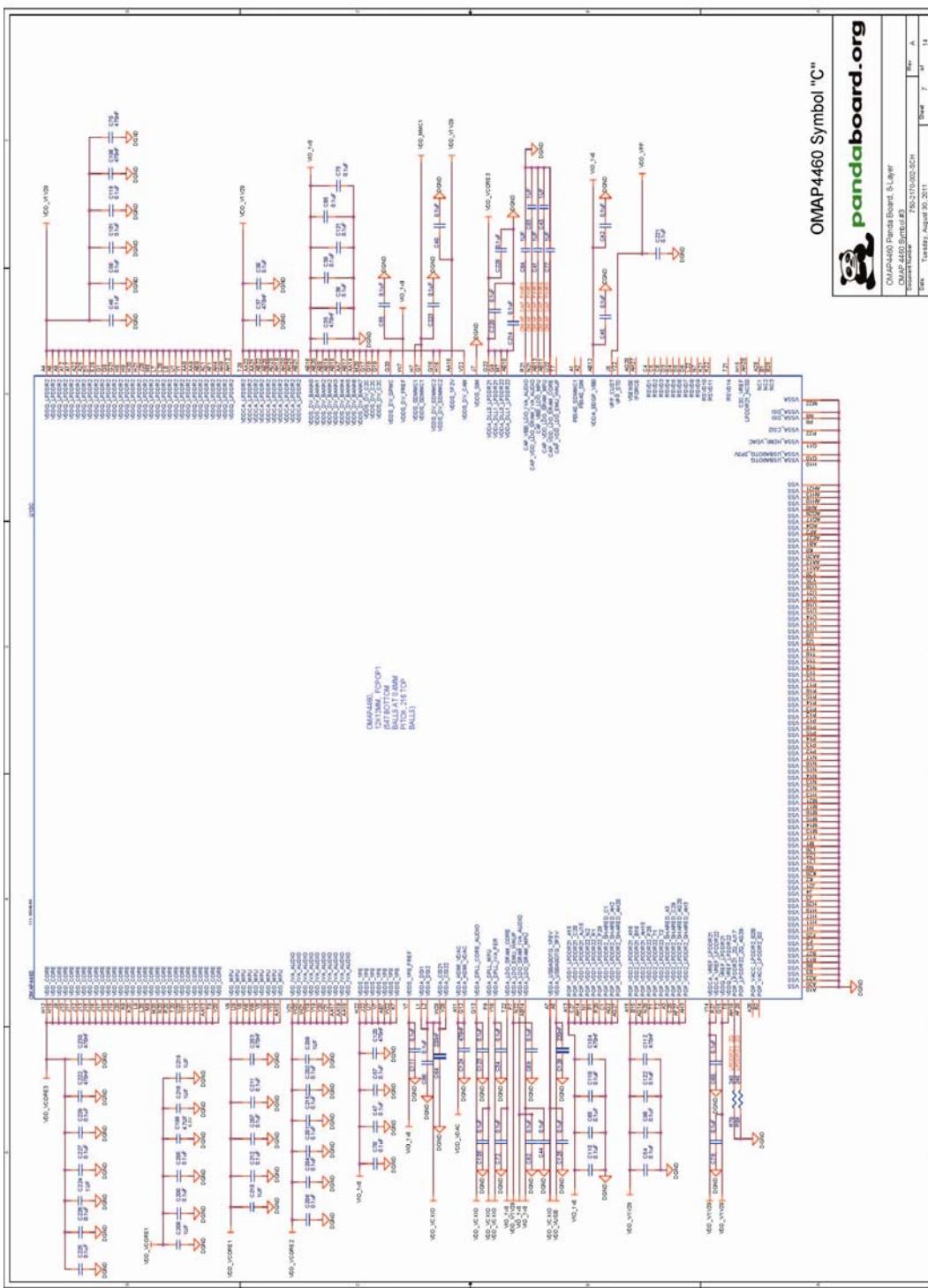
OMAP4460 Pandaboard ES System Reference Manual

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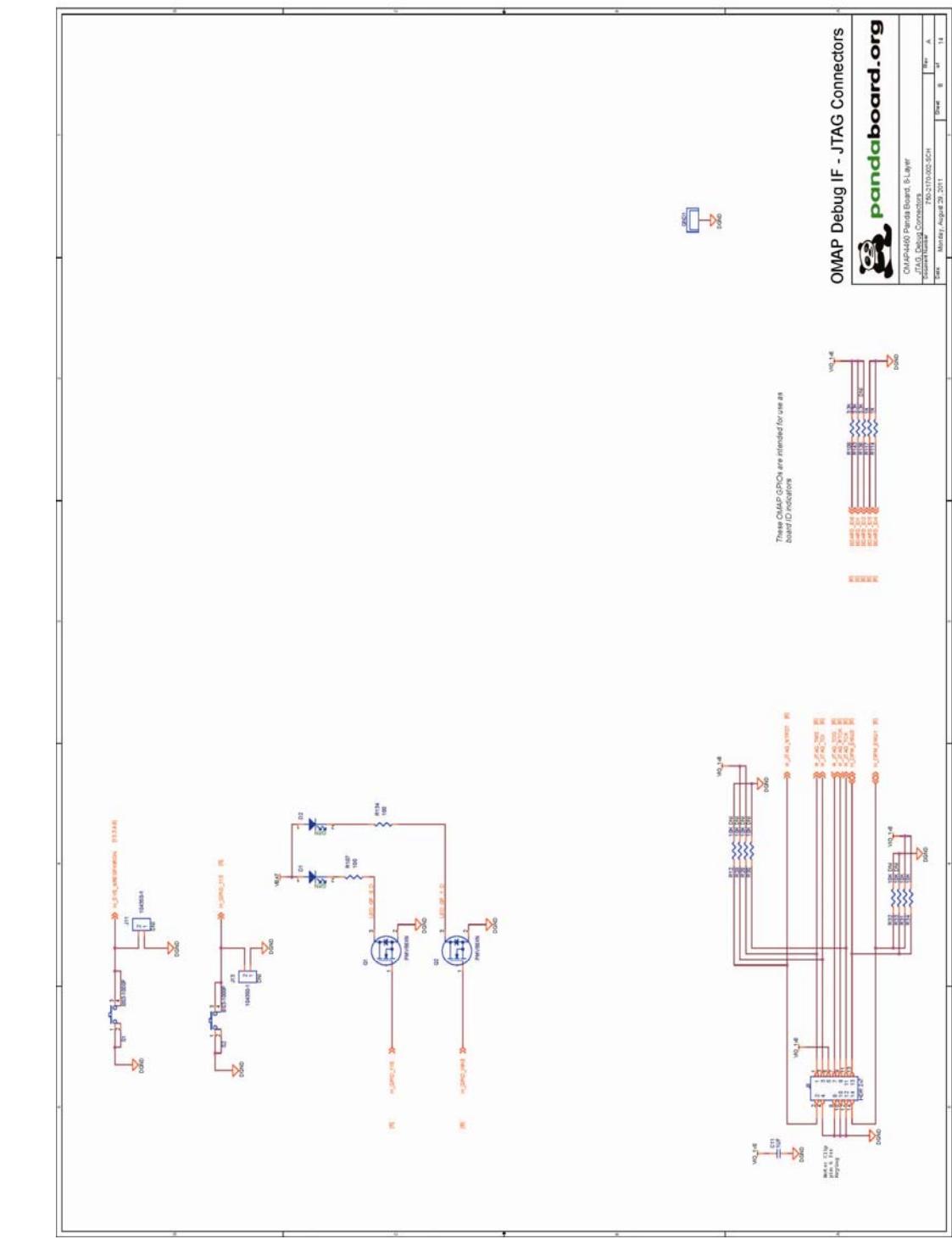


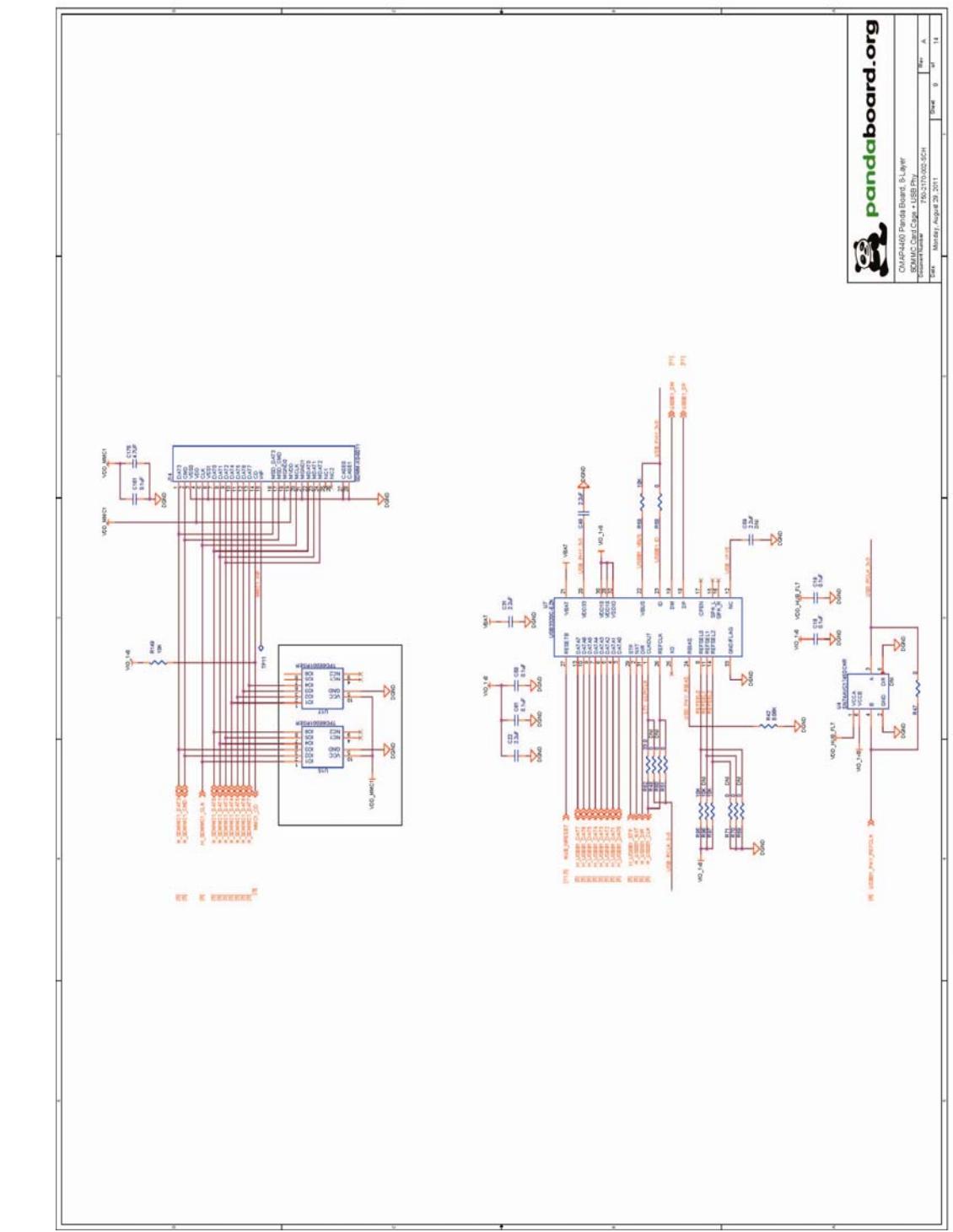
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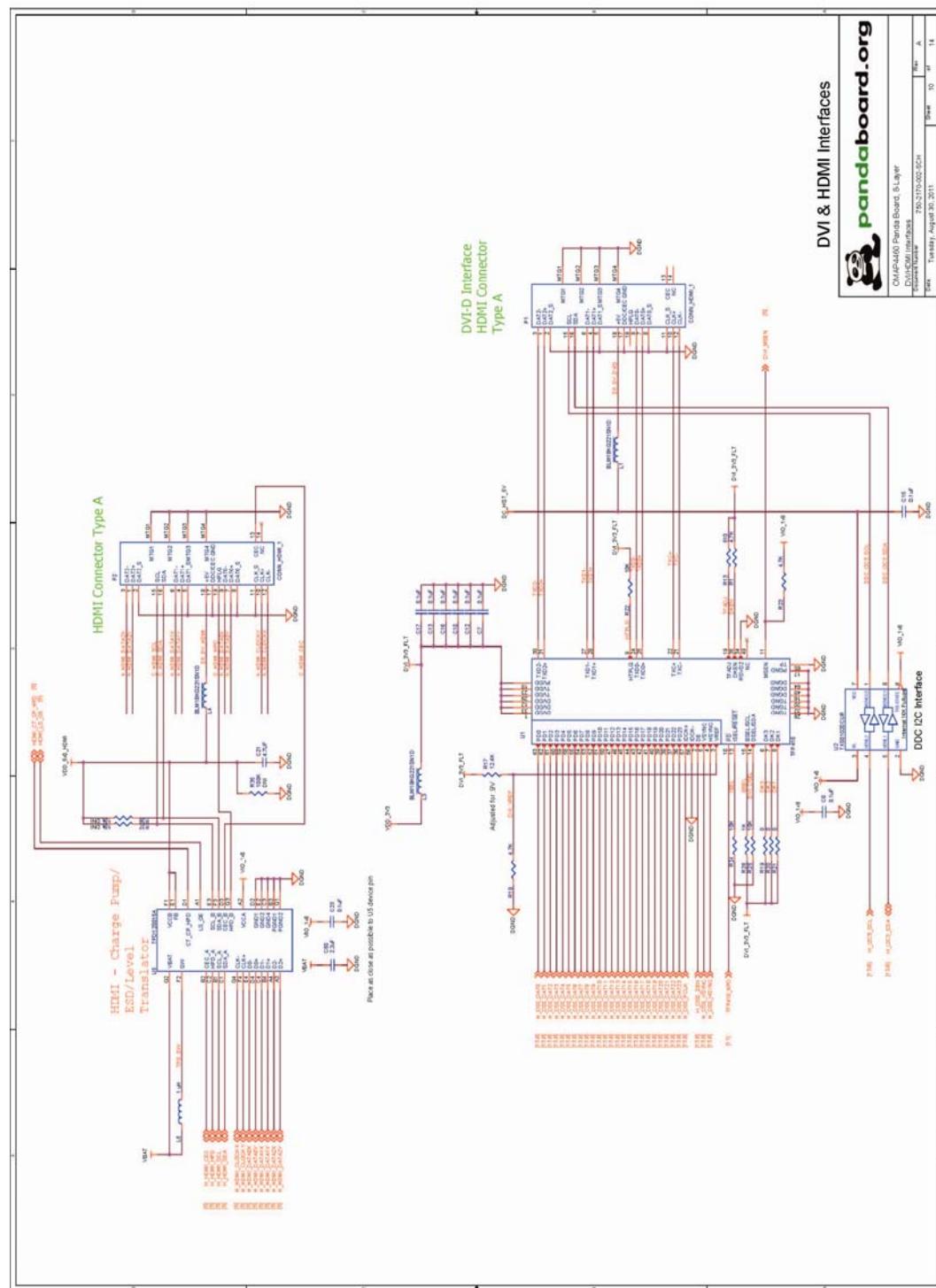


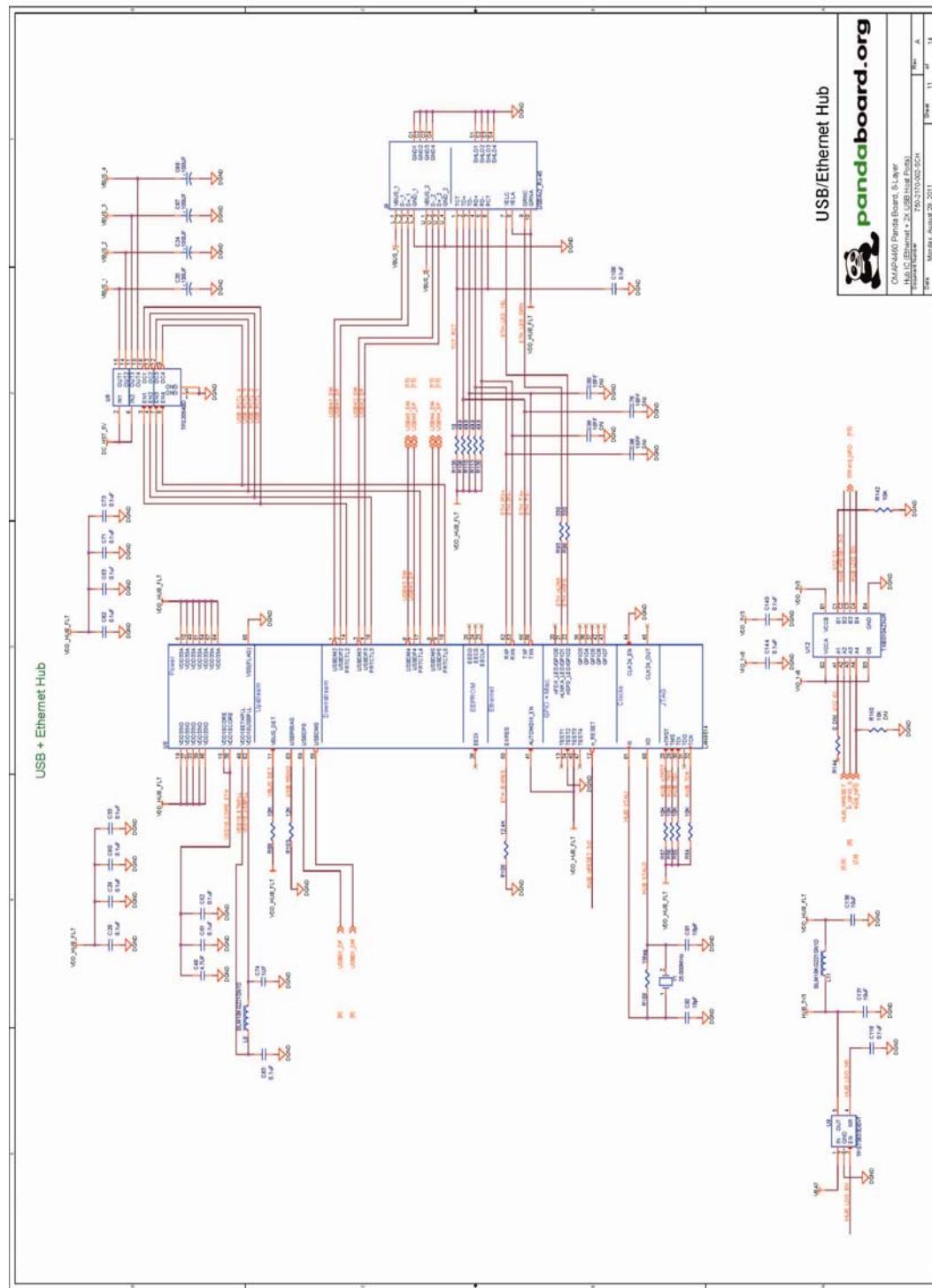


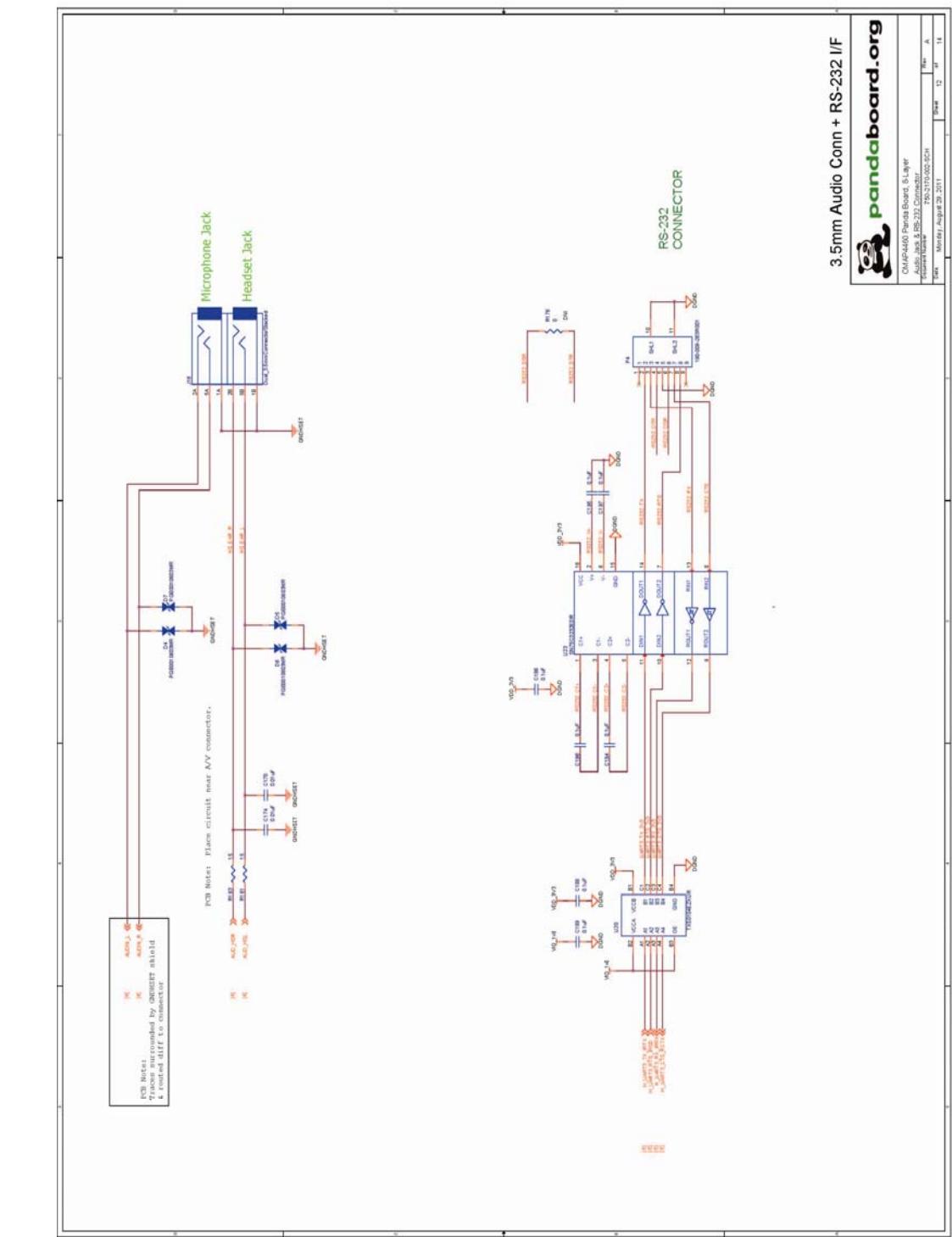
OMAP4460 Symbol "C"

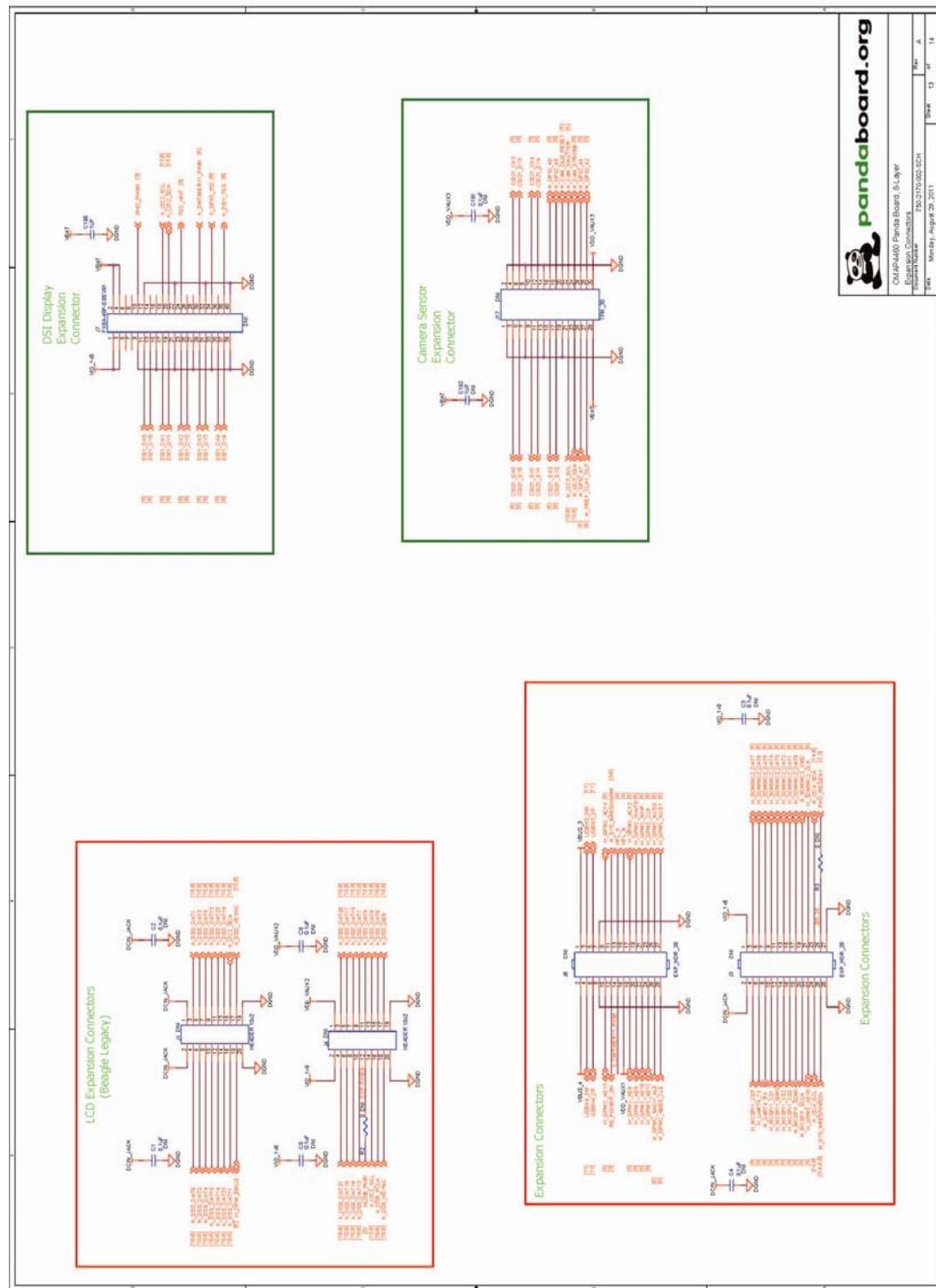


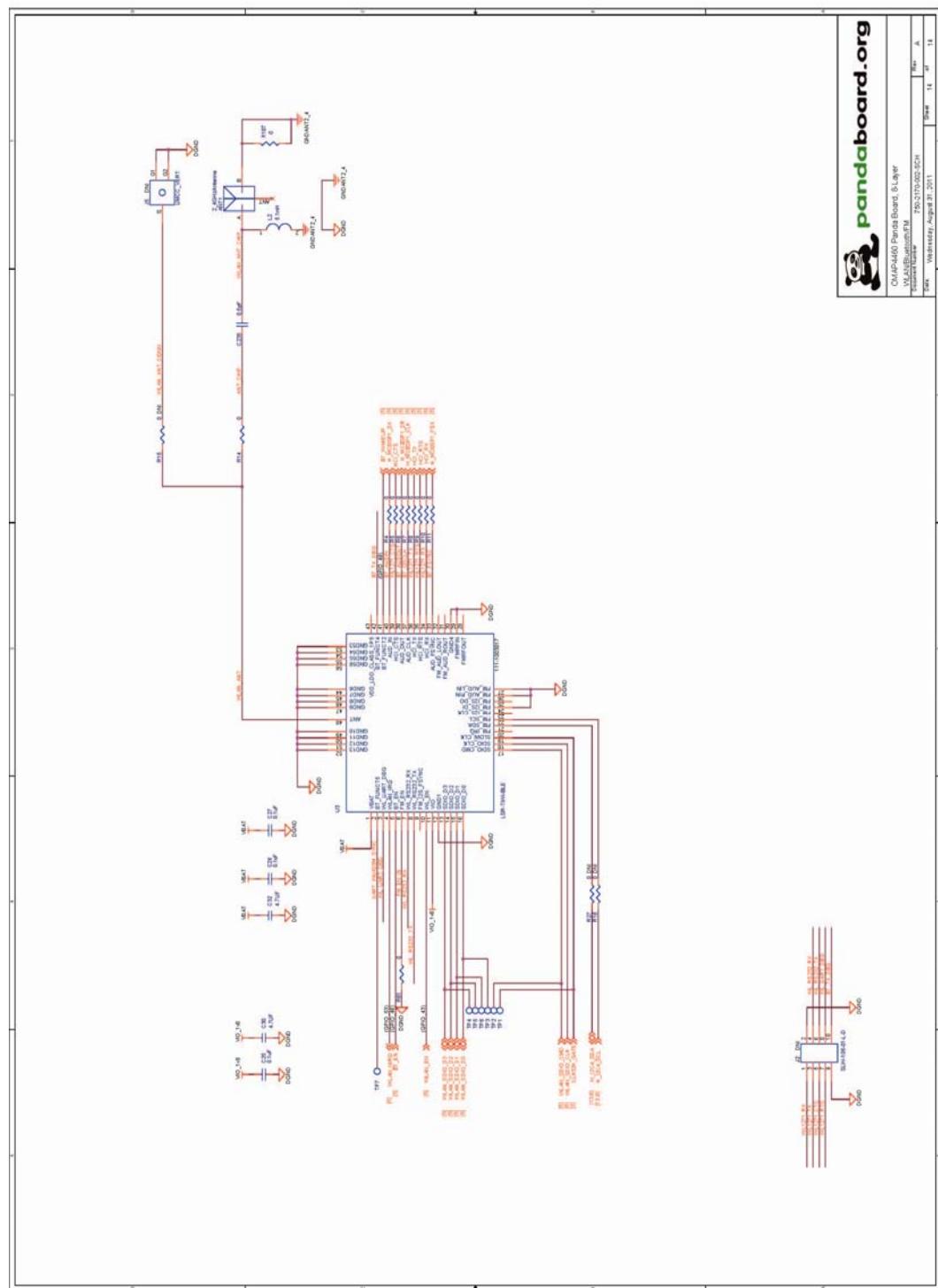














4.5 Pandaboard ES Bill of Materials

The Bill of Material for the OMAP4460 Pandaboard ES is provided at the following location:

<http://Pandaboard.org/content/resources/references>

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4.6 Pandaboard ES PCB Design Information

The PCB Design information (including the Cadence Allegro 16.3 Board file (.brd file) and PCB Gerber design files) are provided at the following location:

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помошь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помошь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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