



# Stratix III 3SL150 Development Board

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## Reference Manual



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## Introduction

This document describes the hardware features of the Stratix® III development board, including detailed pin-out information to enable you to create custom FPGA designs that interface with all components of the board.

- For information about setting the Stratix III development board and using the kit's demo software, refer to the *Stratix III Development Kit User Guide*.

## General Description

The Stratix III development board provides a hardware platform for developing and prototyping low-power, high-performance, and logic-intensive designs. The board provides a wide range of peripherals and memory interfaces to facilitate the design and development of Stratix III FPGA designs. Additionally, two high-speed mezzanine card (HSMC) connectors are available to add additional functionality via a variety of HSMCs available from both Altera and various partners.

- To see a list of the latest available HSMC cards and to request a copy of the HSMC specification, visit [www.altera.com](http://www.altera.com).


Design advancements and innovations, such as Programmable Power Technology and selectable core voltage, ensure that designs implemented in Stratix III FPGAs operate faster, but consume less power than previous generation Stratix devices.

- For more information about Stratix III device Programmable Power Technology, refer to the following documents:

- [Stratix III Programmable Power White Paper](#)
- *PowerPlay Power Analysis* chapter in volume 3 of the *Quartus II Handbook*

With up to 7,280 KByte of enhanced TriMatrix memory and 384 embedded  $18 \times 18$  multipliers, the on-board Stratix III device supplies internal memory while also providing I/O support for a variety of SDRAM (DDR2 or DDR3) and SRAM (QDR II or RLDRAM II) interfaces. Both DDR2 and QDR II are available on the Stratix III development board providing a high bandwidth, high-speed and low-latency solution.

The Stratix III development board is especially suitable for high-performance, logic-rich applications that require stringent signal and power integrity solutions. For example, the wireless, broadcast, and military markets require advanced signal processing techniques and very low power consumption, while also demanding flexibility and adaptability in the field.

 For more information about:

- External memory interfaces in Stratix III devices, refer to the *External Memory Interfaces* chapter in the *Stratix III Device Handbook*
- The Altera DDR and DDR2 SDRAM Controller Compiler MegaCore® function, refer to the *DDR and DDR2 SDRAM Controller Compiler User Guide*
- Power optimization, refer to *AN 437: Power Optimization Techniques in Stratix III FPGAs*
- Altera Video and Image Processing Suite MegaCore functions, refer to the *Video and Image Processing Suite User Guide*

## Board Component Blocks

The board features the following major component blocks:

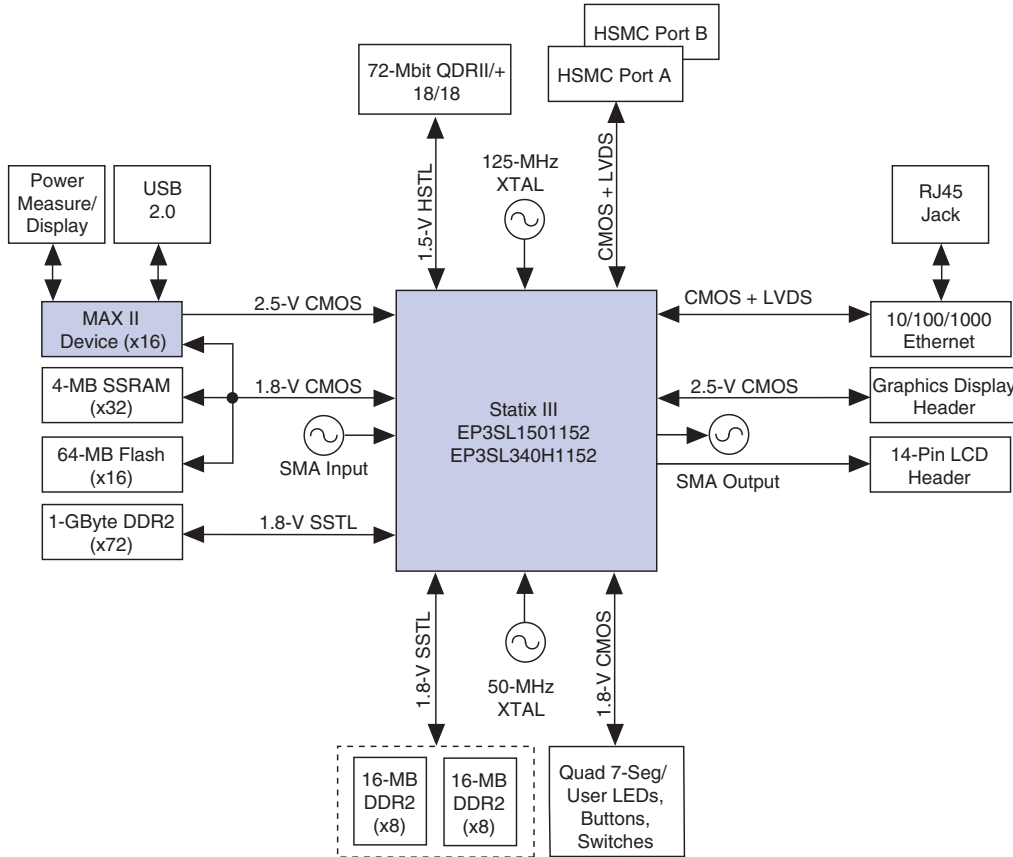
- 1,152-pin Altera Stratix III EP3SL150F FPGA in a ball-grid array (BGA) package
  - 142,000 logic elements (LEs)
  - 5,499 Kbits of memory
  - 384 multiplier blocks
  - Eight phase locked loops (PLLs)
  - 16 global clock networks
  - 736 user I/Os
  - 1.1-V core power
- 256-pin Altera EPM2210GF256 CPLD in a BGA package
  - 1.8-V core power
- On-board memory
  - 1-GByte DDR2 SDRAM DIMM
  - 72-Mbit QDRII/+ SRAM
  - 16-MByte DDR2 SDRAM devices
    - Individually addressable
  - 4-MByte SSRAM
  - 64-MByte flash memory
- FPGA configuration circuitry
  - MAX® II CPLD and flash passive serial configuration
  - On-board USB-Blaster™ circuitry using the Quartus II Programmer

- On-board clocking circuitry
  - Two clock oscillators to support Stratix III device user logic
    - 125 MHz
    - 50 MHz
  - SMA connector for external clock input and output
- General user and configuration interfaces
  - LEDs/displays:
    - Eight user LEDs
    - One configuration-done LED
    - One transmit/receive LED (TX/RX) per HSMC interface
    - One HSMC-present LED per HSMC interface
    - Six Ethernet LEDs
    - User Quad 7-segment display
    - Power consumption display
  - Push-buttons:
    - User reset push-button (CPU reset)
    - Four general user push-buttons
    - System reset push-button (user configuration)
    - One factory push-button switch (factory configuration)
  - DIP switches:
    - MAX II control DIP switch
    - Eight user DIP switches
  - Speaker header
- Displays
  - 128 × 64 graphics LCD
  - 16 × 2 line character LCD
- Power supply
  - 14-V – 20-V DC input
  - On-board power measurement circuitry
  - Up to 20 W per HSMC interface
- Mechanical
  - 7 in. × 8.25 in. board
  - Bench-top design

## Block Diagram

Figure 1-1 shows the functional block diagram of the Stratix III development board.

**Figure 1-1. Stratix III Development Board Block Diagram**



## Handling the Board

When handling the board, it is important to observe the following precaution:



**Static Discharge Precaution:** Without proper anti-static handling, the board can be damaged. Therefore, use anti-static handling precautions when touching the board.



## Introduction

This chapter introduces the important components on the Stratix III development board. [Figure 2–1](#) illustrates component locations and [Table 2–1](#) describes component features.

This chapter consists of the following sections:

- “Featured FPGA (U22)” on page 2–4
- “MAX II CPLD” on page 2–8
- “Configuration, Status, and Setup Elements” on page 2–17
- “Clocking Circuitry” on page 2–25
- “General User Interfaces” on page 2–28
- “Components and Interfaces” on page 2–39
- “On-Board Memory” on page 2–48
- “Power Supply” on page 2–67
- “Statement of China-RoHS Compliance” on page 2–70



A complete set of board schematics, a physical layout database, and GERBER files for the Stratix III development board reside in the Stratix III Development Kit documents directory.



For information about powering up the development board and installing the demo software, refer to the [Stratix III Development Kit User Guide](#).

## Board Overview

This section provides an overview of the Stratix III development board, including an annotated board image and component descriptions.

Figure 2-1 shows the top view of the Stratix III development board.

**Figure 2-1. Top View of the Stratix III Development Board**

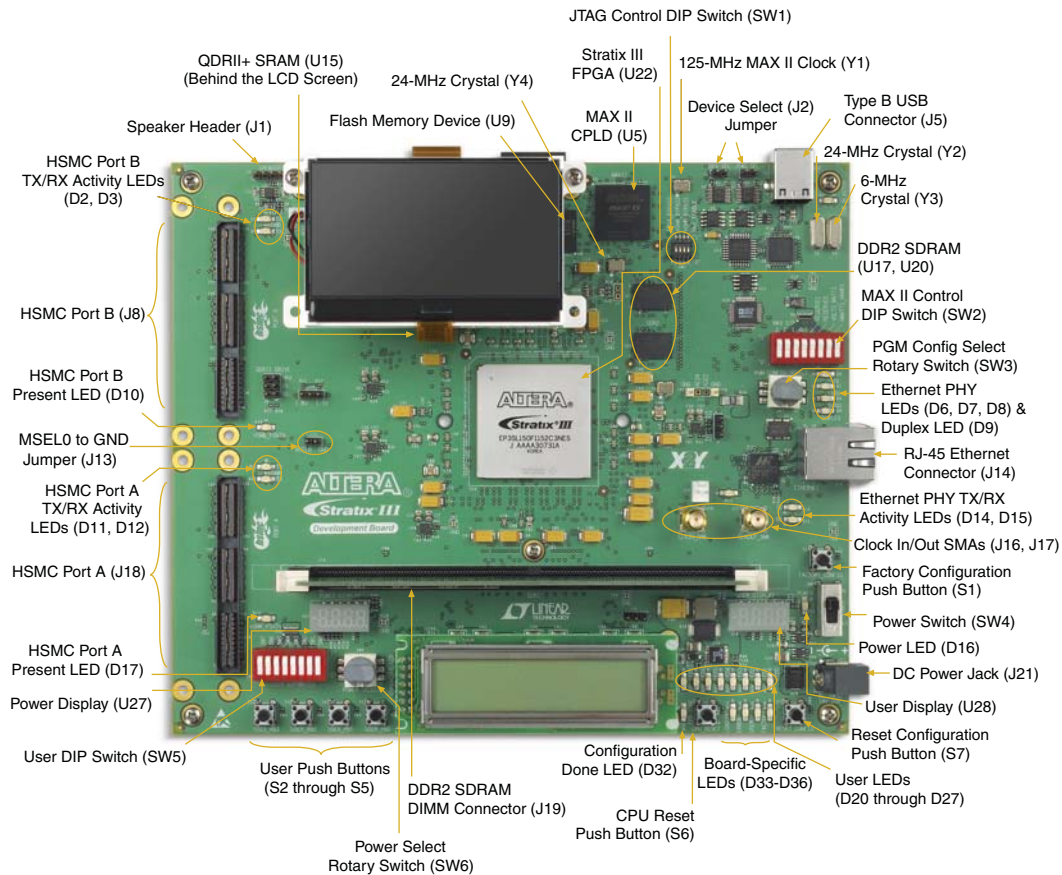


Table 2-1 describes the components and lists their corresponding board references.

**Table 2-1. Stratix III Development Board (Part 1 of 3)**

Board Reference	Type	Description
<b>Featured Devices</b>		
U22	FPGA	EP3SL150F1152, 1152-pin BGA package.
U5	CPLD	EPM2210GF256, 256-pin device in a BGA package.
<b>Configuration Status and Setup Elements</b>		
J2	Device select (DEV_SEL) jumper	Sets target device for JTAG signals when using an external USB Blaster or equivalent.
J5	Input	Type B USB connector that allows for connecting a Type A-B USB cable between a PC and the board.
D32	Configuration done LED	Green LED that illuminates when the FPGA is successfully configured.
D11, D12 (Port A) D2, D3 (Port B)	Channel activity LEDs	Green LEDs that indicate the RX and TX activity on the HSMC Ports A or B.
J1	Header	Speaker header.

**Table 2–1. Stratix III Development Board (Part 2 of 3)**

Board Reference	Type	Description
D6, D7, D8	Ethernet PHY LEDs	Green Ethernet PHY LEDs. Illuminate when Ethernet PHY is using the 10/100/1000 Mbps (D6, D7, D8) connection speeds.
D9	Duplex Ethernet PHY LED	Green Ethernet PHY LED. Illuminates when Ethernet PHY is both sending and receiving data.
D16	Power LED	Blue LED indicates when power is applied to the board.
D14, D15	Ethernet PHY transmit/receive activity LEDs	Green LEDs. Illuminates when transmit/receive data is active from the Ethernet PHY.
SW2	MAX II Control DIP switch	Controls various features of the MAX II device specific to the Stratix III development board.
SW1	JTAG control DIP switch	JTAG control DIP switch used to remove or include devices in the active JTAG chain.
U27	Power display	Displays power measured by the MAX II CPLD.
D11, D12	HSMC Port A transmit/receive activity LEDs	Illuminates when transmit/receive data is active from the HSMC Port A.
D2, D3	HSMC Port B transmit/receive activity LEDs	Illuminates when transmit/receive data is active from the HSMC Port B.
<b>Clock Circuitry</b>		
Y1	125 MHz	MAX II 125-MHz device clock.
Y2	24-MHz crystal	Cypress USB PHY.
Y3	6-MHz crystal	USB PHY FTDI reference clock.
Y4	24 MHz	MAX II 24-MHz device clock.
Y5	125 MHz	125-MHz clock oscillator used for the system clock.
Y6	50 MHz	50-MHz clock oscillator used for data processing.
J16	SMA clock input	SMA connector that allows the provision of an external clock input.
J17	SMA clock output	SMA connector that allows the provision of an external clock output.
<b>General User Input and Output</b>		
S2 through S5	User push-buttons	Four 2.5-V push-button switches for user-defined, logic inputs.
S6	CPU reset push-button	One 2.5-V push-button switch for FPGA logic and CPU reset.
S1 and S7	Reset and factory configuration push-button	Two 2.5-V push-button switches that control FPGA configuration from flash memory.
D20 through D27	User LEDs	Eight user-defined LEDs.
SW3	PGM Config Select rotary switch	Rotary switch to select which FPGA configuration file is loaded from the flash device into the FPGA.
SW6	Power Select rotary switch	Power rail select for on-board power monitor.
U28	User display	User-defined, green 7-segment display.
SW5	User DIP switch	User-defined, eight position DIP switch.
<b>Memory</b>		
U9	Flash	512 Mbits of flash memory.
U4, U10	P-SRAM	The P-SRAM devices connect to the MAX II device as well as the flash memory device.
U17, U20	DDR2 SDRAM	Two 16M × 8, 1.8-V core devices in 60-pin FBGA packages.

**Table 2-1. Stratix III Development Board (Part 3 of 3)**

Board Reference	Type	Description
U15	QDRII	Burst-of-four, 2M × 18, 400-MHz QDRII memory interface in an FBGA package.
J19	DDR2 SDRAM DIMM	Connector for 1 GByte × 72 DDR2 SDRAM DIMM.
<b>Components and Interfaces</b>		
U11	USB device	USB device that provides JTAG programming of on-board devices, including the Stratix III device and flash memory device.
J14	Ethernet cable jack	The RJ-45 jack is for Ethernet cable connection. The connector is fed by a 10/100/1000 base T PHY device with an RGMII interface to the Stratix III device.
J8 and J18	HSMC Port A and Port B	HSMC connectors to allow for expansion via the addition of HSMCs.
<b>Power Supply</b>		
J21	DC power jack	14–20 V DC power source.
SW4	Input	Switches the board's power on and off.

## Featured FPGA (U22)

The Stratix III Development Kit features the EP3SL150F1152C2 device (U22) in a 1152-pin BGA package.

 For more information about Stratix III devices, refer to the *Stratix III Device Handbook*.

Table 2-2 lists the main Stratix III EP3SL150 device features.

**Table 2-2. Stratix III EP3SL150 Device Features**

ALMs	LEs	M9K Blocks	M144K Blocks	MLAB Blocks	Total Embedded RAM Kbits	MLAB Kbits	Total Memory Kbits	18 × 18 Bit Multipliers	PLLs
57	142.5	355	16	2,850	5,499	1,781	7,280	384	8

Table 2-3 lists the Stratix III device component reference and manufacturing information.

**Table 2-3. Stratix III Device Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U22	High-speed, low-power FPGA	Altera Corporation	EP3SL150F1152	<a href="http://www.altera.com">www.altera.com</a>

Table 2-4 lists the Stratix III device EP3SL150F1152 pin count.

**Table 2-4. Stratix III Device Pin Count (Part 1 of 2)**

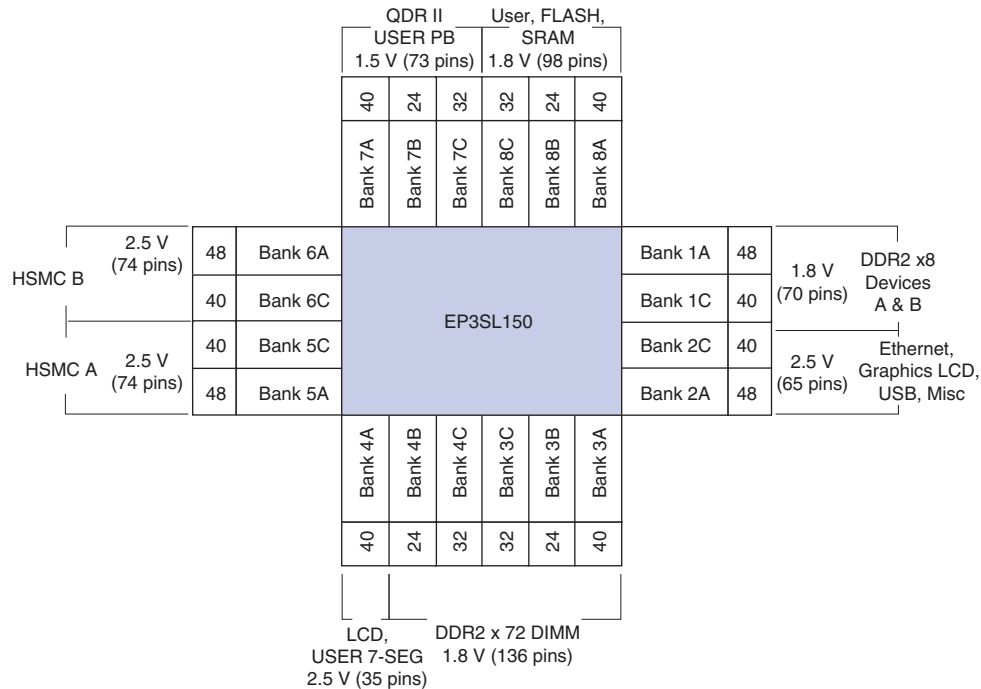
Function	I/O Type	I/O Count	Special Pins
Oscillators and SMAs	1.8-V CMOS	4	Three clock inputs, one output
DDR2 DIMM	1.8-V SSTL	136	18 data strobe signal (DQS) pins
DDR2 devices	1.8-V SSTL	74	Four DQS pins

**Table 2-4. Stratix III Device Pin Count (Part 2 of 2)**

Function	I/O Type	I/O Count	Special Pins
QDRII+	1.5-V/1.8-V HSTL	66	Two CQ pins
Flash/P-SRAM/MAX	1.8-V CMOS	79	—
Ethernet	2.5-V CMOS 2.5-V LVDS	36	6, 2.5 V LVDS
User I/O (LEDs, etc)	1.8-V/2.5 V	30	—
14-pin LCD header	2.5-V CMOS	11	—
Graphics display	2.5-V CMOS	16	—
USB	2.5-V CMOS	0	—
HSMC Port A	2.5-V CMOS 2.5-V LVDS	88	3 clock inputs
HSMC Port B	2.5-V CMOS 2.5-V LVDS	88	3 clock inputs
Device I/O total: 628			
Stratix III device I/O total: 736			

Figure 2-2 shows the EP3SL150 I/O bank diagram from a system perspective.

**Figure 2-2. System I/O Bank Diagram**



 For additional information about Altera devices, go to [www.altera.com/products/devices](http://www.altera.com/products/devices).

## Device Support

Although the target FPGA for the Stratix III development board is the EP3SL150 device, which is the first device in the 65 nm Stratix III FPGA device family, the board is also designed to migrate to the Stratix III EP3SL340H1152 device.

The following list shows the main power rails for the target device:

- 0.9-V/1.1-V  $V_{CCCL}$
- 1.1-V  $V_{CC}$
- 2.5-V  $V_{CCPT}$
- 1.8-V/2.5-V/3.0-V  $V_{CCPGM}$
- 2.5-V/3.0-V  $V_{CCPD}$
- 2.5-V  $V_{CCA\_PLL}$
- 2.5-V  $V_{CC\_CLKIN}$
- 2.5-V  $V_{CCBAT}$
- 1.2-V to 3.3-V  $V_{CCIO}$

The board's target device, the EP3SL150F1152C2, comprises the following:

- 57,000 adaptive logic modules (ALMs)
- 142,000 LEs
- 1,775 KBytes of RAM
- 736 user I/O
- 8 PLLs
- 16 global clocks
- 384  $18 \times 18$  multipliers in finite impulse response (FIR) mode

The board is designed to migrate to the EP3SL340H1152C3 device, which provides the following features in the H1152 package:

- 135,000 ALMs
- 338,000 LEs
- 4,225 KBytes of RAM
- 736 user I/O
- 8 PLLs
- 16 global clocks
- 576  $18 \times 18$  multipliers in FIR mode

## I/O Resources

This section lists specific I/O resources available with the EP3SL150F1152 device, which is from the L family of Stratix III devices.

Table 2-3 shows the configuration of the 20 user I/O banks and each bank's I/O count for the EP3SL150 device. Incidentally, within the same package, the EP3SL150 and the EP3SL340 devices have the same number of PLLs, user I/O banks, and user I/Os.

**Figure 2-3. EP3SL150F1152 Device I/O Bank Resources**

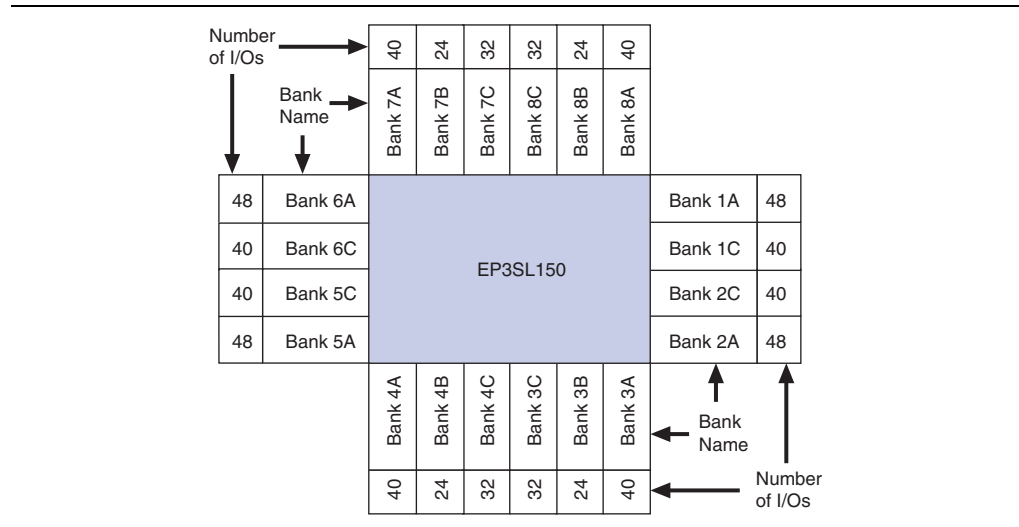
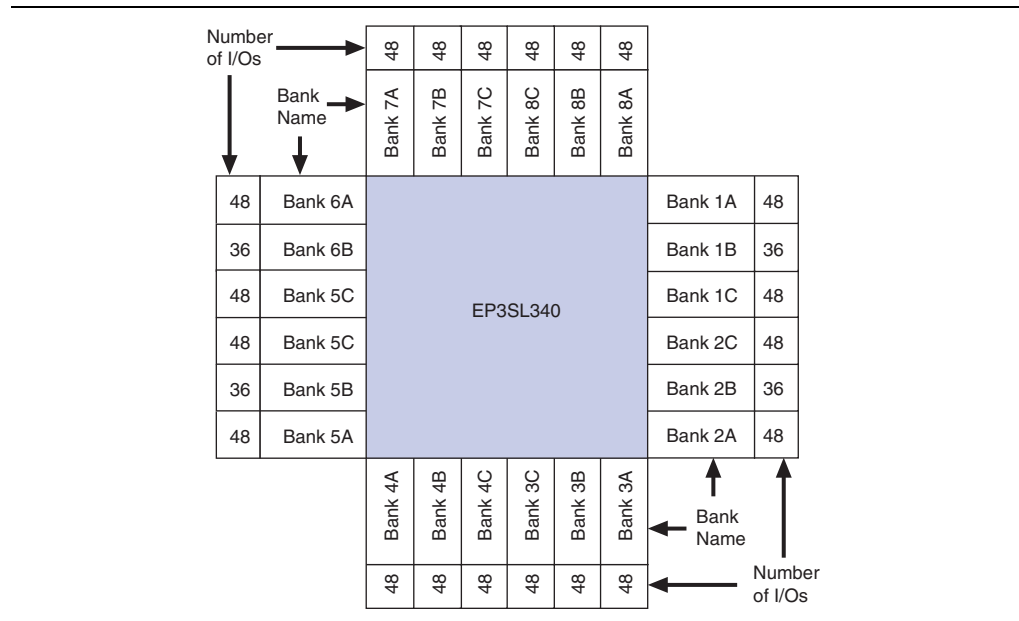


Figure 2-4 shows the configuration of the 24 possible user I/O banks and each bank's I/O count for the EP3SL340 device in its largest package. Banks 1B, 2B, 5B, and 6B are not available in the F1152 package.

**Figure 2-4. EP3SL340F1517 Device I/O Bank Diagram**



# MAX II CPLD

The board utilizes an Altera MAX II CPLD (U5) for the following purposes:

- Power-up configuration of the FPGA from flash memory
- Embedded USB-Blaster core for USB-based configuration of the FPGA
- Power consumption monitoring and display

Additionally, the MAX II device is also used to help dual-footprint the FTDI USB device and Cypress USB device. Each device has a shared path between the USB device and the MAX II CPLD. This path then drives to the FPGA separately.

Figure 2-5 illustrates the MAX II device’s functional block diagram.

**Figure 2-5. MAX II Device’s Block Diagram**

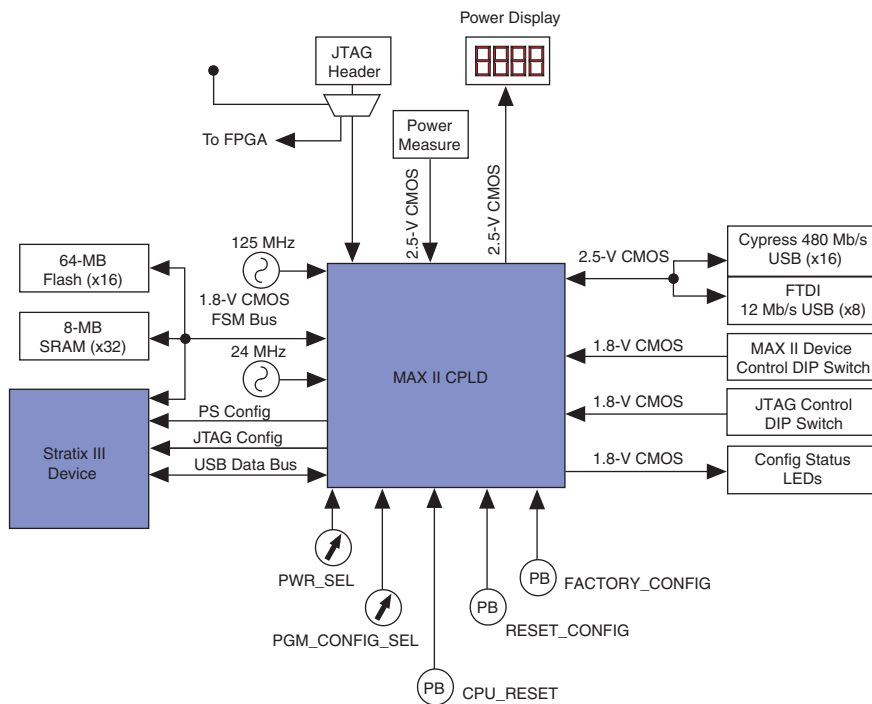


Table 2-5 lists the I/O signals present on the MAX II CPLD. The signal names and functions are relative to the MAX II device (U5).

**Table 2-5. MAX II Device Pin-out (Part 1 of 9)**

MAX II Pin Number	Description	Schematic Signal Name	I/O Standard	Stratrix III Pin Number	Other Connections
N9	Address bus shared with flash and P-SRAM bit 0	FSM_A0	1.8 V	F22	U9 pin A1
T8	Address bus shared with flash and P-SRAM bit 1	FSM_A1	1.8 V	H23	U9 pin B1 and U4 pin A3 and U10 pin A3
T9	Address bus shared with flash and P-SRAM bit 2	FSM_A2	1.8 V	G23	U9 pin C1 and U4 pin A4 and U10 pin A4



**Table 2-5. MAX II Device Pin-out (Part 2 of 9)**

<b>MAX II Pin Number</b>	<b>Description</b>	<b>Schematic Signal Name</b>	<b>I/O Standard</b>	<b>Stratix III Pin Number</b>	<b>Other Connections</b>
R9	Address bus shared with flash and P-SRAM bit 3	FSM_A3	1.8 V	F23	U9 pin D1 and U4 pin A5 and U10 pin A5
P9	Address bus shared with flash and P-SRAM bit 4	FSM_A4	1.8 V	D27	U9 pin D2 and U4 pin B3 and U10 pin B3
T10	Address bus shared with flash and P-SRAM bit 5	FSM_A5	1.8 V	D28	U9 pin A2 and U4 pin B4 and U10 pin B4
P13	Address bus shared with flash and P-SRAM bit 6	FSM_A6	1.8 V	F25	U9 pin C2 and U4 pin C3 and U10 pin C3
R10	Address bus shared with flash and P-SRAM bit 7	FSM_A7	1.8 V	F26	U9 pin A3 and U4 pin C4 and U10 pin C4
M10	Address bus shared with flash and P-SRAM bit 8	FSM_A8	1.8 V	G24	U9 pin B3 and U4 pin D4 and U10 pin D4
T11	Address bus shared with flash and P-SRAM bit 9	FSM_A9	1.8 V	F24	U9 pin C3 and U4 pin H2 and U10 pin H2
N10	Address bus shared with flash and P-SRAM bit 10	FSM_A10	1.8 V	E26	U9 pin C4 and U4 pin H3 and U10 pin H3
R11	Address bus shared with flash and P-SRAM bit 11	FSM_A11	1.8 V	D26	U9 pin C4 and U4 pin H4 and U10 pin H4
P10	Address bus shared with flash and P-SRAM bit 12	FSM_A12	1.8 V	A30	U9 pin A12 and U4 pin H5 and U10 pin H5
T12	Address bus shared with flash and P-SRAM bit 13	FSM_A13	1.8 V	A33	U9 pin B5 and U4 pin G3 and U10 pin G3
M11	Address bus shared with flash and P-SRAM bit 14	FSM_A14	1.8 V	B31	U9 pin C5 and U4 pin G4 and U10 pin G4
R12	Address bus shared with flash and P-SRAM bit 15	FSM_A15	1.8 V	A31	U9 pin D7 and U4 pin F3 and U10 pin F3
N11	Address bus shared with flash and P-SRAM bit 16	FSM_A16	1.8 V	B32	U9 pin D8 and U4 pin F4 and U10 pin F4
T13	Address bus shared with flash and P-SRAM bit 17	FSM_A17	1.8 V	A32	U9 pin A7 and U4 pin E4 and U10 pin E4
P11	Address bus shared with flash and P-SRAM bit 18	FSM_A18	1.8 V	M23	U9 pin B7 and U4 pin D3 and U10 pin D3
R13	Address bus shared with flash and P-SRAM bit 19.	FSM_A19	1.8 V	L23	U9 pin C7 and U4 pin H1 and U10 pin H1
M12	Address bus shared with flash and P-SRAM bit 20	FSM_A20	1.8 V	B29	U9 pin C8 and U4 pin G2 and U10 pin G2
R14	Address bus shared with flash and P-SRAM bit 21	FSM_A21	1.8 V	C29	U9 pin A8 and U4 pin H6 and U10 pin H6
N12	Address bus shared with flash and P-SRAM bit 22	FSM_A22	1.8 V	C31	U9 pin G1

Table 2-5. MAX II Device Pin-out (Part 3 of 9)

MAX II Pin Number	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
T15	Address bus shared with flash and P-SRAM bit 23	FSM_A23	1.8 V	D31	U9 pin H8
P12	Address bus shared with flash and P-SRAM bit 24	FSM_A24	1.8 V	F27	U9 pin B6
P4	Data bus shared with flash and SRAM bit 0	FSM_D0	1.8 V	G27	U9 pin F2 and U4 pin B6
R1	Data bus shared with flash and SRAM bit 1	FSM_D1	1.8 V	F28	U9 pin E2 and U4 pin C5
P5	Data bus shared with flash and SRAM bit 2	FSM_D2	1.8 V	E28	U9 pin G3 and U4 pin C6
T2	Data bus shared with flash and SRAM bit 3	FSM_D3	1.8 V	D30	U9 pin E4 and U4 pin D5
N5	Data bus shared with flash and SRAM bit 4	FSM_D4	1.8 V	C30	U9 pin E5 and U4 pin E5
R3	Data bus shared with flash and SRAM bit 5	FSM_D5	1.8 V	F29	U9 pin G5 and U4 pin F5
P6	Data bus shared with flash and SRAM bit 6	FSM_D6	1.8 V	E29	U9 pin G6 and U4 pin F6
R4	Data bus shared with flash and SRAM bit 7	FSM_D7	1.8 V	J24	U9 pin H7 and U4 pin G6
N6	Data bus shared with flash and SRAM bit 8	FSM_D8	1.8 V	J25	U9 pin E1 and U4 pin B1
T4	Data bus shared with flash and SRAM bit 9	FSM_D9	1.8 V	A24	U9 pin E3 and U4 pin C1
M6	Data bus shared with flash and SRAM bit 10	FSM_D10	1.8 V	A26	U9 pin F3 and U4 pin C2
R5	Data bus shared with flash and SRAM bit 11	FSM_D11	1.8 V	B25	U9 pin F4 and U4 pin D2
P7	Data bus shared with flash and SRAM bit 12	FSM_D12	1.8 V	A25	U9 pin F5 and U4 pin E2
T5	Data bus shared with flash and SRAM bit 13	FSM_D13	1.8 V	J20	U9 pin H5 and U4 pin F2
N7	Data bus shared with flash and SRAM bit 14	FSM_D14	1.8 V	K20	U9 pin G7 and U4 pin F1
R6	Data bus shared with flash and SRAM bit 15	FSM_D15	1.8 V	K21	U9 pin E7 and U4 pin G1
M7	Data bus shared with flash and SRAM bit 16	FSM_D16	1.8 V	K22	U10 pin B6
T6	Data bus shared with flash and SRAM bit 17	FSM_D17	1.8 V	C26	U10 pin C5
P14	Data bus shared with flash and SRAM bit 18	FSM_D18	1.8 V	B26	U10 pin C6
R7	Data bus shared with flash and SRAM bit 19	FSM_D19	1.8 V	J22	U10 pin D5

**Table 2-5. MAX II Device Pin-out (Part 4 of 9)**

<b>MAX II Pin Number</b>	<b>Description</b>	<b>Schematic Signal Name</b>	<b>I/O Standard</b>	<b>Stratix III Pin Number</b>	<b>Other Connections</b>
P8	Data bus shared with flash and SRAM bit 20	FSM_D20	1.8 V	J21	U10 pin E5
T7	Data bus shared with flash and SRAM bit 21	FSM_D21	1.8 V	C24	U10 pin F5
N8	Data bus shared with flash and SRAM bit 22	FSM_D22	1.8 V	E25	U10 pin F6
R8	Data bus shared with flash and SRAM bit 23	FSM_D23	1.8 V	D25	U10 pin G6
F12	Data bus shared with flash and SRAM bit 24	FSM_D24	1.8 V	D24	U10 pin B1
D16	Data bus shared with flash and SRAM bit 25	FSM_D25	1.8 V	A27	U10 pin C1
F13	Data bus shared with flash and SRAM bit 26	FSM_D26	1.8 V	A29	U10 pin C2
D15	Data bus shared with flash and SRAM bit 27	FSM_D27	1.8 V	C27	U10 pin D2
F14	Data bus shared with flash and SRAM bit 28	FSM_D28	1.8 V	C28	U10 pin E2
D14	Data bus shared with flash and SRAM bit 29	FSM_D29	1.8 V	E23	U10 pin F2
E12	Data bus shared with flash and SRAM bit 30	FSM_D30	1.8 V	D23	U10 pin F1
C15	Data bus shared with flash and SRAM bit 31	FSM_D31	1.8 V	B28	U10 pin G1
L13	Flash address valid	FLASH_ADVn	1.8 V	C7	U9 pin F6
K14	Flash chip enable	FLASH_CEn	1.8 V	K25	U9 pin B4
L15	Flash clock	FLASH_CLK	1.8 V	K24	U9 pin E6
M16	Flash output enable	FLASH_OEn	1.8 V	K23	U9 pin F8
L11	Flash ready/busy	FLASH_RDYBSYn	1.8 V	L16	U9 pin F7
M15	Flash reset	FLASH_RESETn	1.8 V	E13	U9 pin D4
L12	Flash write enable	FLASH_WEn	1.8 V	L22	U9 pin G8
N13	Flash page select	PGM0	1.8 V	—	SW3 pin 1
P15	Flash page select	PGM1	1.8 V	—	SW3 pin 2
M14	Flash page select	PGM2	1.8 V	—	SW3 pin 4
N16	Flash page select	PGM3	1.8 V	—	SW3 pin 8
D3	FPGA configuration complete	FPGA_CONF_DONE	2.5 V	AH29	—
D3	FPP configuration data bus bit 0	FPGA_DATA0	2.5 V	T28	—
K4	FPP configuration data bus bit 1	FPGA_DATA1	2.5 V	T27	—
M2	FPP configuration data bus bit 2	FPGA_DATA2	2.5 V	R34	—
K3	FPP configuration data bus bit 3	FPGA_DATA3	2.5 V	R33	—
M2	FPP configuration data bus bit 4	FPGA_DATA4	2.5 V	T25	—

Table 2-5. MAX II Device Pin-out (Part 5 of 9)

MAX II Pin Number	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
L5	FPP configuration data bus bit 5	FPGA_DATA5	2.5 V	T24	—
M3	FPP configuration data bus bit 6	FPGA_DATA6	2.5 V	T32	—
L4	FPP configuration data bus bit 7	FPGA_DATA7	2.5 V	R31	—
C2	FPP configuration clock	FPGA_DCLK	2.5 V	AL3	—
E4	FPGA configuration start	FPGA_NCONFIG	2.5 V	AE25	—
C3	FPGA configuration status	FPGA_NSTATUS	2.5 V	AH28	—
E10	USB command/data select	USB_CMD_DATA	2.5 V	Y28	—
B10	USB empty from MAX II device to Stratix III device	USB_EMPTY	2.5 V	AH12	—
F9	USB data from MAX II to Stratix III bit 0	USB_FD0	2.5 V	AE33	—
A9	USB data from MAX II to Stratix III bit 1	USB_FD1	2.5 V	AE31	—
A8	USB data from MAX II to Stratix III bit 2	USB_FD2	2.5 V	AC28	—
B8	USB data from MAX II to Stratix III bit 3	USB_FD3	2.5 V	AA24	—
E8	USB data from MAX II to Stratix III bit 4	USB_FD4	2.5 V	AF34	—
A7	USB data from MAX II to Stratix III bit 5	USB_FD5	2.5 V	AG33	—
D8	USB data from MAX II to Stratix III bit 6	USB_FD6	2.5 V	AA25	—
B7	USB data from MAX II to Stratix III bit 7	USB_FD7	2.5 V	AE32	—
C9	USB full from MAX II to Stratix III device	USB_FULLL	2.5 V	AE11	—
J14	USB clock from MAX II to Stratix III device	USB_IFCLK	2.5 V	U1	—
A11	USB read enable from MAX II to Stratix III device	USB_REN	2.5 V	N5	—
B5	USB write enable from MAX II to Stratix III device	USB_WEN	2.5 V	W11	—
L16	Cypress USB pin multiplexed for I/O or FIFO select	USB_PA5_IF0ADR1	2.5 V	—	U12 pin 38
K5	Cypress USB pin multiplexed for I/O or FIFO packet commit	USB_PA6_PKTEND	2.5 V	—	U12 pin 39
L2	Cypress USB pin multiplexed for I/O or gate for other FIFO slaves	USB_PA7_SLCSn	2.5 V	—	U12 pin 40
C13	Cypress/FTDI USB data bus bit 0	USB_PHY_FD0	2.5 V	—	U12 pin 18 and U11 pin 25
B16	Cypress/FTDI USB data bus bit 1	USB_PHY_FD1	2.5 V	—	U12 pin 19 and U11 pin 24

**Table 2-5. MAX II Device Pin-out (Part 6 of 9)**

MAX II Pin Number	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
C12	Cypress/FTDI USB data bus bit 2	USB_PHY_FD2	2.5 V	—	U12 pin 20 and U11 pin 23
A15	Cypress/FTDI USB data bus bit 3	USB_PHY_FD3	2.5 V	—	U12 pin 21 and U11 pin 22
D12	Cypress/FTDI USB data bus bit 4	USB_PHY_FD4	2.5 V	—	U12 pin 22 and U11 pin 21
B14	Cypress/FTDI USB data bus bit 5	USB_PHY_FD5	2.5 V	—	U12 pin 23 and U11 pin 20
C11	Cypress/FTDI USB data bus bit 6	USB_PHY_FD6	2.5 V	—	U12 pin 24 and U11 pin 19
B13	Cypress/FTDI USB data bus bit 7	USB_PHY_FD7	2.5 V	—	U12 pin 25 and U11 pin 18
D11	Cypress USB data bus bit 8	USB_PHY_FD8	2.5 V	—	U12 pin 45
A13	Cypress USB data bus bit 9	USB_PHY_FD9	2.5 V	—	U12 pin 46
E11	Cypress USB data bus bit 10	USB_PHY_FD10	2.5 V	—	U12 pin 47
B12	Cypress USB data bus bit 11	USB_PHY_FD11	2.5 V	—	U12 pin 48
C10	Cypress USB data bus bit 12	USB_PHY_FD12	2.5 V	—	U12 pin 49
A12	Cypress USB data bus bit 13	USB_PHY_FD13	2.5 V	—	U12 pin 50
D10	Cypress USB data bus bit 14	USB_PHY_FD14	2.5 V	—	U12 pin 51
B11	Cypress USB data bus bit 15	USB_PHY_FD15	2.5 V	—	U12 pin 52
C7	Cypress USB clock	USB_PHY_IFCLK	2.5 V	—	R89
A4	Cypress USB command/data select	USB_PHY_CMD_DATA	2.5 V	—	U12 pin 29
E6	Cypress USB read enable	USB_PHY_REN	2.5 V	—	U12 pin 30
B4	Cypress USB write enable	USB_PHY_WEN	2.5 V	—	U12 pin 31
D6	Cypress USB empty	USB_PHY_EMPTY	2.5 V	—	U12 pin 1
C4	Cypress USB full	USB_PHY_FULL	2.5 V	—	U12 pin 29
C6	Cypress USB reset	USB_RESETn	2.5 V	—	U12 pin 41
B3	Cypress USB clock out	USB_CLKOUT	2.5 V	—	U12 pin 54
C5	Cypress USB wake up	USB_WAKEUP	2.5 V	—	U12 pin 44
B6	Cypress USB pin multiplexed for I/O or FIFO select	USB_PA4_IF0ADR0	2.5 V	—	U12 pin 37
A2	Cypress USB pin multiplexed for I/O or 8051 interrupt	USB_PA0_INT0n	2.5 V	—	U12 pin 33 and U11 pin 14
D5	Cypress USB pin multiplexed for I/O or 8051 interrupt	USB_PA1_INT1n	2.5 V	—	U12 pin 34 and U11 pin 12
B1	Cypress USB pin multiplexed for I/O or output enable for the slave FIFOs.	USB_PA2_SLOE	2.5 V	—	U12 pin 35
D4	Cypress USB pin multiplexed for I/O or alternate wake up signal	USB_PA3_WU2	2.5 V	—	U12 pin 36 and U11 pin 11

Table 2-5. MAX II Device Pin-out (Part 7 of 9)

MAX II Pin Number	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
C8	FTDI USB read enable	USB_RDn	2.5 V	—	U11 pin 16
A6	FTDI USB write enable	USB_WR	2.5 V	—	U11 pin 15
A5	FTDI USB reset	USB_RSTn	2.5 V	—	U11 pin 4
D7	FTDI USB reset output	USB_RSTOUTn	2.5 V	—	U11 pin 5
K12	FTDI USB power enable	USB_PWR_ENn	1.8 V	—	U11 pin 10
D2	MAX II output to power seven segment display	PWR_SEG_A	2.5 V	—	U27 pin 12
E5	MAX II output to power 7-segment display	PWR_SEG_B	2.5 V	—	U27 pin 11
D1	MAX II output to power 7-segment display	PWR_SEG_C	2.5 V	—	U27 pin 3
F3	MAX II output to power 7-segment display	PWR_SEG_D	2.5 V	—	U27 pin 8
E2	MAX II output to power 7-segment display	PWR_SEG_E	2.5 V	—	U27 pin 2
F4	MAX II output to power 7-segment display	PWR_SEG_F	2.5 V	—	U27 pin 9
E10	MAX II output to power 7-segment display	PWR_SEG_G	2.5 V	—	U27 pin 7
F5	MAX II output to power 7-segment display	PWR_SEG_DP	2.5 V	—	U27 pin 5
F2	MAX II output to power 7-segment display	PWR_SEG_MINUS	2.5 V	—	U27 pin 13
F6	MAX II output to power 7-segment display	PWR_DIG_SEL1	2.5 V	—	U27 pin 1
F1	MAX II output to power 7-segment display	PWR_DIG_SEL2	2.5 V	—	U27 pin 10
G3	MAX II output to power 7-segment display	PWR_DIG_SEL3	2.5 V	—	U27 pin 4
G2	MAX II output to power 7-segment display	PWR_DIG_SEL4	2.5 V	—	U27 pin 6
H5	Chip select to the power monitor A/D	PMON_CSN	2.5 V	—	U18 pin 7
J1	Clock to/from the power monitor A/D	PMON_CLK	2.5 V	—	U18 pin 9 and U19, pin 19
H4	Data from the power monitor A/D	PMON_SDI	2.5 V	—	U18 pin 8
H3	Data to the power monitor multiplexer	PMON_DATA	2.5 V	—	U19 pin 19
J2	Frame synchronization signal to the power monitor multiplexer	PMON_SYNC	2.5 V	—	U19 pin 17
J16	Power selection input	PWR_SELO	1.8 V	—	SW6 pin P1
J13	Power selection input	PWR_SEL1	1.8 V	—	SW6 pin P2

**Table 2-5. MAX II Device Pin-out (Part 8 of 9)**

<b>MAX II Pin Number</b>	<b>Description</b>	<b>Schematic Signal Name</b>	<b>I/O Standard</b>	<b>Stratix III Pin Number</b>	<b>Other Connections</b>
H16	Power selection input	PWR_SEL2	1.8 V	—	SW6 pin P4
H13	Power selection input	PWR_SEL3	1.8 V	—	SW6 pin P8
M4	JTAG master data input signal	FPGA_JTAG_TDI	2.5 V	G28	U2 pin 13
N2	JTAG master data output	FPGA_JTAG_TDO	2.5 V	G29	U2 pin 10
L16	MAX II chip select	MAX_CS <sub>n</sub>	1.8 V	C20	—
P3	JTAG clock	MAX_JTAG_TCK	2.5 V	F30	U3 pin 2 and U2 pin 2
N4	JTAG mode select	MAX_JTAG_TMS	2.5 V	—	U3 pin 5, U2 pin 5
K15	MAX II write enable	MAX_WEn	1.8 V	G21	—
K13	MAX II output enable	MAX_OEn	1.8 V	D20	—
H1	Connected to Stratix III device	MAX_TO_STRATIX3	2.5 V	K1	—
G4	N/A	MAXGP_JTAG_TCK	2.5 V	—	U3 pin 3
G1	N/A	MAXGP_JTAG_TDI	2.5 V	—	U3 pin 13
G5	N/A	MAXGP_JTAG_TDO	2.5 V	—	U3 pin 10
H2	N/A	MAXGP_JTAG_TMS	2.5 V	—	U3 pin 6
J4	Synchronous clock for switching regulators	LT4601_CLK0	2.5 V	—	U32 pin A8
K1	Synchronous clock for switching regulators	LT4601_CLK90	2.5 V	—	U33 pin A8
J3	Synchronous clock for switching regulators	LT4601_CLK180	2.5 V	—	U34 pin A8
N3	JTAG clock	FPGA_JTAG_TCK	2.5 V	F30	J18 pin 35 and J8 pin 35 and U2 pin 3
P2	JTAG mode select	FPGA_JTAG_TMS	2.5 V	H28	J18 pin 36 and J8 pin 36 and U2 pin 6
L6	JTAG data input	MAX_JTAG_TDI	2.5 V	—	U3 pin 14 and U2 pin 14
M5	JTAG data output	MAX_JTAG_TDO	2.5 V	—	U3 pin 11 and U2 pin 11
A10	Push-button that re-loads the factory default image into the Stratix III device	FACTORY_CONFIG <sub>n</sub>	2.5 V	—	S1
B9	JTAG input to HSMC B	HSMB_JTAG_TDI	2.5 V	—	J8 pin 38
D9	JTAG input to HSMC A	HSMA_JTAG_TDI	2.5 V	—	J18 pin 38
C8	FTDI USB read enable	USB_RD <sub>n</sub>	2.5 V	—	U11 pin 16
A6	FTDI USB write enable	USB_WR	2.5 V	—	U11 pin 15
A5	FTDI USB reset	USB_RST <sub>n</sub>	2.5 V	—	U11 pin 4
D7	FTDI USB reset output	USB_RSTOUT <sub>n</sub>	2.5 V	—	U11 pin 5
K12	FTDI USB power enable	USB_PWR_EN <sub>n</sub>	1.8 V	—	U11 pin 10
J12	24 MHz clock input	CLKIN_24	1.8 V	—	Y4 pin 3
H12	125 MHz clock input	CLKIN_MAX_125	1.8 V	—	Y1 pin 4

Table 2-5. MAX II Device Pin-out (Part 9 of 9)

MAX II Pin Number	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
G15	JTAG output from HSMC A	HSMA_JTAG_TDO	1.8 V	—	J18 pin 37
F15	JTAG output from HSMC B	HSMB_JTAG_TDO	1.8 V	—	J8 pin 37
F16	HSMC A present	HSMA_PSNTn	1.8 V	—	J18 pin 160
G13	HSMC B present	HSMB_PSNTn	1.8 V	—	J8 pin 160
G14	JTAG control signal	FPGA_BYPASS	1.8 V	—	SW1 pin 8
E16	JTAG control signal	HSMA_BYPASS	1.8 V	—	SW1 pin 7
F11	JTAG control signal	HSMB_BYPASS	1.8 V	—	SW1 pin 6
C14	JTAG control signal	JTAG_SEL	1.8 V	—	U3 pin 1 and J3 pin 1
M9	MAX II reset	CPU_RESETh	1.8 V	AP5	S6
M8	MAX II enable	MAX_EN	1.8 V	—	SW1 pin 5
H15	MAX II status signal	MAX_ERROR	1.8 V	—	D34
H14	MAX II status signal	MAX_LOAD	1.8 V	—	D33
G16	MAX II status signal	MAX_FACTORY	1.8 V	—	D36
G12	MAX II status signal	MAX_USER	1.8 V	—	D35
E15	MAX II status signal	MAX_EMB	1.8 V	—	D1
E13	MAX II status signal	DEV_SEL	1.8 V	—	U2 pin 1 and J2 pin 1
E14	Control signal	MWATTS_MAMPS	1.8 V	—	SW2 pin 1
D13	Control signal	VOLTS_WATTS	1.8 V	—	SW2 pin 2
R16	Control signal	RESET_CONFIGn	1.8 V	—	S7
N14	PFL enable	MAX_DIP0	1.8 V	—	SW2 pin 5
M13	N/A	MAX_DIP1	1.8 V	—	SW2 pin 6
N15	N/A	MAX_DIP2	1.8 V	—	SW2 pin 7
L14	N/A	MAX_DIP3	1.8 V	—	SW2 pin 8
K16	N/A	MAX_RESERVE0	1.8 V	—	SW2 pin 3
J15	N/A	MAX_RESERVE1	1.8 V	—	SW2 pin 4
E7	N/A	OVERTEMPn	2.5 V	—	J7 pin 2
N1	N/A	TSENSE_SMB_DATA	2.5 V	—	U16 pin 7
L3	N/A	TSENSE_SMB_CLK	2.5 V	—	U16 pin 6

Table 2-6 lists the MAX II component reference and manufacturing information.

Table 2-6. MAX II Component Reference and Manufacturing Information

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U5	256-pin device in a BGA package	Altera Corporation	EPM2210GF256C3N	<a href="http://www.altera.com">www.altera.com</a>



## Configuration, Status, and Setup Elements

This section describes the board's configuration, status, and setup elements, and is divided into the following groups:

- [“Configuration” on page 2-17](#)
  - FPGA programming over USB
  - FPGA programming from flash memory
  - Flash programming over USB
- [“Status Elements” on page 2-19](#)
  - Board-specific LEDs
  - Power display
- [“Setup Elements” on page 2-21](#)
  - JTAG control DIP switch
  - MAX II device control DIP switch
  - System reset and configuration push-button switches
  - Power Select rotary switch
  - PGM Config Select rotary switch

### Configuration

This section discusses FPGA, flash memory, and MAX II device programming methods supported by the Stratix III development board.

#### FPGA Programming Over USB

You can configure the FPGA at any time the board is powered on using the USB 2.0 interface and the Quartus II Programmer in JTAG mode.

The JTAG chain is mastered by the embedded USB-Blaster function found in the MAX II device. Only a USB cable is needed to program the Stratix III FPGA. Any device can be bypassed by using the appropriate switch on the JTAG control DIP switch.



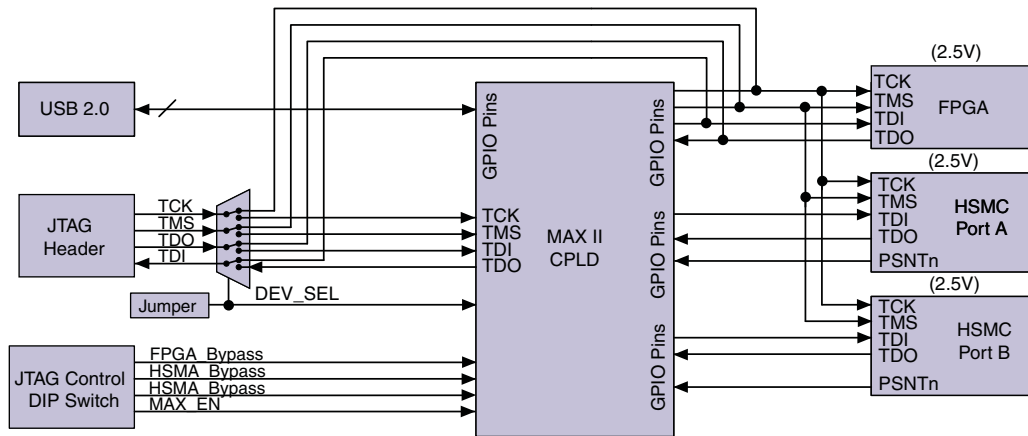
Board reference SW1 position 4 (SW1.4), labeled `MAX_ENABLE` must be in the 0 position for this feature to work properly.

For more information about:

- Advanced JTAG settings, refer to [Table 2-7](#).

- The JTAG control switch, refer to “JTAG Control DIP Switch” on page 2–21.

**Figure 2–6. JTAG Chain with the MAX II Device and the Stratix III Device**



You can use the JTAG header can be used with an external USB-Blaster cable, or equivalent, to program either the MAX II CPLD or the Stratix III FPGA. Most users of the Stratix III development board do not use the JTAG header at all and instead use a USB cable along with the embedded USB-Blaster. Using an external USB-Blaster with the JTAG header requires disabling the embedded USB-Blaster function. See [Table 2–7](#).



If complete repower is required, unplug and replug the USB cable into board reference J5.

**Table 2–7. JTAG Settings <sup>(1)</sup>**

Number	Description	FPGA Bypass (SW1.1)	HSMA Bypass (SW1.2)	HSMB Bypass (SW1.3)	MAX Enable (SW1.4)	PFL Enable (SW2.5) <sup>(5)</sup>	Device Select (DEV_SEL) Jumper, J2
1	Embedded USB Blaster <sup>(2), (3)</sup> Stratix III target device only	1	0	0	0	1	X
2	Embedded USB Blaster <sup>(2), (3)</sup> Stratix III device + HSMC Port A	1	1	0	0	1	X
3	Embedded USB Blaster <sup>(2), (3)</sup> Stratix III device + HSMC Port B	1	0	1	0	1	X
4	External USB Blaster <sup>(4)</sup> Stratix III target device only	X	X	X	1	1	Off
5	External USB Blaster <sup>(4)</sup> MAX II target device only	X	X	X	X	X	On

**Notes to Table 2–7:**

- (1) The nomenclature SW1.1 indicates board reference SW1, position 1.
- (2) Requires USB cable plugged into board reference J5.
- (3) Board reference SW2.5 might need to be set to off (0) for the embedded USB-Blaster to program the Stratix III FPGA.
- (4) Requires external USB-Blaster or equivalent plugged into board reference J23 (PCB bottom).
- (5) “1” indicates the PFL is enabled and “0” indicates the PFL is disabled.

## FPGA Programming from Flash Memory

On power-up or after pressing the RESET\_CONFIG or FACTORY\_CONFIG push-button switch, the MAX II CPLD device's parallel flash loader (PFL) megafunction configures the Stratix III FPGA from flash memory.

The PFL megafunction reads 16-bit data from the flash memory and converts it to passive serial format. The data is written to the Stratix III device's dedicated DCLK and D0 configuration pins at 12 MHz.

You can source the FPGA configuration from flash memory from one of eight images. The image is selected by the PGM Config Select rotary switch, board reference SW3. The rotary switch has 16 positions, but only the first eight are used. The positions correspond to an offset in flash memory where the PFL is directed to for FPGA configuration data.



Board reference SW1 position 4 (SW1.4), labeled MAX\_ENABLE, must be in the 0 position (off) to enable the configuring from flash memory feature.

## Flash Programming over USB Interface

You can program the flash memory at any time the board is powered up using the USB 2.0 interface and the Quartus II Programmer's JTAG mode.

The development kit implements the Altera PFL megafunction for flash programming. The PFL is a block of logic that is programmed into an Altera programmable logic device (FPGA or CPLD). The PFL functions as a utility for writing to a compatible flash device. The development kit ships with a pre-built PFL design called **stratixIII\_3sl150\_dev\_pfl**. The PFL design is programmed onto the FPGA whenever the flash is to be written using the Quartus II software.



For more information about:

- The PFL megafunction, refer to *AN 386: Using the Parallel Flash Loader with the Quartus II Software*.
- Basic flash programming instructions for the development board, refer to *Appendix A: Programming the Flash Device* in the *Stratix III Development Kit User Guide*.

## Status Elements

The development board includes general user, board specific, and HSMC user-defined LEDs. This section discusses board-specific LEDs as well as the power display device. For information about general and HSMC user-defined LEDs, refer to "User-Defined LEDs" on page 2-30.

## Board Specific LEDs

There are 18 board-specific, factory-designated LEDs. [Table 2-8](#) lists the LED board references, names, and descriptions.

**Table 2-8. Board-Specific LEDs**

Board Reference	LED Name	Description
D16	Power	Illuminates when board power switch SW4 is on. (Requires 14 V to 20 V input to DC input jack J2)
D32	CONF DONE	Illuminates when FPGA is successfully configured. Driven by Stratix III FPGA.
D33	Loading	Illuminates when MAX II CPLD is actively configuring the FPGA. Driven by the MAX II CPLD.
D34	Error	Illuminates when MAX II CPLD fails to successfully configure the FPGA. Driven by the MAX II CPLD.
D36	Factory	Illuminates when FPGA is configured with the default factory FPGA design. Driven by the MAX II CPLD.
D35	User	Illuminates when FPGA is configured with a design other than the default factory FPGA design. Driven by the MAX II CPLD.
D14	ENET TX	Illuminates when transmit data is active from the Ethernet PHY. Driven by the Marvell 88E1111 PHY.
D15	ENET RX	Illuminates when receive data is active from the Ethernet PHY. Driven by the Marvell 88E1111 PHY.
D6	10 MBytes	Illuminates when Ethernet PHY is using the 10-Mbps connection speed. Driven by the Marvell 88E1111 PHY.
D7	100 MBytes	Illuminates when Ethernet PHY is using the 100-Mbps connection speed. Driven by the Marvell 88E1111 PHY.
D8	1000 MBytes	Illuminates when Ethernet PHY is using the 1000-Mbps connection speed. Driven by the Marvell 88E1111 PHY. Also connects to Stratix III FPGA.
D9	Duplex	Illuminates when Ethernet PHY is both sending and receiving data. Driven by the Marvell 88E1111 PHY.
D17	HSMC Port A present	Illuminates when HSMC Port A has a board or cable attached that grounds pin 160.
D10	HSMC Port B present	Illuminates when HSMC Port B has a board or cable attached that grounds pin 160.
D2	HSMC Port B TX	Illuminates when transmit data is active from the HSMC. Driven by the Stratix III device.
D3	HSMC Port B RX	Illuminates when receive data is active from the HSMC. Driven by the Stratix III device.
D11	HSMC Port A TX	Illuminates when transmit data is active from the HSMC. Driven by the Stratix III device.
D12	HSMC Port A RX	Illuminates when receive data is active from the HSMC. Driven by the Stratix III device.

Table 2-9 lists the board-specific LEDs component reference and manufacturing information.

**Table 2-9. Board-Specific LEDs Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
D2, D3, D6 – D12, D14, D15, D17, D32, D33, D35, D36	Green LED, 1206, SMT, clear lens, 2.1 V	Lumex, Inc.	SML-LX1206GC-TR	<a href="http://www.lumex.com">www.lumex.com</a>
D16	Blue LED, 1206, SMT, clear lens, 3.5 V	Lumex, Inc.	SML-LX1206USBC-TR	<a href="http://www.lumex.com">www.lumex.com</a>
D34	Red LED, 1206, SMT, clear lens, 2.0 V	Lumex, Inc.	SML-LX1206IC-TR	<a href="http://www.lumex.com">www.lumex.com</a>

### Power Display

The power being measured by the MAX II CPLD and associated A/D is displayed on a dedicated 7-segment display connected to the MAX II device called *Power Display*.

## Setup Elements

The development board includes user, JTAG control, and board-specific DIP switches; system reset and configuration push-button switches; and rotary switches. This section discusses the following items:

- JTAG control DIP switch
- MAX II device control DIP switch
- System reset and configuration push-buttons
- Power Select rotary switch
- PGM Config Select rotary switch

### JTAG Control DIP Switch

Board reference SW1 is a four-position JTAG control DIP switch, provided to either remove or include devices in the active JTAG chain. Additionally, the JTAG control DIP switch is also used to disable the embedded USB-Blaster cable when using an external USB-Blaster cable. Table 2-10 lists the switch position, name, and description.

**Table 2-10. JTAG Control DIP Switch Signal Names and Descriptions (Part 1 of 2)**

DIP Switch	Signal Name	Description
1	FPGA_BYPASS	1 = FPGA in JTAG chain 0 = FPGA not in JTAG chain
2	HSMC_BYPASS	1 = HSMC Port A in JTAG chain (only if installed) 0 = HSMC Port A not in JTAG chain

**Table 2-10. JTAG Control DIP Switch Signal Names and Descriptions (Part 2 of 2)**

DIP Switch	Signal Name	Description
3	HSMB_BYPASS	1 = HSMC Port B in JTAG chain (only if installed) 0 = HSMC Port B not in JTAG chain
4	MAX_ENABLE	1 = MAX II device disabled 0 = MAX II device enabled

Because the JTAG chain also contains the two HSMC interface connectors, the SW1 DIP switch allows data to bypass the HSMC interfaces as well as the MAX II CPLD. See “FPGA Programming Over USB” on page 2-17. For information about user-defined DIP switches, refer to “User-Defined DIP Switches” on page 2-29.

Table 2-11 lists the JTAG control switch component reference and manufacturing information.

**Table 2-11. JTAG Control Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number
SW1	Four-position slider DIP switch	C&K Components ITT Industries	TDA04H0SB1

### MAX II Device Control DIP Switch

Board reference SW2 is the MAX II device control DIP switch, which controls various features specific to the Stratix III development board. Table 2-12 lists the switch position, name, and description.

**Table 2-12. MAX II Device Control DIP Switch Position, Name, and Description**

Switch	Name	Description
8	MAX_DIP3	Reserved
7	MAX_DIP2	Reserved
6	MAX_DIP1	Reserved
5	MAX_DIP0	1 = MAX II device PFL enabled, 0 = MAX II device PFL disabled
4	RESERVE1	Reserved
3	RESERVE0	Reserved
2	VOLTS_WATTS	1 = power display shows mW/mA, 0 = power display shows voltage
1	MWATTS_MAMPS	1 = power display shows mA, 0 = power display shows mW

Table 2-13 lists the MAX II device control DIP switch component reference and manufacturing information.

**Table 2-13. MAX II Device Control DIP Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
SW2	8-position rocker DIP switch	Grayhill Corporation	76SB08ST	<a href="http://www.grayhill.com">www.grayhill.com</a>

## System Reset and Configuration Switches

Board reference S7 is the system reset push-button switch, RESET\_CONFIG, which is an input to the MAX II device. This switch forces a reconfiguration of the FPGA from flash memory. The location in flash memory is based on the input from the PGM Config Select rotary switch position for the signals PGM [2:0]. The MAX II device uses the RESET\_CONFIGn pin as its reset along with the CPU\_RESET pin push-button.

Board reference S6 is the CPU reset push-button switch, CPU\_RESET, which is an input to both the Stratix III FPGA and the MAX II CPLD. The CPU\_RESET push-button is intended to be the master reset signal for the FPGA design loaded in the Stratix III device, and connects to a regular I/O pin on the FPGA. The MAX II device uses this push-button as its reset along with the RESET\_CONFIG and FACTORY\_CONFIG push-buttons.

Board reference S1 is the factory push-button, FACTORY\_CONFIG, which is an input to the MAX II device. The FACTORY\_CONFIG pin forces a reconfiguration of the FPGA with the factory default FPGA design, which is located at the base of flash memory. See Table 2-14.

**Table 2-14. Push-Button Switch Signal Name and Function**

Board Reference	Schematic Signal Name	Stratix III Device Pin Number	MAX II Device Pin Number
S1	FACTORY_CONFIG	—	A10
S7	RESET_CONFIGn	—	R16
S6	CPU_RESET	T21	M9

Table 2-15 lists the push-button switch component reference and manufacturing information.

**Table 2-15. Push-Button Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
S1, S6, S7	Push-button switch	Panasonic	EVQAPAC07K	<a href="http://www.panasonic.com">www.panasonic.com</a>

For information about user-defined push-buttons, refer to “User-Defined Push-Button Switches” on page 2-28.

## Power Select Rotary Switch

A 16-position rotary switch, board reference SW6, is used to select the current power rail whose power is being measured and displayed on the power display. The rotary switch is connected to the MAX II CPLD.

Upon first use, after configuring or powering up the board, make sure you initiate changes to the rotary switch (SW6) so that the measurement circuit can initiate a channel reading. Otherwise, the measurement might be reading a previous capture.

Table 2–16 lists the Power Select rotary switch number, name, power pin, and description.

**Table 2–16. Power Select Rotary Switch Number, Name, Pin, and Description**

Number	Schematic Signal Name	Power Pin Name	Description
0	VCCL	VCCL	FPGA core voltage power
1	1.1V_VCC	VCC	FPGA I/O registers power
2	2.5V_A	VCCA, VCCPT	FPGA analog power, programmable power technology
3	2.5V_VCCPD	VCCPD	FPGA I/O pre-driver power
4	2.5V_VCCPGM	VCCPGM	FPGA configuration pins power
5	—	—	—
6	1.8 V_S3	VCCIO 1A, 1C, 3A, 3B, 3C, 4B, 4C, 8A, 8B, 8C	FPGA I/O power banks 1A, 1C, 3A, 3B, 3C, 4B, 4C, 8A, 8B, 8C
7	2.5V_B2	VCCIO 2A, 2C	FPGA I/O power banks 2A, 2C
8	2.5V_B4A_B5_B6	VCCIO 4A, 5A, 5C, 6A, 6C	FPGA I/O power banks 4A, 5A, 5C, 6A, 6C
9	1.5V_1.8V_B7	VCCIO 7A, 7B, 7C	FPGA I/O power banks 7A,7B,7C
10	—	—	—
11	—	—	—
12	—	—	—
13	—	—	—
14	—	—	—
15	—	—	—

Table 2–17 lists Power Select rotary switch component reference and manufacturing information.

**Table 2–17. Power Select Rotary Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
SW6	16-position rotary switch	Grayhill Corporation	94HCB16WT	<a href="http://www.grayhill.com">www.grayhill.com</a>

### PGM Config Select Rotary Switch

A 16-position rotary switch, board reference SW3, is used to set the location in flash memory from which the Stratix III FPGA design is loaded. The rotary switch has 16 positions but only the first eight are used.

For information about the flash memory locations, refer to “Flash Memory” on page 2–63.



Table 2-18 lists PGM Config Select rotary switch component reference and manufacturing information.

**Table 2-18. PGM Config Select Rotary Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
SW3	Rotary switch	Grayhill Corporation	94HCB16WT	<a href="http://www.grayhill.com">www.grayhill.com</a>

## Clocking Circuitry

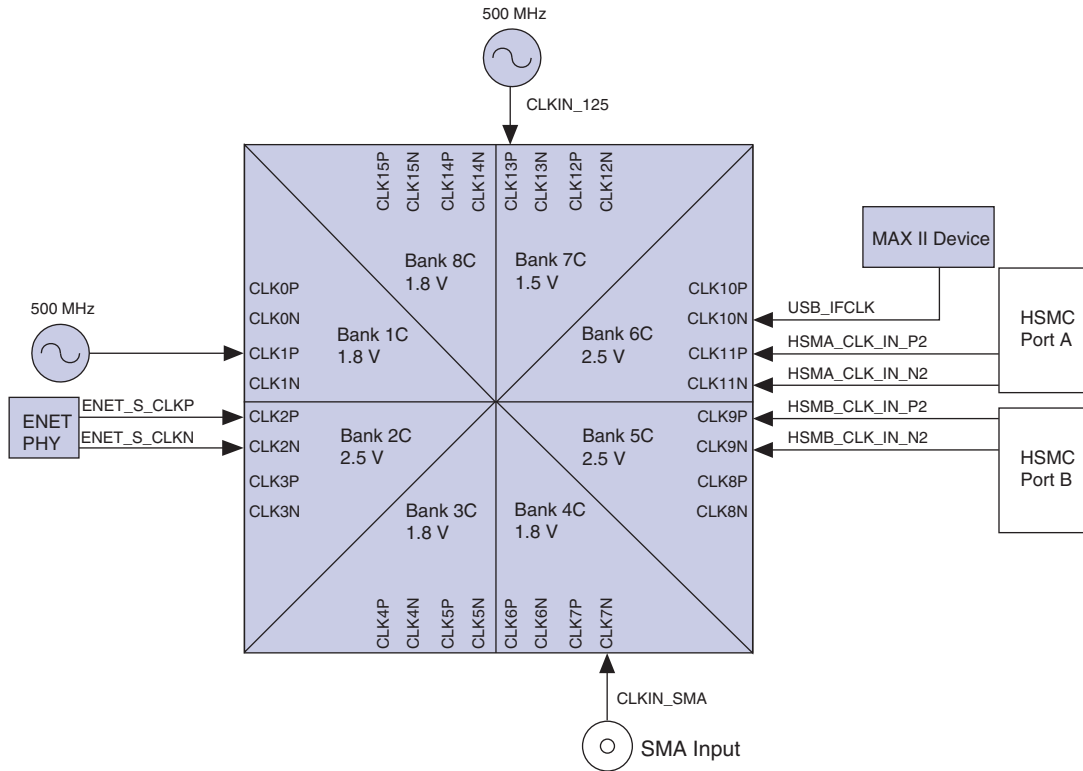
This section describes the Stratix III FPGA clocking inputs and outputs. The clocking block comprises the following items:

- High-speed clock oscillators:
  - 50-MHz, FPGA PLL input
  - 125-MHz FPGA PLL input
  - 125-MHz MAX II CPLD input
  - 24-MHz MAX II CPLD input
- Reference clocks:
  - 6-MHz USB PHY reference clock (FTDI device)
  - 24-MHz USB PHY reference clock (Cypress device)
  - 25-MHz Ethernet PHY reference clock
- SMA connectors for clocking input and output signals

## Stratix III FPGA Clock Inputs

Figure 2-7 outlines the inputs from the Stratix III FPGA. All PLL inputs are located in the C sub-bank of each device bank. The clocks are sourced by the on-board oscillators, SMA connectors, Ethernet, MAX II CPLD, and HSMC ports.

Figure 2-7. Stratix III FPGA Clock Inputs



## Stratix III FPGA Clock Outputs

Figure 2-8 outlines the outputs from the Stratix III FPGA. Most of the output clocks originate from the regular I/O pins (non-PLL pins). These clocks drive each of the interfaces on the Stratix III development board.

Figure 2-8. Stratix III FPGA Clock Outputs

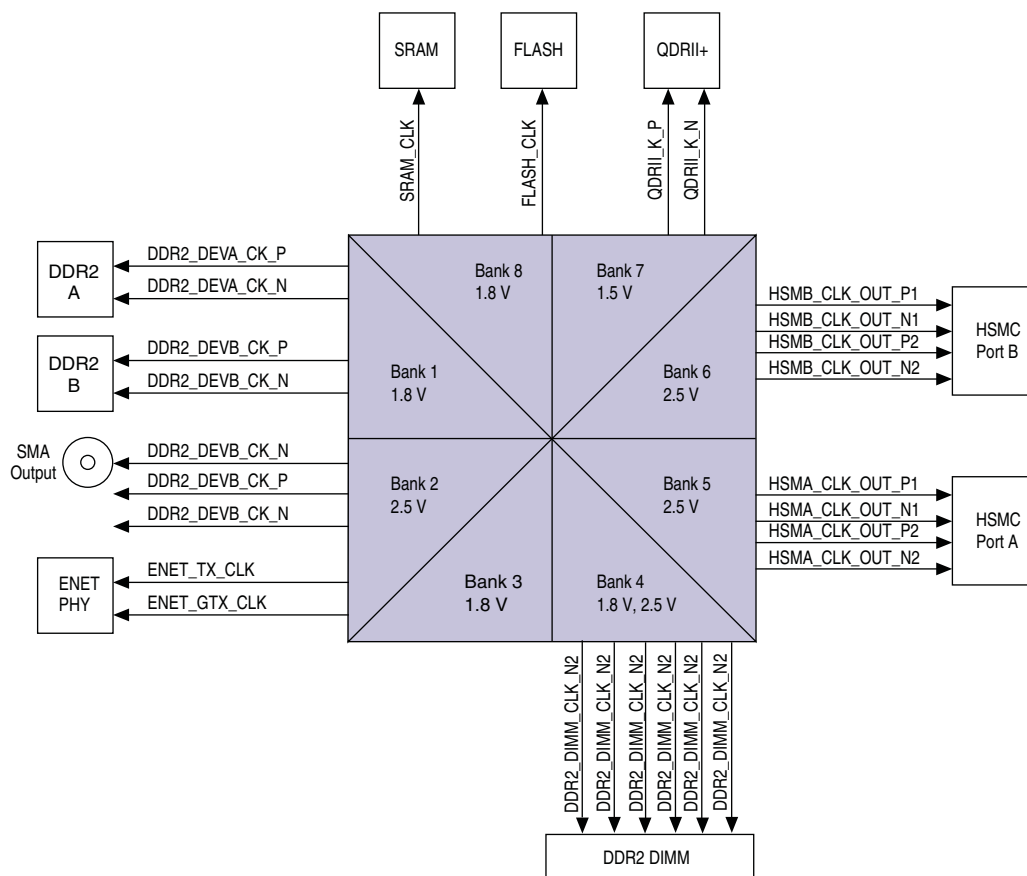


Table 2-19 shows the clocking parts list.

Table 2-19. Stratix III Development Board Clocking Parts List

Board Reference	Description	Manufacturer	Manufacturer Part Number	Manufacturer Website
Y6	50-MHz LVDS oscillator	Pletronics	SM5545TEX-50.00M	<a href="http://www.pletronics.com">www.pletronics.com</a>
Y1,Y5	125-MHz LVDS oscillator	Pletronics	SM5545TEX-125.00M	<a href="http://www.pletronics.com">www.pletronics.com</a>
J16, J17	SMA for external clock input/output	Lighthouse Technologies	LTI-SASF546-P26-X1	<a href="http://www.rfconnector.com">www.rfconnector.com</a>
Y2	24-MHz crystal	Abracon Corporation	ABL-24.000MHZ-12	<a href="http://www.abracon.com">www.abracon.com</a>
Y3	6-MHz crystal	Abracon Corporation	ABL-6.000MHZ-B2	<a href="http://www.abracon.com">www.abracon.com</a>
X1	25-MHz crystal oscillator	ECS, Inc.	ECS-3953C-250-B	<a href="http://www.ecsxtal.com">www.ecsxtal.com</a>
Y4	24-MHz crystal oscillator	Pletronics	SM5545TEX-24.00M	<a href="http://www.pletronics.com">www.pletronics.com</a>

Table 2–20 lists the board’s clock distribution system.

**Table 2–20. Stratix III Development Board Clock Distribution**

Source	Schematic Signal Name	I/O Standard	Signal Originates From	Signal Propagates To
125-MHz (Y5) oscillator	clk <sub>in</sub> _125	Input	Y5	Stratix III device pin B16
50-MHz (Y6) oscillator	clk <sub>in</sub> _50	Input	Y6	Stratix III device pin T33
User input (SMA clock input)	clk <sub>in</sub> _sma	Input	J16	Stratix III device pin AP15
User output (SMA clock output)	clk <sub>out</sub> _sma	Output	J17	From Stratix III device pin AE27
25 MHz (reference clock) This clock can change both speed and direction depending on the Ethernet link speed (10/100/1000)	enet_rx_clk	Input	U25	Stratix III device pin AK28
24-MHz (Y4) oscillator	clk <sub>in</sub> _24	Input	Y4	MAX II device pin J12 (Bank 3)
6-MHz crystal	XTIN/XTOUT	Input	Y3	FTDI USB PHY
24-MHz crystal	XTALIN/XTALOUT	Input	Y2	Cypress USB PHY
125-MHz (Y1) oscillator	clk <sub>in</sub> _max_125	Input	Y1	MAX II device pin H12 (Bank 3)

 For more information about the board’s clocking scheme, refer to the Stratix III development board schematics included with the Stratix III development board kit.

## General User Interfaces

To allow you to fully leverage the I/O capabilities of the Stratix III device for debugging, control, and monitoring purposes, the following general user interfaces are available on the board:

- “User-Defined Push-Button Switches” on page 2–28
- “User-Defined DIP Switches” on page 2–29
- “User-Defined LEDs” on page 2–30
- “7-Segment Displays” on page 2–31
- “LCD Displays” on page 2–33
- “Speaker Header” on page 2–38

### User-Defined Push-Button Switches

The development board includes four general user and one user reset push-button. For information about the system and reset push-button switches, refer to “System Reset and Configuration Switches” on page 2–23.

Board references S2 through S5 are push-button switches allowing user interactions with the Stratix III device. When the switch is pressed and held down, the device pin is set to a logic 0; when the switch is released, the device pin is set to a logic 1. There is no board-specific function for these four push-button switches.

Board reference S6 is the user reset push-button switch, CPU\_RESET, which is an input to both the Stratix III device and MAX II CPLD. The CPU\_RESET is intended to be the master reset signal for the FPGA design loaded into the Stratix III device. Still, the CPU\_RESET is also a regular I/O pin. The MAX II device uses the DEV\_CLR pin as its reset along with the RESET\_CONFIG push-button switch.

Table 2–21 lists the schematic signal names and corresponding Stratix III pin numbers.

**Table 2–21. User Push-Button Switch Signal Names and Functions**

Board Reference	Description	Schematic Signal Name	Stratix III Device Pin Number	Other Connections
S2	User-defined push-button	USER_PB3	K17	—
S3	User-defined push-button	USER_PB2	A16	—
S4	User-defined push-button	USER_PB1	A17	—
S5	User-defined push-button	USER_PB0	B17	—
S6	User-defined push-button	CPU_RESET	AP5	U5 pin M9

**Note to Table 2–21:**

- (1) The pull-up resistors for the push-buttons are connected to 2.5 V. The inputs pads on the FPGA can accept an input voltage up to the maximum input voltage for the device. The logic threshold is determined by the VCCIO of the bank and the selected I/O configuration.

Table 2–22 lists the push-button switch component reference and manufacturing information.

**Table 2–22. Push-Button Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
S2 through S6	Push-button switch	Panasonic	EVQPAC07K	<a href="http://www.panasonic.com">www.panasonic.com</a>

## User-Defined DIP Switches

Board reference SW5 is an 8-pin DIP switch. The switches in SW5 are user-defined, and are provided for additional FPGA input control. Each pin can be set to a logic 1 by pushing it to the open position, and each pin can be set to a logic 0 by pushing it to the closed position. There is no board-specific function for these switches.

Table 2–23 lists the user DIP switch settings, schematic signal name, and corresponding Stratix III device’s pin number.

**Table 2–23. User-Defined DIP Switch Pin-Out (SW5) (Part 1 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number
SW5 pin1	User-defined DIP switch pin 1	USER_DIPSW0	1.8 V	B19
SW5 pin 2	User-defined DIP switch pin 2	USER_DIPSW1	1.8 V	A19
SW5 pin 3	User-defined DIP switch pin 3	USER_DIPSW2	1.8 V	C18
SW5 pin 4	User-defined DIP switch pin 4	USER_DIPSW3	1.8 V	A20
SW5 pin 5	User-defined DIP switch pin 5	USER_DIPSW4	1.8 V	K19
SW5 pin 6	User-defined DIP switch pin 6	USER_DIPSW5	1.8 V	J19

**Table 2-23. User-Defined DIP Switch Pin-Out (SW5) (Part 2 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number
SW5 pin 7	User-defined DIP switch pin 7	USER_DIPSW6	1.8 V	L19
SW5 pin 8	User-defined DIP switch pin 8	USER_DIPSW7	1.8 V	L20

Table 2-24 lists the user-defined DIP switch component reference and manufacturing information.

**Table 2-24. User-Defined DIP Switch Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
SW5	8-position rocker DIP switch	Grayhill Corporation	76SB08ST	<a href="http://www.grayhill.com">www.grayhill.com</a>

## User-Defined LEDs

The board includes general and HSMC user-defined LEDs. This section discusses all user-defined LEDs. For information about board specific or status LEDs, refer to “Status Elements” on page 2-19.

### General User-Defined LEDs

Board references D20 through D27 are eight user LEDs, which allow status and debugging signals to be driven to LEDs from the FPGA designs loaded into the Stratix III device. The LEDs illuminate when a logic 0 is driven, and do not illuminate when a logic 1 is driven. There is no board-specific function for these LEDs.

Table 2-25 lists the general user LED reference number, schematic signal name, and corresponding Stratix III device pin number.

**Table 2-25. LED Reference Number, Schematic Signal Name, and Stratix III Device Pin Number**

LED Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number
D27	User-defined LED	USER_LED0	1.8 V	F21
D26	User-defined LED	USER_LED1	1.8 V	C23
D25	User-defined LED	USER_LED2	1.8 V	B23
D24	User-defined LED	USER_LED3	1.8 V	A23
D23	User-defined LED	USER_LED4	1.8 V	D19
D22	User-defined LED	USER_LED5	1.8 V	C19
D21	User-defined LED	USER_LED6	1.8 V	F19
D20	User-defined LED	USER_LED7	1.8 V	E19

Table 2-26 lists the general user-defined LED component reference and manufacturing information.

**Table 2-26. General User-Defined LED Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
D20-D27	Green LEDs, 1206, SMT, clear lens, 2.1 V	Lumex, Inc.	SML-LX1206GC-TR	<a href="http://www.lumex.com">www.lumex.com</a>

### HSMC User-Defined LEDs

The HSMC cards Port A and Port B have two LEDs located nearby. There are no board-specific functions for the HSMC LEDs; however, the LEDs are labeled *TX* and *RX*, and are intended to display data flow to and from connected HSMC cards. The LEDs are driven by the Stratix III device.

Table 2-27 lists the HSMC user-defined LED board reference number, schematic signal name, and corresponding Stratix III device pin number.

**Table 2-27. HSMC User-Defined LEDs**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number
D11	User-defined LED, but labeled <i>TX</i> in silk-screen for HSMC Port A.	HSMA_TX_LED	1.8 V	AG29
D12	User-defined LED, but labeled <i>RX</i> in silk-screen for HSMC Port A.	HSMA_RX_LED	1.8 V	Y25
D2	User-defined LED, but labeled <i>TX</i> in silk-screen for HSMC Port B.	HSMA_TX_LED	1.8 V	AG34
D3	User-defined LED, but labeled <i>RX</i> in silk-screen for HSMC Port B.	HSMA_RX_LED	1.8 V	AJ12

Table 2-28 lists the HSMC user-defined LED component reference and manufacturing information.

**Table 2-28. HSMC User-Defined LED Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
D2, D3, D11, D12	Green LED, 1206, SMT, clear lens, 2.1 V	Lumex, Inc.	SML-LX1206GC-TR	<a href="http://www.lumex.com">www.lumex.com</a>

## 7-Segment Displays

This section discusses the following two on-board displays:

- User 7-segment display
- Power 7-segment display

## User 7-Segment Display

Board reference U28 is a four-digit, user-defined, 7-segment display that is labeled *User Display*. Each segment's LED driver input signals are multiplexed to each of the four digits and a minus sign. Table 2-29 lists the 7-segment display pin-out.

**Table 2-29. User-Defined 7-Segment Display Pin-Out**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Name
U28 pin 12	User-defined display signal	SEVEN_SEG_A	2.5 V	AE10
U28 pin 11	User-defined display signal	SEVEN_SEG_B	2.5 V	AL5
U28 pin 3	User-defined display signal	SEVEN_SEG_C	2.5 V	AC12
U28 pin 8	User-defined display signal	SEVEN_SEG_D	2.5 V	AM5
U28 pin 9	User-defined display signal	SEVEN_SEG_E	2.5 V	AF11
U28 pin 7	User-defined display signal	SEVEN_SEG_F	2.5 V	AM6
U28 pin 5	User-defined display signal	SEVEN_SEG_G	2.5 V	AP3
U28 pin 2	User-defined display signal	SEVEN_SEG_DP	2.5 V	AK6
U28 pin 13	User-defined display signal	SEVEN_SEG_MINUS	2.5 V	AH11
U28 pin 1	User-defined display select signal	SEVEN_SEG_SEL1	2.5 V	AM4
U28 pin 10	User-defined display select signal	SEVEN_SEG_SEL2	2.5 V	AE12
U28 pin 4	User-defined display select signal	SEVEN_SEG_SEL3	2.5 V	AL4
U28 pin 6	User-defined display select signal	SEVEN_SEG_SEL4	2.5 V	AH8



The four-pin, 7-segment display uses fewer pins than 2-digit, 7-segment displays. See Figure 2-9.

**Figure 2-9. 7-Segment Display**

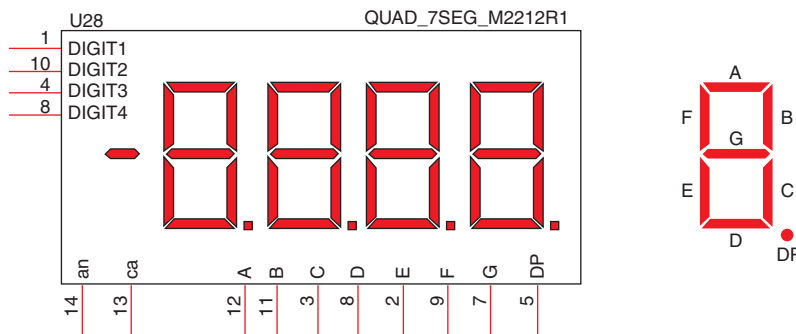


Table 2-30 lists the 7-segment display component reference and manufacturing information.

**Table 2-30. 7-Segment Display Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U28	7-segment, green LED display	Lumex, Inc.	LDQ-M2212R1	<a href="http://www.lumex.com">www.lumex.com</a>



## Power 7-Segment Display

The power measured by the MAX II CPLD and associated A/D is displayed on board reference U27, which is a dedicated 7-segment display connected to the MAX II CPLD, labeled *Power Display*.

Table 2-31 lists the power 7-segment display component reference and manufacturing information.

**Table 2-31. Power 7-Segment Display Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U27	7-segment, green LED display	Lumex, Inc.	LDQ-M2212R1	<a href="http://www.lumex.com">www.lumex.com</a>

## LCD Displays

The development board accommodates two LCD displays:

- Character LCD
- Graphics LCD

The character display is a 16-character, by 2-line LCD display. The graphics is a 128 × 64 pixel transmissive graphics LCD. The two displays have separate buses. This section describes both displays.

### Character LCD

The board contains a single 14-pin 0.1 in. pitch dual-row header, used to interface to a 16-character by 2-line LCD display, manufactured by Lumex (part number LCM-S01602DSR/C). The LCD has a 14-pin receptacle that mounts directly to the board's 14-pin header, so it can be easily removed for access to components under the display—or to use the header for debugging or other purposes.

Table 2-32 summarizes the character LCD interface pins. Signal name and direction are relative to the Stratix III FPGA. For functional descriptions, see Table 2-33.

**Table 2-32. Character LCD (J22) Header I/O**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J22 pin 7	LCD data bus bit 0	LCD_DATA0	2.5 V	AJ8
J22 pin 8	LCD data bus bit 1	LCD_DATA1	2.5 V	AJ6
J22 pin 9	LCD data bus bit 2	LCD_DATA2	2.5 V	AD13
J22 pin 10	LCD data bus bit 3	LCD_DATA3	2.5 V	AJ7
J22 pin 11	LCD data bus bit 4	LCD_DATA4	2.5 V	AF10
J22 pin 12	LCD data bus bit 5	LCD_DATA5	2.5 V	AN6
J22 pin 13	LCD data bus bit 6	LCD_DATA6	2.5 V	AN3
J22 pin 14	LCD data bus bit 7	LCD_DATA7	2.5 V	AK7
J22 pin 4	LCD data/command select	LCD_D_Cn	2.5 V	AP2
J22 pin 5	LCD write enable	LCD_WEn	2.5 V	AL8
J22 pin 6	LCD chip select	LCD_CSn	2.5 V	AD12

Table 2-33 shows pin definitions, and is an excerpt from the Lumex data sheet.

For more information such as timing, character maps, interface guidelines, and related documentation, visit [www.lumex.com](http://www.lumex.com).

**Table 2-33. Character LCD Display Pin Definitions**

Pin Number	Symbol	Level	Function	
1	$V_{DD}$	—	Power supply	
2	$V_{SS}$	—		5 V
3	$V_0$	—		GND (0V)
4	RS	H/L	Register select signal H: Data input L: Instruction input	
5	R/W	H/L	H: Data read (module to MPU) L: Data write (MPU to module)	
6	E	H, H to L	Enable	
7~14	DB0~DB7	H/L	Data bus, software selectable 4- or 8-bit mode	

Figure 2-10 shows a functional block diagram of the Lumex LCD display device.

The particular model used does not have a backlight and the LCD drive pin is not connected.

**Figure 2-10. LCD Display Block Diagram**

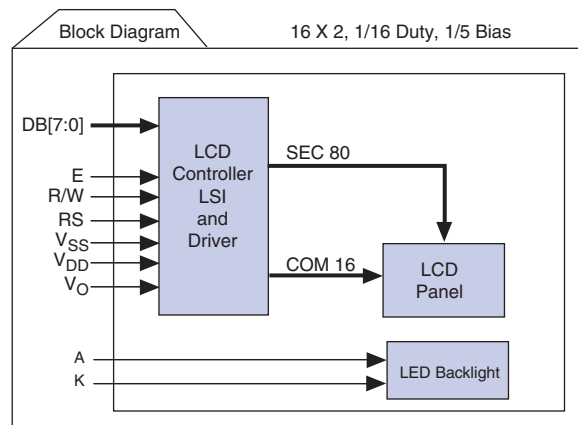


Figure 2-11 shows a mechanical diagram of the LCD display. The 14-pin receptacle mounts underneath the display in the holes to the left.

Figure 2-11. LCD Display Dimensions

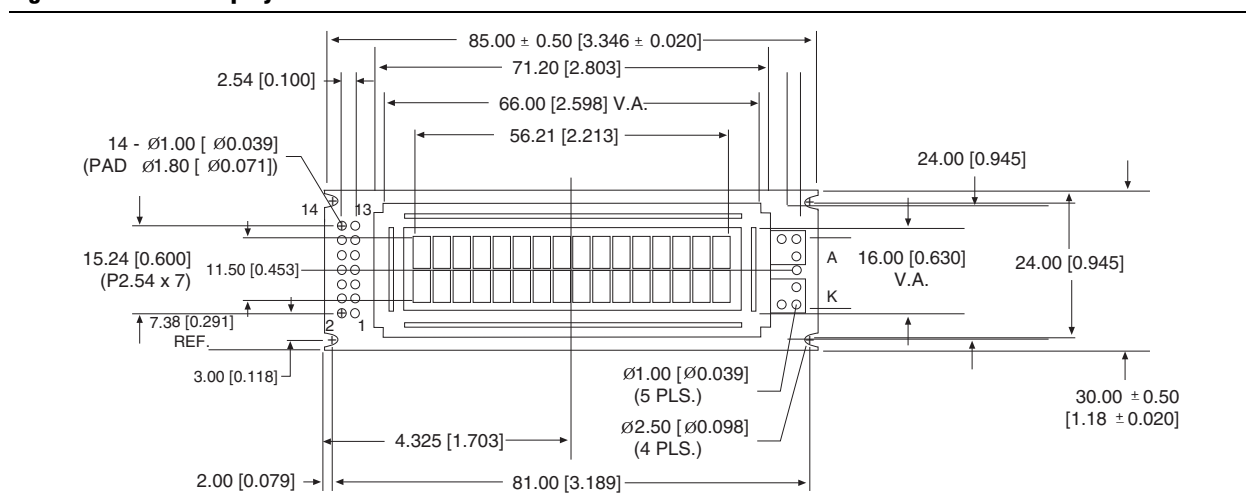


Table 2-34 lists the character LCD display component reference and manufacturing information.

Table 2-34. Character LCD Display Component Reference and Manufacturing Information

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
J22	2 × 7 pin, 100 mil, vertical header	Samtec	TSM-107-01-G-DV	<a href="http://www.samtec.com">www.samtec.com</a>
	2 × 16 character display, 5 × 8 dot matrix	Lumex Inc.	LCM-S01602DSR/C	<a href="http://www.lumex.com">www.lumex.com</a>

## Graphics LCD

The board contains a 30-pin, fine-pitch connector to interface directly to a 128 × 64 dot matrix graphics LCD display via a flex-cable that is soldered to the display itself. The display is an Optrex, part number F-51852GNFQJ-LB-AIN (blue pixels) or F-51852GNFQJ-LB-CAN (green pixels). The pin-out of this interface connector is compatible with a variety of displays.

 For the graphics LCD data sheet and related documentation, visit [www.optrex.com](http://www.optrex.com).

Table 2-35 lists the graphics LCD pin name, description, and type. Signal name and direction are relative to the Stratix III FPGA.

Table 2-35. Graphics LCD Header (J24) (Part 1 of 2)

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J24 pin 6	LCD data bus bit 0	OLED_DATA0	2.5 V	AB31
J24 pin 7	LCD data bus bit 1	OLED_DATA1	2.5 V	AG32
J24 pin 8	LCD data bus bit 2	OLED_DATA2	2.5 V	AB27
J24 pin 9	LCD data bus bit 3	OLED_DATA3	2.5 V	AC32

**Table 2–35. Graphics LCD Header (J24) (Part 2 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J24 pin 10	LCD data bus bit 4	OLED_DATA4	2.5 V	AL32
J24 pin 11	LCD data bus bit 5	OLED_DATA5	2.5 V	AB30
J24 pin 12	LCD data bus bit 6 (or SCLK)	OLED_DATA6	2.5 V	AC26
J24 pin 13	LCD data bus bit 7 (or SDATA)	OLED_DATA7	2.5 V	AA30
J24 pin 28	Parallel interface selection (high = 68 series, low = 80 series)	OLED_BS1	2.5 V	Y26
J24 pin 1	LCD chip select	OLED_CS <sub>n</sub>	2.5 V	AE30
J24 pin 3	LCD data/command select	OLED_D_C <sub>n</sub>	2.5 V	AD26
J24 pin 5	LCD read enable	OLED_E_RD <sub>n</sub>	2.5 V	AG31
J24 pin 2	LCD reset	OLED_RST <sub>n</sub>	2.5 V	AP4
J24 pin 29	LCD parallel/serial data select	OLED_SER <sub>n</sub>	2.5 V	AA27
J24 pin 4	LCD write enable	OLED_WEn	2.5 V	AA31



For more information about the data sheet and related documentation, visit Lumex at [www.lumex.com](http://www.lumex.com).



Board defaults graphics LCD interface to 80 series CPU mode and parallel interface. You can modify these defaults by writing to the appropriate register in the MAX II CPLD using the FSM bus.

Figure 2–12 is an excerpt from the Optrex data sheet showing the control chip in the LCD module and illustrates the functional block diagram of the display driver. The control chip is from New Japan Radio Corporation, part number NJU6676.

For more information, contact Optrex America at [www.optrex.com](http://www.optrex.com) or New Japan Radio at [www.njr.co.jp](http://www.njr.co.jp).

Figure 2-12. Graphics LCD Functional Block Diagram of Display Driver

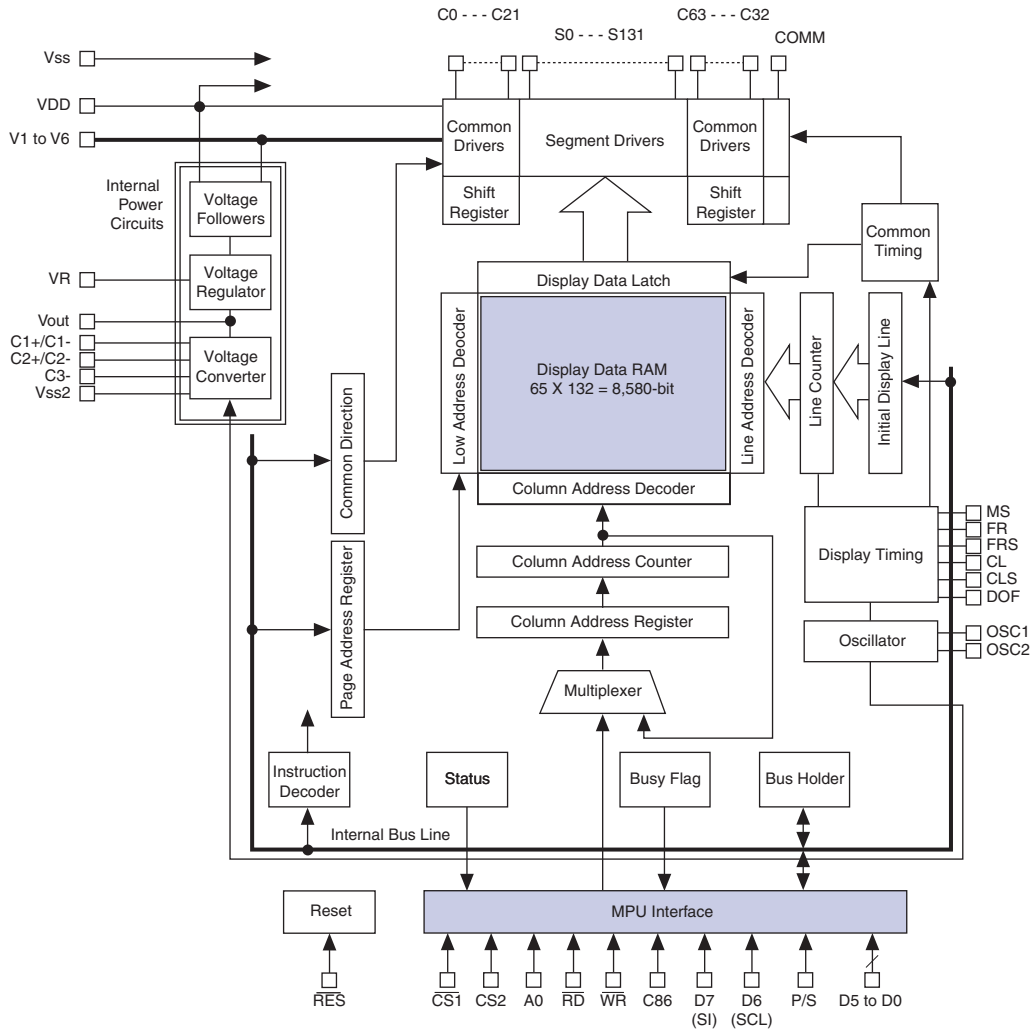
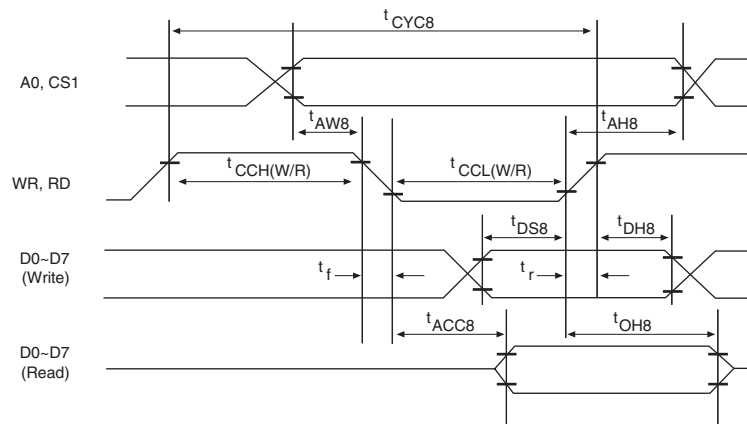


Figure 2-13 is an excerpt from the Optrex data sheet and shows the module interface signals for both read and write transactions.

**Figure 2-13. Graphics LCD Timing Diagram**



For more information about timing parameters, visit [www.optrex.com](http://www.optrex.com).

Table 2-36 lists the graphics LCD display component reference and manufacturing information.

**Table 2-36. Graphics LCD Display Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
J24	FPC/FFC 30-position flick lock connector, bottom contact	Hirose Electronics, Co.	FH12S-30S-0.55H(55)	<a href="http://www.hirose.com">www.hirose.com</a>
	128 × 64 graphics module, blue LCD (1)	Optrex America, Inc.	F-51852GNFQJ-LB-AIN	<a href="http://www.optrex.com">www.optrex.com</a>
	128 × 64 graphics module, green LCD (1)	Optrex America, Inc.	F-51852GNFQJ-LG-ACN	<a href="http://www.optrex.com">www.optrex.com</a>

**Note to Table 2-36:**

(1) The Stratix III development board is shipped with either a blue or green Optrex LCD display.

## Speaker Header

A four-pin 0.1 in. pitch header, board reference J1, is used for a PC speaker connection. The FPGA drives an R/C filter from a 2.5-V CMOS I/O pin allowing tones to be generated by driving different frequencies to the pin. Stratix III device pin AJ11 drives the input of the R/C filter (U1).

Table 2-37 lists speaker header component reference and manufacturing information.

**Table 2-37. Speaker Header Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
J1	Speaker header	Samtec	TSW-104-07-G-S	<a href="http://www.samtec.com">www.samtec.com</a>

## Components and Interfaces

This section describes the board’s communication ports and interface cards relative to the Stratix III device. The board supports the following communication ports:

- “USB 2.0 MAC/PHY” on page 2-39
- “10/100/1000 Ethernet” on page 2-39
- “High-Speed Mezzanine Cards” on page 2-41

### USB 2.0 MAC/PHY

The board incorporates the FTDI USB 2.0 PHY chip. The device interfaces to J5, a Type B USB connector. The maximum speed of the interface is 12 Mbps. Typical application speeds are around 1.5 Mbps; however, actual system speed may vary.

The primary usage for the USB device is to provide JTAG programming of on-board devices such as the FPGA and flash memory. The interface is also the default connection between the FPGA and the host PC applications such as SignalTap® II, DSP Builder, and the Nios® II JTAG universal asynchronous receiver/transmitter (UART).



For more information about the data sheet and related documentation, contact FTDI at [www.ftdichip.com](http://www.ftdichip.com).

Table 2-38 lists the FTDI USB interface component reference and manufacturing information.

**Table 2-38. FTDI Interface Component Reference and Manufacturing Information**

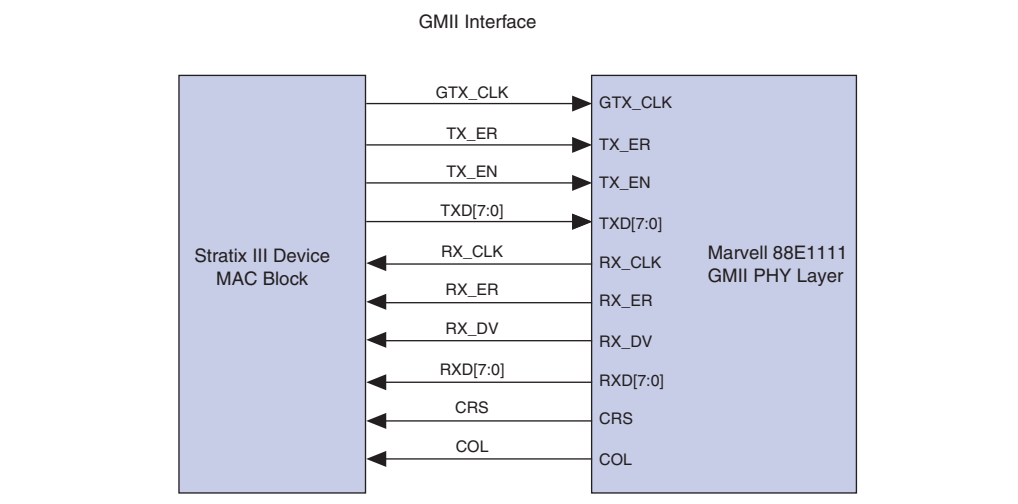
Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U11	FTDI USB device	FTDI Ltd.	FT245BL	<a href="http://www.ftdichip.com">www.ftdichip.com</a>

### 10/100/1000 Ethernet

A Marvell 88E1111 device is used for 10/100/1000 base-T Ethernet connection. The device is an auto-negotiating Ethernet PHY with a GMII, RGMII, or SGMII interface to the FPGA. Stratix III devices can communicate with LVDS interfaces at up to 1.25 Gbps, which is well above the 1.0 Gbps SGMII requirement. The MAC function must be provided in the FPGA for typical networking applications. The Marvell PHY uses 2.5-V and 1.1-V power rails and requires a 25-MHz reference clock driven from a dedicated oscillator. It interfaces to a HALO HFJ11-1G02E model RJ-45 with internal magnetics that can be used for driving copper lines with Ethernet traffic.

Figure 2-14 and Figure 2-15 show the GMII and the SGMII interfaces between the FPGA (MAC) and Marvell PHY 88E1111 device.

**Figure 2-14. Marvell 88E1111 GMII Interface**



**Figure 2-15. Marvell 88E1111 SGMII Interface**

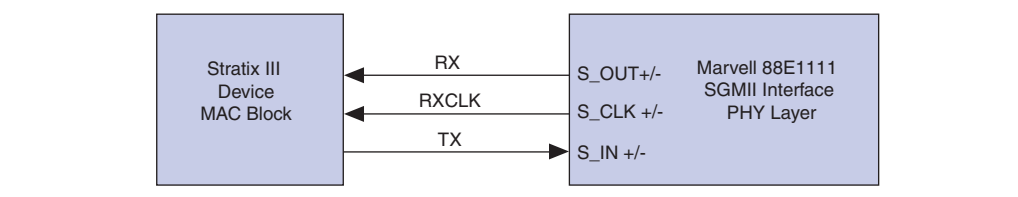


Table 2-39 lists the pins of the Gigabit Ethernet interface.

**Table 2-39. Ethernet PHY (U25) Pin-Out (Part 1 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U25 pin 8	RGMII interface transmit clock	ENET_GTX_CLK	2.5 V	AB33
U25 pin 23	Management bus interrupt	ENET_INTn	2.5 V	AB32
U25 pin 73	1000 MBytes link established	ENET_LED_LINK1000	2.5 V	A28
U25 pin 25	Management bus data clock	ENET_MDC	2.5 V	Y2
U25 pin 24	Management bus data	ENET_MDIO	2.5 V	AD30
U25 pin 28	Reset	ENET_RESETN	2.5 V	Y31
U25 pin 2	RGMII interface receive clock	ENET_RX_CLK	1.8 V	AK28
U25 pin 83	GMII interface collision	ENET_RX_COL	2.5 V	V33
U25 pin 84	GMII interface carrier sense	ENET_RX_CRIS	2.5 V	V3
U25 pin 95	GMII/ RGMII interface receive data bus bit 0	ENET_RX_D0	2.5 V	AE29
U25 pin 92	GMII/ RGMII interface receive data bus bit 1	ENET_RX_D1	2.5 V	AM34
U25 pin 93	GMII/ RGMII interface receive data bus bit 2	ENET_RX_D2	2.5 V	AL33
U25 pin 91	GMII/ RGMII interface receive data bus bit 3	ENET_RX_D3	2.5 V	AJ32



**Table 2–39. Ethernet PHY (U25) Pin-Out (Part 2 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U25 pin 90	GMII interface receive data bus bit 4	ENET_RX_D4	2.5 V	AH34
U25 pin 89	GMII interface receive data bus bit 5	ENET_RX_D5	2.5 V	AF29
U25 pin 87	GMII interface receive data bus bit 6	ENET_RX_D6	2.5 V	AH33
U25 pin 86	GMII interface receive data bus bit 7	ENET_RX_D7	2.5 V	V34
U25 pin 94	RGMII interface receive control	ENET_RX_DV	2.5 V	W5
U25 pin 3	GMII interface receive error	ENET_RX_ER	2.5 V	AJ10
U25 pin 75	SGMII interface receive data	ENET_RX_N	LVDS	Y34
U25 pin 77	SGMII interface receive data	ENET_RX_P	LVDS	AA33
U25 pin 80	SGMII interface (625 MHz) clock	ENET_S_CLKN	LVDS	W34
U25 pin 79	SGMII interface (625 MHz) clock	ENET_S_CLKP	LVDS	W33
U25 pin 4	MII interface (25 MHz) clock	ENET_TX_CLK	2.5 V	AB34
U25 pin 11	RGMII interface transmit data bus bit 0	ENET_TX_D[0]	2.5 V	AF28
U25 pin 12	RGMII interface transmit data bus bit 1	ENET_TX_D[1]	2.5 V	AD34
U25 pin 14	RGMII interface transmit data bus bit 2	ENET_TX_D[2]	2.5 V	AL34
U25 pin 16	RGMII interface transmit data bus bit 3	ENET_TX_D[3]	2.5 V	W30
U25 pin 17	RGMII interface transmit data bus bit 4	ENET_TX_D[4]	2.5 V	AD33
U25 pin 18	RGMII interface transmit data bus bit 5	ENET_TX_D[5]	2.5 V	AJ34
U25 pin 19	RGMII interface transmit data bus bit 6	ENET_TX_D[6]	2.5 V	AJ31
U25 pin 20	RGMII interface transmit data bus bit 7	ENET_TX_D[7]	2.5 V	AG30
U25 pin 9	RGMII interface transmit control	ENET_TX_EN	2.5 V	AA34
U25 pin 7	RGMII interface transmit error	ENET_TX_ER	2.5 V	AA29
U25 pin 81	SGMII interface transmit data	ENET_TX_N	LVDS	V29
U25 pin 82	SGMII interface transmit data	ENET_TX_P	LVDS	W28

Table 2–40 lists the Ethernet PHY component reference and manufacturing information.


**Table 2–40. Ethernet PHY Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U25	Ethernet PHY base-T device	Marvel Semiconductor	88E1111-B2-CAAIC000	<a href="http://www.marvell.com">www.marvell.com</a>

## High-Speed Mezzanine Cards

The board contains two HSMC interfaces called Port A and Port B. These HSMC interfaces support both single-ended and differential signaling. The connector part number is Samtec ASP-122953-01. The HSMC interface also allows for JTAG, SMBus, clock outputs and inputs, as well as power for compatible HSMCs.

The HSMC is an Altera-developed specification, which allows users to expand the functionality of the development board through the addition of daughter cards (HSMCs).

 For more information about the HSMC specification such as signaling standards, signal integrity, compatible connectors, and mechanical information, visit [www.altera.com](http://www.altera.com).


The HSMC connector has 172 total pins, including 120 signal pins, 39 power pins, and 13 ground pins. The ground pins are located between the two rows of signal and power pins, acting as both shield and reference. The HSMC host connector is based on the 0.5 mm-pitch QSH/QTH family of high-speed, board-to-board connectors from Samtec. There are three banks in this connector. Bank 1 has every third pin removed as it is done in the QSH-DP/QTH-DP series. Banks 2 and 3 have all of the pins populated as it is done in the QSH/QTH series.

The Stratix III development board does not use bank 1 transceiver signals intended for clock-data-recover (CDR) applications such as PCI Express and Rapid I/O<sup>®</sup>. These 32 pins are left floating. Banks 2 and 3 are fully supported and can be used in two different configurations, as shown in [Figure 2-16](#).

**Figure 2-16. HSMC Signal and Bank Diagram**

Bank 3 Power D(79:40) -or- LVDS CLKIN2, CLKOUT2
Bank 2 Power D(39:0) -or- D[3:0] + LVDS CLKIN1, CLKOUT1
Bank 1 8 TX Channels CDR 8 RX Channels CDR JTAG SMBus CLKIN0, CLKOUT0

The HSMC interface has programmable bi-directional I/O pins that can be used as 2.5-V LVCMOS, which is 3.3-V LVTTTL-compatible. These pins can also be used as various differential I/O standards including, but not limited to LVDS, mini-LVDS, and RSDS with up to 17-channels full-duplex.

 As noted in the HSMC specification, LVDS and single-ended I/O standards are only guaranteed to function when mixed according to either the generic single-ended pin-out or the generic differential pin-out.

For the Stratix III FPGA Development Kit, there is only one clock per HSMC interface that can drive a PLL. If you want to drive a PLL from the HSMC interface make sure you use either `HSMA_CLK_P2` for Port A or `HSMB_CLK_P2` for Port B.

*Section 2.2.4 of the HSMC Specification* recommends that a dedicated clock input be used for the single-ended clock (CMOS CLK) on pin 40 of the HSMC connector. The Stratix III board uses a regular input pin due to lack of input clock resources. This means that clocks driven from the HSMC cannot be routed to a PLL. This limitation is true for both HSMC Port A and HSMC Port B.

Section 2.2.5 of the *HSMC Specification* recommends that dedicated clock inputs are used for the differential LVDS clocks (LVDS CLK/CMOS) on pin pairs (96, 98) and (156, 158) of the HSMC connector. The specification makes CLKIN2p/n the priority as such the Stratix III board has a standard LVDS input pair due to lack of input clock resources. This means that the clock driven into CLKIN1p/n from the HSMC cannot be routed to a PLL. This limitation is true for both HSMC Port A and HSMC Port B.

If you must use another clock, you can drive the clock to the SMA output of the board, then attach a cable from the SMA output to the SMA input. In this case, assign the Stratix III pin that corresponds to the SMA input as your clock.

Table 2-41 lists the HSMC Port A interface signal name, description, and signal type.

**Table 2-41. HSMC Port A Interface Signal Name, Description, and Type (Part 1 of 3)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J18 pin 33	Management serial data	HSMA_SDA	2.5 V	P8
J18 pin 34	Management serial clock	HSMA_SCL	2.5 V	AA32
J18 pin 35	JTAG clock signal	FPGA_JTAG_TCK	2.5 V	F30
J18 pin 36	JTAG mode select signal	FPGA_JTAG_TMS	2.5 V	N/A
J18 pin 37	JTAG data output	HSMA_JTAG_TDO	2.5 V	N/A
J18 pin 38	JTAG data input	HSMA_JTAG_TDI	2.5 V	N/A
J18 pin 39	Dedicated CMOS clock out	HSMA_CLK_OUT0	2.5 V	AD28
J18 pin 40	Dedicated CMOS clock in	HSMA_CLK_IN0	2.5 V	W10
J18 pin 41	Dedicated CMOS I/O bit 0	HSMA_D0	2.5 V	AK9
J18 pin 42	Dedicated CMOS I/O bit 1	HSMA_D1	2.5 V	AJ9
J18 pin 43	Dedicated CMOS I/O bit 2	HSMA_D2	2.5 V	AL7
J18 pin 44	Dedicated CMOS I/O bit 3	HSMA_D3	2.5 V	AL9
J18 pin 47	LVDS TX or CMOS I/O bit 0	HSMA_TX_P0	LVDS or 2.5 V	AC11
J18 pin 48	LVDS RX or CMOS I/O bit 0	HSMA_RX_P0	LVDS or 2.5 V	AJ4
J18 pin 49	LVDS TX or CMOS I/O bit 0	HSMA_TX_N0	LVDS or 2.5 V	AB10
J18 pin 50	LVDS RX or CMOS I/O bit 0	HSMA_RX_N0	LVDS or 2.5 V	AJ3
J18 pin 53	LVDS TX or CMOS I/O bit 1	HSMA_TX_P1	LVDS or 2.5 V	AC9
J18 pin 54	LVDS RX or CMOS I/O bit 1	HSMA_RX_P1	LVDS or 2.5 V	AG4
J18 pin 55	LVDS TX or CMOS I/O bit 1	HSMA_TX_N1	LVDS or 2.5 V	AC8
J18 pin 56	LVDS RX or CMOS I/O bit 1	HSMA_RX_N1	LVDS or 2.5 V	AG3
J18 pin 59	LVDS TX or CMOS I/O bit 2	HSMA_TX_P2	LVDS or 2.5 V	AH5
J18 pin 60	LVDS RX or CMOS I/O bit 2	HSMA_RX_P2	LVDS or 2.5 V	AM2
J18 pin 61	LVDS TX or CMOS I/O bit 2	HSMA_TX_N2	LVDS or 2.5 V	AH4
J18 pin 62	LVDS RX or CMOS I/O bit 2	HSMA_RX_N2	LVDS or 2.5 V	AM1
J18 pin 65	LVDS TX or CMOS I/O bit 3	HSMA_TX_P3	LVDS or 2.5 V	AE8
J18 pin 66	LVDS RX or CMOS I/O bit 3	HSMA_RX_P3	LVDS or 2.5 V	AL2
J18 pin 67	LVDS TX or CMOS I/O bit 3	HSMA_TX_N3	LVDS or 2.5 V	AE7
J18 pin 68	LVDS RX or CMOS I/O bit 3	HSMA_RX_N3	LVDS or 2.5 V	AL1
J18 pin 71	LVDS TX or CMOS I/O bit 4	HSMA_TX_P4	LVDS or 2.5 V	AF6

**Table 2-41. HSMC Port A Interface Signal Name, Description, and Type (Part 2 of 3)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J18 pin 72	LVDS RX or CMOS I/O bit 4	HSMA_RX_P4	LVDS or 2.V5	AJ2
J18 pin 73	LVDS TX or CMOS I/O bit 4	HSMA_TX_N4	LVDS or 2.5 V	AF5
J18 pin 74	LVDS RX or CMOS I/O bit 4	HSMA_RX_N4	LVDS or 2.5 V	AK1
J18 pin 77	LVDS TX or CMOS I/O bit 5	HSMA_TX_P5	LVDS or 2.5 V	AD7
J18 pin 78	LVDS RX or CMOS I/O bit 5	HSMA_RX_P5	LVDS or 2.5 V	AH2
J18 pin 79	LVDS TX or CMOS I/O bit 5	HSMA_TX_N5	LVDS or 2.5 V	AD6
J18 pin 80	LVDS RX or CMOS I/O bit 5	HSMA_RX_N5	LVDS or 2.5 V	AJ1
J18 pin 83	LVDS TX or CMOS I/O bit 6	HSMA_TX_P6	LVDS or 2.5 V	AE6
J18 pin 84	LVDS RX or CMOS I/O bit 6	HSMA_RX_P6	LVDS or 2.5 V	AF4
J18 pin 85	LVDS TX or CMOS I/O bit 6	HSMA_TX_N6	LVDS or 2.5 V	AE5
J18 pin 86	LVDS RX or CMOS I/O bit 6	HSMA_RX_N6	LVDS or 2.5 V	AF3
J18 pin 89	LVDS TX or CMOS I/O bit 7	HSMA_TX_P7	LVDS or 2.5 V	AD4
J18 pin 90	LVDS RX or CMOS I/O bit 7	HSMA_RX_P7	LVDS or 2.5 V	AG1
J18 pin 91	LVDS TX or CMOS I/O bit 7	HSMA_TX_N7	LVDS or 2.5 V	AD3
J18 pin 92	LVDS RX or CMOS I/O bit 7	HSMA_RX_N7	LVDS or 2.5 V	AH1
J18 pin 95	LVDS or CMOS clock out	HSMA_CLK_OUT_P1	LVDS or 2.5 V	V10
J18 pin 96	LVDS or CMOS clock in	HSMA_CLK_IN_P1	LVDS or 2.5 V	Y4
J18 pin 97	LVDS or CMOS clock out	HSMA_CLK_OUT_N1	LVDS or 2.5 V	W9
J18 pin 98	LVDS or CMOS clock in	HSMA_CLK_IN_N1	LVDS or 2.5 V	W3
J18 pin 101	LVDS TX or CMOS I/O bit 8	HSMA_TX_P8	LVDS or 2.5 V	AC6
J18 pin 102	LVDS RX or CMOS I/O bit 8	HSMA_RX_P8	LVDS or 2.5 V	AF2
J18 pin 103	LVDS TX or CMOS I/O bit 8	HSMA_TX_N8	LVDS or 2.5 V	AC5
J18 pin 104	LVDS RX or CMOS I/O bit 8	HSMA_RX_N8	LVDS or 2.5 V	AF1
J18 pin 107	LVDS TX or CMOS I/O bit 9	HSMA_TX_P9	LVDS or 2.5 V	AB6
J18 pin 108	LVDS RX or CMOS I/O bit 9	HSMA_RX_P9	LVDS or 2.5 V	AE2
J18 pin 109	LVDS TX or CMOS I/O bit 9	HSMA_TX_N9	LVDS or 2.5 V	AB5
J18 pin 110	LVDS RX or CMOS I/O bit 9	HSMA_RX_N9	LVDS or 2.5 V	AE1
J18 pin 113	LVDS TX or CMOS I/O bit 10	HSMA_TX_P10	LVDS or 2.5 V	AB8
J18 pin 114	LVDS RX or CMOS I/O bit 10	HSMA_RX_P10	LVDS or 2.5 V	AE4
J18 pin 115	LVDS TX or CMOS I/O bit 10	HSMA_TX_N10	LVDS or 2.5 V	AC7
J18 pin 116	LVDS RX or CMOS I/O bit 10	HSMA_RX_N10	LVDS or 2.5 V	AE3
J18 pin 119	LVDS TX or CMOS I/O bit 11	HSMA_TX_P11	LVDS or 2.5 V	Y6
J18 pin 120	LVDS RX or CMOS I/O bit 11	HSMA_RX_P11	LVDS or 2.5 V	AC2
J18 pin 121	LVDS TX or CMOS I/O bit 11	HSMA_TX_N11	LVDS or 2.5 V	Y5
J18 pin 122	LVDS RX or CMOS I/O bit 11	HSMA_RX_N11	LVDS or 2.5 V	AD1
J18 pin 125	LVDS TX or CMOS I/O bit 12	HSMA_TX_P12	LVDS or 2.5 V	AA7
J18 pin 126	LVDS RX or CMOS I/O bit 12	HSMA_RX_P12	LVDS or 2.5 V	AB2
J18 pin 127	LVDS TX or CMOS I/O bit 12	HSMA_TX_N12	LVDS or 2.5 V	AA6
J18 pin 128	LVDS RX or CMOS I/O bit 12	HSMA_RX_N12	LVDS or 2.5 V	AC1

**Table 2-41. HSMC Port A Interface Signal Name, Description, and Type (Part 3 of 3)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J18 pin 131	LVDS TX or CMOS I/O bit 13	HSMA_TX_P13	LVDS or 2.5 V	Y8
J18 pin 132	LVDS RX or CMOS I/O bit 13	HSMA_RX_P13	LVDS or 2.5 V	AA1
J18 pin 133	LVDS TX or CMOS I/O bit 13	HSMA_TX_N13	LVDS or 2.5 V	Y7
J18 pin 134	LVDS RX or CMOS I/O bit 13	HSMA_RX_N13	LVDS or 2.5 V	AB1
J18 pin 137	LVDS TX or CMOS I/O bit 14	HSMA_TX_P14	LVDS or 2.5 V	Y10
J18 pin 138	LVDS RX or CMOS I/O bit 14	HSMA_RX_P14	LVDS or 2.5 V	AC4
J18 pin 139	LVDS TX or CMOS I/O bit 14	HSMA_TX_N14	LVDS or 2.5 V	Y9
J18 pin 140	LVDS RX or CMOS I/O bit 14	HSMA_RX_N14	LVDS or 2.5 V	AB3
J18 pin 143	LVDS TX or CMOS I/O bit 15	HSMA_TX_P15	LVDS or 2.5 V	W12
J18 pin 144	LVDS RX or CMOS I/O bit 15	HSMA_RX_P15	LVDS or 2.5 V	AB4
J18 pin 145	LVDS TX or CMOS I/O bit 15	HSMA_TX_N15	LVDS or 2.5 V	Y11
J18 pin 146	LVDS RX or CMOS I/O bit 15	HSMA_RX_N15	LVDS or 2.5 V	AA3
J18 pin 149	LVDS TX or CMOS I/O bit 16	HSMA_TX_P16	LVDS or 2.5 V	AA12
J18 pin 150	LVDS RX or CMOS I/O bit 16	HSMA_RX_P16	LVDS or 2.5 V	AA4
J18 pin 151	LVDS TX or CMOS I/O bit 16	HSMA_TX_N16	LVDS or 2.5 V	AB11
J18 pin 152	LVDS RX or CMOS I/O bit 16	HSMA_RX_N16	LVDS or 2.5 V	Y3
J18 pin 155	LVDS or CMOS clock out	HSMA_CLK_OUT_P2	LVDS	W8
J18 pin 156	LVDS or CMOS clock in	HSMA_CLK_IN_P2	LVDS	T2
J18 pin 157	LVDS or CMOS clock out	HSMA_CLK_OUT_N2	2.5 V	W7
J18 pin 158	LVDS or CMOS clock in	HSMA_CLK_IN_N2	2.5 V	T1
N/A	User LED intended to show RX data activity on the HSMC interface	HSMA_RX_LED	2.5 V	Y25
N/A	User LED intended to show TX data activity on the HSMC interface	HSMA_TX_LED	2.5 V	AG29

Table 2-42 lists the HSMC Port B interface signal name, description, and signal type.

**Table 2-42. HSMC Port B Interface Signal Name, Description, and Type (Part 1 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J8 pin 33	Serial data	HSMB_SDA	2.5 V	U11
J8 pin 34	Serial clock	HSMB_SCL	2.5 V	AD31
J8 pin 35	JTAG clock signal	FPGA_JTAG_TCK	2.5 V	F30
J8 pin 36	JTAG mode select signal	FPGA_JTAG_TMS	2.5 V	N/A
J8 pin 37	JTAG data output	HSMB_JTAG_TDO	2.5 V	G28
J8 pin 38	JTAG data input	HSMB_JTAG_TDI	2.5 V	N/A
J8 pin 39	Dedicated CMOS clock out	HSMB_CLK_OUT0	2.5 V	AC34
J8 pin 40	Dedicated CMOS clock in	HSMB_CLK_IN0	2.5 V	V4
J8 pin 41	Dedicated CMOS I/O bit 0	HSMB_D0	2.5 V	AB24
J8 pin 42	Dedicated CMOS I/O bit 1	HSMB_D1	2.5 V	AB25

**Table 2-42. HSMC Port B Interface Signal Name, Description, and Type (Part 2 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J8 pin 43	Dedicated CMOS I/O bit 2	HSMB_D2	2.5 V	AF32
J8 pin 44	Dedicated CMOS I/O bit 3	HSMB_D3	2.5 V	AF31
J8 pin 47	LVDS TX or CMOS I/O bit 0	HSMB_TX_P0	LVDS or 2.5 V	P11
J8 pin 48	LVDS RX or CMOS I/O bit 0	HSMB_RX_P0	LVDS or 2.5 V	R4
J8 pin 49	LVDS TX or CMOS I/O bit 0	HSMB_TX_N0	LVDS or 2.5 V	P10
J8 pin 50	LVDS RX or CMOS I/O bit 0	HSMB_RX_N0	LVDS or 2.5 V	R3
J8 pin 53	LVDS TX or CMOS I/O bit 1	HSMB_TX_P1	LVDS or 2.5 V	T9
J8 pin 54	LVDS RX or CMOS I/O bit 1	HSMB_RX_P1	LVDS or 2.5 V	P4
J8 pin 55	LVDS TX or CMOS I/O bit 1	HSMB_TX_N1	LVDS or 2.5 V	T8
J8 pin 56	LVDS RX or CMOS I/O bit 1	HSMB_RX_N1	LVDS or 2.5 V	P3
J8 pin 59	LVDS TX or CMOS I/O bit 2	HSMB_TX_P2	LVDS or 2.5 V	T7
J8 pin 60	LVDS RX or CMOS I/O bit 2	HSMB_RX_P2	LVDS or 2.5 V	P2
J8 pin 61	LVDS TX or CMOS I/O bit 2	HSMB_TX_N2	LVDS or 2.5 V	U6
J8 pin 62	LVDS RX or CMOS I/O bit 2	HSMB_RX_N2	LVDS or 2.5 V	R1
J8 pin 65	LVDS TX or CMOS I/O bit 3	HSMB_TX_P3	LVDS or 2.5 V	T5
J8 pin 66	LVDS RX or CMOS I/O bit 3	HSMB_RX_P3	LVDS or 2.5 V	N2
J8 pin 67	LVDS TX or CMOS I/O bit 3	HSMB_TX_N3	LVDS or 2.5 V	T4
J8 pin 68	LVDS RX or CMOS I/O bit 3	HSMB_RX_N3	LVDS or 2.5 V	P1
J8 pin 71	LVDS TX or CMOS I/O bit 4	HSMB_TX_P4	LVDS or 2.5 V	R10
J8 pin 72	LVDS RX or CMOS I/O bit 4	HSMB_RX_P4	LVDS or 2.5 V	M1
J8 pin 73	LVDS TX or CMOS I/O bit 4	HSMB_TX_N4	LVDS or 2.5 V	R9
J8 pin 74	LVDS RX or CMOS I/O bit 4	HSMB_RX_N4	LVDS or 2.5 V	N1
J8 pin 77	LVDS TX or CMOS I/O bit 5	HSMB_TX_P5	LVDS or 2.5 V	R7
J8 pin 78	LVDS RX or CMOS I/O bit 5	HSMB_RX_P5	LVDS or 2.5 V	L2
J8 pin 79	LVDS TX or CMOS I/O bit 5	HSMB_TX_N5	LVDS or 2.5 V	R6
J8 pin 80	LVDS RX or CMOS I/O bit 5	HSMB_RX_N5	LVDS or 2.5 V	L1
J8 pin 83	LVDS TX or CMOS I/O bit 6	HSMB_TX_P6	LVDS or 2.5 V	N9
J8 pin 84	LVDS RX or CMOS I/O bit 6	HSMB_RX_P6	LVDS or 2.5 V	K4
J8 pin 85	LVDS TX or CMOS I/O bit 6	HSMB_TX_N6	LVDS or 2.5 V	N8
J8 pin 86	LVDS RX or CMOS I/O bit 6	HSMB_RX_N6	LVDS or 2.5 V	K3
J8 pin 89	LVDS TX or CMOS I/O bit 7	HSMB_TX_P7	LVDS or 2.5 V	M7
J8 pin 90	LVDS RX or CMOS I/O bit 7	HSMB_RX_P7	LVDS or 2.5 V	J4
J8 pin 91	LVDS TX or CMOS I/O bit 7	HSMB_TX_N7	LVDS or 2.5 V	M6
J8 pin 92	LVDS RX or CMOS I/O bit 7	HSMB_RX_N7	LVDS or 2.5 V	J3
J8 pin 95	LVDS or CMOS clock out	HSMB_CLK_OUT_P1	LVDS or 2.5 V	P6
J8 pin 96	LVDS or CMOS clock in	HSMB_CLK_IN_P1	LVDS or 2.5 V	N4
J8 pin 97	LVDS or CMOS clock out	HSMB_CLK_OUT_N1	LVDS or 2.5 V	P5
J8 pin 98	LVDS or CMOS clock in	HSMB_CLK_IN_N1	LVDS or 2.5 V	N3
J8 pin 101	LVDS TX or CMOS I/O bit 8	HSMB_TX_P8	LVDS or 2.5 V	L7

**Table 2-42. HSMC Port B Interface Signal Name, Description, and Type (Part 3 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J8 pin 102	LVDS RX or CMOS I/O bit 8	HSMB_RX_P8	LVDS or 2.5 V	H2
J8 pin 103	LVDS TX or CMOS I/O bit 8	HSMB_TX_N8	LVDS or 2.5 V	L6
J8 pin 104	LVDS RX or CMOS I/O bit 8	HSMB_RX_N8	LVDS or 2.5 V	J1
J8 pin 107	LVDS TX or CMOS I/O bit 9	HSMB_TX_P9	LVDS or 2.5 V	L5
J8 pin 108	LVDS TX or CMOS I/O bit 9	HSMB_RX_P9	LVDS or 2.5 V	G2
J8 pin 109	LVDS RX or CMOS I/O bit 9	HSMB_TX_N9	LVDS or 2.5 V	L4
J8 pin 110	LVDS RX or CMOS I/O bit 9	HSMB_RX_N9	LVDS or 2.5 V	H1
J8 pin 113	LVDS TX or CMOS I/O bit 10	HSMB_TX_P10	LVDS or 2.5 V	K6
J8 pin 114	LVDS RX or CMOS I/O bit 10	HSMB_RX_P10	LVDS or 2.5 V	F1
J8 pin 115	LVDS TX or CMOS I/O bit 10	HSMB_TX_N10	LVDS or 2.5 V	K5
J8 pin 116	LVDS RX or CMOS I/O bit 10	HSMB_RX_N10	LVDS or 2.5 V	G1
J8 pin 119	LVDS TX or CMOS I/O bit 11	HSMB_TX_P11	LVDS or 2.5 V	J7
J8 pin 120	LVDS RX or CMOS I/O bit 11	HSMB_RX_P11	LVDS or 2.5 V	H4
J8 pin 121	LVDS TX or CMOS I/O bit 11	HSMB_TX_N11	LVDS or 2.5 V	J6
J8 pin 122	LVDS RX or CMOS I/O bit 11	HSMB_RX_N11	LVDS or 2.5 V	H3
J8 pin 125	LVDS TX or CMOS I/O bit 12	HSMB_TX_P12	LVDS or 2.5 V	H6
J8 pin 126	LVDS RX or CMOS I/O bit 12	HSMB_RX_P12	LVDS or 2.5 V	E2
J8 pin 127	LVDS TX or CMOS I/O bit 12	HSMB_TX_N12	LVDS or 2.5 V	H5
J8 pin 128	LVDS RX or CMOS I/O bit 12	HSMB_RX_N12	LVDS or 2.5 V	E1
J8 pin 131	LVDS TX or CMOS I/O bit 13	HSMB_TX_P13	LVDS or 2.5 V	K8
J8 pin 132	LVDS RX or CMOS I/O bit 13	HSMB_RX_P13	LVDS or 2.5 V	C1
J8 pin 133	LVDS TX or CMOS I/O bit 13	HSMB_TX_N13	LVDS or 2.5 V	K7
J8 pin 134	LVDS RX or CMOS I/O bit 13	HSMB_RX_N13	LVDS or 2.5 V	D1
J8 pin 137	LVDS TX or CMOS I/O bit 14	HSMB_TX_P14	LVDS or 2.5 V	L8
J8 pin 138	LVDS RX or CMOS I/O bit 14	HSMB_RX_P14	LVDS or 2.5 V	D3
J8 pin 139	LVDS TX or CMOS I/O bit 14	HSMB_TX_N14	LVDS or 2.5 V	L8
J8 pin 140	LVDS RX or CMOS I/O bit 14	HSMB_RX_N14	LVDS or 2.5 V	D2
J8 pin 143	LVDS TX or CMOS I/O bit 15	HSMB_TX_P15	LVDS or 2.5 V	M10
J8 pin 144	LVDS RX or CMOS I/O bit 15	HSMB_RX_P15	LVDS or 2.5 V	G5
J8 pin 145	LVDS TX or CMOS I/O bit 15	HSMB_TX_N15	LVDS or 2.5 V	M9
J8 pin 146	LVDS RX or CMOS I/O bit 15	HSMB_RX_N15	LVDS or 2.5 V	G4
J8 pin 149	LVDS TX or CMOS I/O bit 16	HSMB_TX_P16	LVDS or 2.5 V	N11
J8 pin 150	LVDS RX or CMOS I/O bit 16	HSMB_RX_P16	LVDS or 2.5 V	F4
J8 pin 151	LVDS TX or CMOS I/O bit 16	HSMB_TX_N16	LVDS or 2.5 V	N10
J8 pin 152	LVDS RX or CMOS I/O bit 16	HSMB_RX_N16	LVDS or 2.5 V	F3
J8 pin 155	LVDS or CMOS clock out	HSMB_CLK_OUT_P2	LVDS	R12
J8 pin 156	LVDS or CMOS clock in	HSMB_CLK_IN_P2	LVDS	U4
J8 pin 157	LVDS or CMOS clock out	HSMB_CLK_OUT_N2	2.5 V	T11
J8 pin 158	LVDS or CMOS clock in	HSMB_CLK_IN_N2	2.5 V	U3

**Table 2-42. HSMC Port B Interface Signal Name, Description, and Type (Part 4 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
N/A	User LED intended to show RX Data activity on the HSMC	HSMB_RX_LED	2.5 V	AJ12
N/A	User LED intended to show TX Data activity on the HSMC	HSMB_TX_LED	2.5 V	AG34

The board provides both 12-V and 3.3-V power supply to install daughter cards up to 18.6 W each. Table 2-43 shows the maximum current allowed per voltage.

**Table 2-43. HSMC Power Supply**

Voltage	Minimum Current From Host	Minimum Wattage
12 V	1.0 A	12.0 W
3.3 V	2.0 A	6.6 W

Table 2-44 lists HSMC component reference and manufacturing information.

**Table 2-44. HSMC Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
J8 and J18	High-speed mezzanine card (HSMC), custom version of QSH-DP family high-speed socket	Samtec	ASP-122953-01	<a href="http://www.samtec.com">www.samtec.com</a>

## On-Board Memory

This section describes the on-board memory interface support, and provides signal name, type, and signal connectivity relative to the Stratix III device.

The board has the following on-board memory:

- “DDR2 SDRAM DIMM” on page 2-49
- “DDR2 SDRAM Devices” on page 2-53
- “QDR II+ SRAM ” on page 2-55
- “P-SRAM” on page 2-58
- “Flash Memory” on page 2-63



For more information, refer to:

- AN 435: Using DDR and DDR2 SDRAM in Stratix III and Stratix IV Devices
- AN 438: Constraining and Analyzing Timing for External Memory Interfaces in Stratix III and Cyclone III Devices



## DDR2 SDRAM DIMM

The board has 1 GByte DDR2 SDRAM DIMM memory interface with a 72-bit data width on the vertical I/O banks, which is typically used as a 64-bit interface with the additional 8 bits serving as error correction coding (ECC) bits for each of the 8-byte lanes. The target frequency is 400 MHz (800 Mbps) with potential operation of up to 533 MHz (1,066 Mbps). The theoretical bandwidth of the entire DDR2 interface is 6,388 Mbps plus ECC, or 7,187 Mbps raw throughput.

The data interface to the FPGA fabric runs at either one-half or one-quarter the physical layer data rate when using the Altera DDR2 MegaCore® function, which equates to a doubling or quadrupling of the physical data bus width (144 bits or 288 bits, respectively). For example, a 72-bit interface with a 400-MHz external clock speed can have a 400-MHz 144-bit internal bus or a 200-MHz 288-bit interface.

Table 2-45 lists the DDR2 DIMM interface signals. Signal names and type are relative to the Stratix III device regarding the I/O setting and direction. JEDEC bus widths are used.

**Table 2-45. DDR2 DIMM Interface I/O Signals (Part 1 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J19 pin 188	Address bit 0	DDR2_DIMM_A0	SSTL-18 class I	AM19
J19 pin 183	Address bit 1	DDR2_DIMM_A1	SSTL-18 class I	AM18
J19 pin 63	Address bit 2	DDR2_DIMM_A2	SSTL-18 class I	AF16
J19 pin 182	Address bit 3	DDR2_DIMM_A3	SSTL-18 class I	AN16
J19 pin 61	Address bit 4	DDR2_DIMM_A4	SSTL-18 class I	AM17
J19 pin 60	Address bit 5	DDR2_DIMM_A5	SSTL-18 class I	AL19
J19 pin 180	Address bit 6	DDR2_DIMM_A6	SSTL-18 class I	AK18
J19 pin 58	Address bit 7	DDR2_DIMM_A7	SSTL-18 class I	AD16
J19 pin 179	Address bit 8	DDR2_DIMM_A8	SSTL-18 class I	AE16
J19 pin 177	Address bit 9	DDR2_DIMM_A9	SSTL-18 class I	AM16
J19 pin 70	Address bit 10	DDR2_DIMM_A10	SSTL-18 class I	AH19
J19 pin 57	Address bit 11	DDR2_DIMM_A11	SSTL-18 class I	AL16
J19 pin 176	Address bit 12	DDR2_DIMM_A12	SSTL-18 class I	AF20
J19 pin 196	Address bit 13	DDR2_DIMM_A13	SSTL-18 class I	AE23
J19 pin 174	Address bit 14	DDR2_DIMM_A14	SSTL-18 class I	AG19
J19 pin 173	Address bit 15	DDR2_DIMM_A15	SSTL-18 class I	AP12
J19 pin 71	Bank address bit 0	DDR2_DIMM_BA0	SSTL-18 class I	AN18
J19 pin 190	Bank address bit 1	DDR2_DIMM_BA1	SSTL-18 class I	AL17
J19 pin 54	Bank address bit 2	DDR2_DIMM_BA2	SSTL-18 class I	AD15
J19 pin 125	Data write mask (byte enables) bit 0	DDR2_DIMM_DM0	SSTL-18 class I	AL12
J19 pin 134	Data write mask (byte enables) bit 1	DDR2_DIMM_DM1	SSTL-18 class I	AP10
J19 pin 146	Data write mask (byte enables) bit 2	DDR2_DIMM_DM2	SSTL-18 class I	AJ15
J19 pin 155	Data write mask (byte enables) bit 3	DDR2_DIMM_DM3	SSTL-18 class I	AL22
J19 pin 202	Data write mask (byte enables) bit 4	DDR2_DIMM_DM4	SSTL-18 class I	AE22

Table 2-45. DDR2 DIMM Interface I/O Signals (Part 2 of 4)

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J19 pin 211	Data write mask (byte enables) bit 5	DDR2_DIMM_DM5	SSTL-18 class I	AK27
J19 pin 223	Data write mask (byte enables) bit 6	DDR2_DIMM_DM6	SSTL-18 class I	AJ28
J19 pin 232	Data write mask (byte enables) bit 7	DDR2_DIMM_DM7	SSTL-18 class I	AP32
J19 pin 164	Data write mask (byte enables) bit 8	DDR2_DIMM_DM8	SSTL-18 class I	AH23
J19 pin 3	Data bit 0	DDR2_DIMM_DQ0	SSTL-18 class I	AP6
J19 pin 4	Data bit 1	DDR2_DIMM_DQ1	SSTL-18 class I	AN7
J19 pin 9	Data bit 2	DDR2_DIMM_DQ2	SSTL-18 class I	AK10
J19 pin 10	Data bit 3	DDR2_DIMM_DQ3	SSTL-18 class I	AK12
J19 pin 122	Data bit 4	DDR2_DIMM_DQ4	SSTL-18 class I	AM7
J19 pin 123	Data bit 5	DDR2_DIMM_DQ5	SSTL-18 class I	AM8
J19 pin 128	Data bit 6	DDR2_DIMM_DQ6	SSTL-18 class I	AM11
J19 pin 129	Data bit 7	DDR2_DIMM_DQ7	SSTL-18 class I	AP8
J19 pin 12	Data bit 8	DDR2_DIMM_DQ8	SSTL-18 class I	AE13
J19 pin 13	Data bit 9	DDR2_DIMM_DQ9	SSTL-18 class I	AF13
J19 pin 21	Data bit 10	DDR2_DIMM_DQ10	SSTL-18 class I	AP11
J19 pin 22	Data bit 11	DDR2_DIMM_DQ11	SSTL-18 class I	AF15
J19 pin 131	Data bit 12	DDR2_DIMM_DQ12	SSTL-18 class I	AE14
J19 pin 132	Data bit 13	DDR2_DIMM_DQ13	SSTL-18 class I	AE15
J19 pin 140	Data bit 14	DDR2_DIMM_DQ14	SSTL-18 class I	AP9
J19 pin 141	Data bit 15	DDR2_DIMM_DQ15	SSTL-18 class I	AN10
J19 pin 24	Data bit 16	DDR2_DIMM_DQ16	SSTL-18 class I	AN12
J19 pin 25	Data bit 17	DDR2_DIMM_DQ17	SSTL-18 class I	AM12
J19 pin 30	Data bit 18	DDR2_DIMM_DQ18	SSTL-18 class I	AG15
J19 pin 31	Data bit 19	DDR2_DIMM_DQ19	SSTL-18 class I	AH15
J19 pin 143	Data bit 20	DDR2_DIMM_DQ20	SSTL-18 class I	AN13
J19 pin 144	Data bit 21	DDR2_DIMM_DQ21	SSTL-18 class I	AP13
J19 pin 149	Data bit 22	DDR2_DIMM_DQ22	SSTL-18 class I	AP14
J19 pin 150	Data bit 23	DDR2_DIMM_DQ23	SSTL-18 class I	AK15
J19 pin 33	Data bit 24	DDR2_DIMM_DQ24	SSTL-18 class I	AJ21
J19 pin 34	Data bit 25	DDR2_DIMM_DQ25	SSTL-18 class I	AM22
J19 pin 39	Data bit 26	DDR2_DIMM_DQ26	SSTL-18 class I	AN21
J19 pin 40	Data bit 27	DDR2_DIMM_DQ27	SSTL-18 class I	AP21
J19 pin 152	Data bit 28	DDR2_DIMM_DQ28	SSTL-18 class I	AJ20
J19 pin 153	Data bit 29	DDR2_DIMM_DQ29	SSTL-18 class I	AK21
J19 pin 158	Data bit 30	DDR2_DIMM_DQ30	SSTL-18 class I	AP20
J19 pin 159	Data bit 31	DDR2_DIMM_DQ31	SSTL-18 class I	AM21
J19 pin 80	Data bit 32	DDR2_DIMM_DQ32	SSTL-18 class I	AE20
J19 pin 81	Data bit 33	DDR2_DIMM_DQ33	SSTL-18 class I	AF21
J19 pin 86	Data bit 34	DDR2_DIMM_DQ34	SSTL-18 class I	AP24

**Table 2–45. DDR2 DIMM Interface I/O Signals (Part 3 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J19 pin 87	Data bit 35	DDR2_DIMM_DQ35	SSTL-18 class I	AP26
J19 pin 199	Data bit 36	DDR2_DIMM_DQ36	SSTL-18 class I	AD21
J19 pin 200	Data bit 37	DDR2_DIMM_DQ37	SSTL-18 class I	AE21
J19 pin 205	Data bit 38	DDR2_DIMM_DQ38	SSTL-18 class I	AP23
J19 pin 206	Data bit 39	DDR2_DIMM_DQ39	SSTL-18 class I	AN24
J19 pin 89	Data bit 40	DDR2_DIMM_DQ40	SSTL-18 class I	AP27
J19 pin 90	Data bit 41	DDR2_DIMM_DQ41	SSTL-18 class I	AN27
J19 pin 95	Data bit 42	DDR2_DIMM_DQ42	SSTL-18 class I	AL28
J19 pin 96	Data bit 43	DDR2_DIMM_DQ43	SSTL-18 class I	AK25
J19 pin 208	Data bit 44	DDR2_DIMM_DQ44	SSTL-18 class I	AM26
J19 pin 209	Data bit 45	DDR2_DIMM_DQ45	SSTL-18 class I	AL26
J19 pin 214	Data bit 46	DDR2_DIMM_DQ46	SSTL-18 class I	AP29
J19 pin 215	Data bit 47	DDR2_DIMM_DQ47	SSTL-18 class I	AM28
J19 pin 98	Data bit 48	DDR2_DIMM_DQ48	SSTL-18 class I	AN30
J19 pin 99	Data bit 49	DDR2_DIMM_DQ49	SSTL-18 class I	AM30
J19 pin 107	Data bit 50	DDR2_DIMM_DQ50	SSTL-18 class I	AJ26
J19 pin 108	Data bit 51	DDR2_DIMM_DQ51	SSTL-18 class I	AH27
J19 pin 217	Data bit 52	DDR2_DIMM_DQ52	SSTL-18 class I	AM29
J19 pin 218	Data bit 53	DDR2_DIMM_DQ53	SSTL-18 class I	AL29
J19 pin 226	Data bit 54	DDR2_DIMM_DQ54	SSTL-18 class I	AJ29
J19 pin 227	Data bit 55	DDR2_DIMM_DQ55	SSTL-18 class I	AJ27
J19 pin 110	Data bit 56	DDR2_DIMM_DQ56	SSTL-18 class I	AF24
J19 pin 111	Data bit 57	DDR2_DIMM_DQ57	SSTL-18 class I	AG24
J19 pin 116	Data bit 58	DDR2_DIMM_DQ58	SSTL-18 class I	AF23
J19 pin 117	Data bit 59	DDR2_DIMM_DQ59	SSTL-18 class I	AN31
J19 pin 229	Data bit 60	DDR2_DIMM_DQ60	SSTL-18 class I	AH25
J19 pin 230	Data bit 61	DDR2_DIMM_DQ61	SSTL-18 class I	AH26
J19 pin 235	Data bit 62	DDR2_DIMM_DQ62	SSTL-18 class I	AP31
J19 pin 236	Data bit 63	DDR2_DIMM_DQ63	SSTL-18 class I	AP30
J19 pin 42	Data bit 64	DDR2_DIMM_DQ64	SSTL-18 class I	AH22
J19 pin 43	Data bit 65	DDR2_DIMM_DQ65	SSTL-18 class I	AM23
J19 pin 48	Data bit 66	DDR2_DIMM_DQ66	SSTL-18 class I	AJ23
J19 pin 49	Data bit 67	DDR2_DIMM_DQ67	SSTL-18 class I	AJ24
J19 pin 161	Data bit 68	DDR2_DIMM_DQ68	SSTL-18 class I	AK22
J19 pin 162	Data bit 69	DDR2_DIMM_DQ69	SSTL-18 class I	AL23
J19 pin 167	Data bit 70	DDR2_DIMM_DQ70	SSTL-18 class I	AL25
J19 pin 168	Data bit 71	DDR2_DIMM_DQ71	SSTL-18 class I	AK24
J19 pin 6	Data strobe bit 0	DDR2_DIMM_DQS_N0	SSTL-18 class I	AL11
J19 pin 15	Data strobe bit 1	DDR2_DIMM_DQS_N1	SSTL-18 class I	AN9

**Table 2-45. DDR2 DIMM Interface I/O Signals (Part 4 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
J19 pin 27	Data strobe bit 2	DDR2_DIMM_DQS_N2	SSTL-18 class I	AJ14
J19 pin 36	Data strobe bit 3	DDR2_DIMM_DQS_N3	SSTL-18 class I	AP22
J19 pin 83	Data strobe bit 4	DDR2_DIMM_DQS_N4	SSTL-18 class I	AP25
J19 pin 92	Data strobe bit 5	DDR2_DIMM_DQS_N5	SSTL-18 class I	AP28
J19 pin 104	Data strobe bit 6	DDR2_DIMM_DQS_N6	SSTL-18 class I	AM32
J19 pin 113	Data strobe bit 7	DDR2_DIMM_DQS_N7	SSTL-18 class I	AP33
J19 pin 45	Data strobe bit 8	DDR2_DIMM_DQS_N8	SSTL-18 class I	AM24
J19 pin 7	Data strobe bit 0	DDR2_DIMM_DQS_P0	SSTL-18 class I	AL10
J19 pin 16	Data strobe bit 1	DDR2_DIMM_DQS_P1	SSTL-18 class I	AM9
J19 pin 28	Data strobe bit 2	DDR2_DIMM_DQS_P2	SSTL-18 class I	AH14
J19 pin 37	Data strobe bit 3	DDR2_DIMM_DQS_P3	SSTL-18 class I	AN22
J19 pin 84	Data strobe bit 4	DDR2_DIMM_DQS_P4	SSTL-18 class I	AN25
J19 pin 93	Data strobe bit 5	DDR2_DIMM_DQS_P5	SSTL-18 class I	AN28
J19 pin 105	Data strobe bit 6	DDR2_DIMM_DQS_P6	SSTL-18 class I	AM31
J19 pin 114	Data strobe bit 7	DDR2_DIMM_DQS_P7	SSTL-18 class I	AN33
J19 pin 46	Data strobe bit 8	DDR2_DIMM_DQS_P8	SSTL-18 class I	AL24
J19 pin 195	On-die termination control bit 0	DDR2_DIMM_ODT0	SSTL-18 class I	AE19
J19 pin 77	On-die termination control bit 1	DDR2_DIMM_ODT1	SSTL-18 class I	AD19
J19 pin 52	Clock enable bit 0	DDR2_DIMM_CKE0	SSTL-18 class I	AJ16
J19 pin 171	Clock enable bit 1	DDR2_DIMM_CKE1	SSTL-18 class I	AP7
J19 pin 186	Differential output clock 0	DDR2_DIMM_CLK_N0	SSTL-18 class I	AM14
J19 pin 138	Differential output clock 1	DDR2_DIMM_CLK_N1	SSTL-18 class I	AL13
J19 pin 221	Differential output clock 2	DDR2_DIMM_CLK_N2	SSTL-18 class I	AM15
J19 pin 185	Differential output clock 0	DDR2_DIMM_CLK_P0	SSTL-18 class I	AL14
J19 pin 137	Differential output clock 1	DDR2_DIMM_CLK_P1	SSTL-18 class I	AK13
J19 pin 220	Differential output clock 2	DDR2_DIMM_CLK_P2	SSTL-18 class I	AL15
J19 pin 193	Chip select	DDR2_DIMM_CSn0	SSTL-18 class I	AG21
J19 pin 76	Chip select	DDR2_DIMM_CSn1	SSTL-18 class I	AC22
J19 pin 74	Column address strobe	DDR2_DIMM_CASn	SSTL-18 class I	AD18
J19 pin 192	Row address strobe	DDR2_DIMM_RASn	SSTL-18 class I	AN19
J19 pin 18	Reset	DDR2_DIMM_RESEn	SSTL-18 class I	AE18
J19 pin 120	Presence-detect clock	DDR2_DIMM_SCL	SSTL-18 class I	AN15
J19 pin 119	Presence-detect data	DDR2_DIMM_SDA	SSTL-18 class I	AK19
J19 pin 73	Write enable	DDR2_DIMM_WEn	SSTL-18 class I	AJ19

Table 2-46 lists the DDR2 SDRAM DIMM component reference and manufacturing information.

**Table 2-46. DDR2 SDRAM DIMM Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
J19	400 MHz DIMM for 128 M × 72 (1 GByte plus ECC)	Micron Technology, Inc.	MT9HTF12872AY-800	<a href="http://www.micron.com">www.micron.com</a>

## DDR2 SDRAM Devices

The board supports two independent 8-bit DDR2 SDRAM interfaces on the horizontal I/O banks.

The target speed on the side bank is 300-MHz DDR.

Table 2-47 lists the DDR2 device A interface signals. JEDEC bus widths are used.

Table 2-47 also shows a summary of the required number of pins to support the largest possible DDR2 devices available in a ×8 data configuration.

**Table 2-47. DDR2 Device A Interface I/O (Part 1 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U17 pin H8	Address bit 0	DDR2_DEVA_A0	SSTL-18 class I	U22-F34
U17 pin H3	Address bit 1	DDR2_DEVA_A1	SSTL-18 class I	U22-G34
U17 pin H7	Address bit 2	DDR2_DEVA_A2	SSTL-18 class I	U22-G31
U17 pin J2	Address bit 3	DDR2_DEVA_A3	SSTL-18 class I	U22-N24
U17 pin J8	Address bit 4	DDR2_DEVA_A4	SSTL-18 class I	U22-L29
U17 pin J3	Address bit 5	DDR2_DEVA_A5	SSTL-18 class I	U22-M30
U17 pin J7	Address bit 6	DDR2_DEVA_A6	SSTL-18 class I	U22-L31
U17 pin K2	Address bit 7	DDR2_DEVA_A7	SSTL-18 class I	U22-P25
U17 pin K8	Address bit 8	DDR2_DEVA_A8	SSTL-18 class I	U22-K33
U17 pin K3	Address bit 9	DDR2_DEVA_A9	SSTL-18 class I	U22-M29
U17 pin H2	Address bit 10	DDR2_DEVA_A10	SSTL-18 class I	U22-J34
U17 pin K7	Address bit 11	DDR2_DEVA_A11	SSTL-18 class I	U22-L32
U17 pin L2	Address bit 12	DDR2_DEVA_A12	SSTL-18 class I	U22-P23
U17 pin L8	Address bit 13	DDR2_DEVA_A13	SSTL-18 class I	U22-M26
U17 pin L3	Address bit 14	DDR2_DEVA_A14	SSTL-18 class I	U22-N26
U17 pin G2	Bank address bit 0	DDR2_DEVA_BA0	SSTL-18 class I	U22-H34
U17 pin G3	Bank address bit 1	DDR2_DEVA_BA1	SSTL-18 class I	U22-K30
U17 pin G1	Bank address bit 2	DDR2_DEVA_BA2	SSTL-18 class I	U22-J33
U17 pin C8	Data bit 0	DDR2_DEVA_DQ0	SSTL-18 class I	U22-K27
U17 pin C2	Data bit 1	DDR2_DEVA_DQ1	SSTL-18 class I	U22-J30
U17 pin D7	Data bit 2	DDR2_DEVA_DQ2	SSTL-18 class I	U22-K28
U17 pin D3	Data bit 3	DDR2_DEVA_DQ3	SSTL-18 class I	U22-J29
U17 pin D1	Data bit 4	DDR2_DEVA_DQ4	SSTL-18 class I	U22-H32

**Table 2-47. DDR2 Device A Interface I/O (Part 2 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U17 pin D9	Data bit 5	DDR2_DEVA_DQ5	SSTL-18 class I	U22-M24
U17 pin B1	Data bit 6	DDR2_DEVA_DQ6	SSTL-18 class I	U22-H31
U17 pin B9	Data bit 7	DDR2_DEVA_DQ7	SSTL-18 class I	U22-N25
U17 pin A8	Data strobe	DDR2_DEVA_DQS_N	SSTL-18 class I	U22-C34
U17 pin B7	Data strobe	DDR2_DEVA_DQS_P	SSTL-18 class I	U22-C33
U17 pin F8	Differential output clock	DDR2_DEVA_CK_N	SSTL-18 class I	U22-K32
U17 pin E8	Differential output clock	DDR2_DEVA_CK_P	SSTL-18 class I	U22-K31
U17 pin F2	Clock enable	DDR2_DEVA_CKE	SSTL-18 class I	U22-M27
U17 pin G8	Chip select	DDR2_DEVA_CS <sub>n</sub>	SSTL-18 class I	U22-E34
U17 pin F3	Write enable	DDR2_DEVA_WEn	SSTL-18 class I	U22-G33
U17 pin G7	Column address strobe	DDR2_DEVA_CAS <sub>n</sub>	SSTL-18 class I	U22-G30
U17 pin F7	Row address strobe	DDR2_DEVA_RAS <sub>n</sub>	SSTL-18 class I	U22-F32
U17 pin B3	Data write mask	DDR2_DEVA_DM	SSTL-18 class I	U22-F31
U17 pin F9	On-die termination control pin	DDR2_DEVA_ODT	SSTL-18 class I	U22-M28

Table 2-48 lists the DDR2 SDRAM devices A and B component reference and manufacturing information.

**Table 2-48. DDR2 SDRAM Devices A and B Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U17, U20	333 MHz devices for 32M x8 (256 MBytes)	Micron Technology, Inc.	MT47H32M8BP-3:B	<a href="http://www.micron.com">www.micron.com</a>

Table 2-49 lists the DDR2 device B interface signals. JEDEC bus widths are used.

**Table 2-49. DDR2 Device B Interface I/O (Part 1 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U20 pin H8	Address bit 0	DDR2_DEVB_A0	SSTL-18 class I	U22-R27
U20 pin H3	Address bit 1	DDR2_DEVB_A1	SSTL-18 class I	U22-R29
U20 pin H7	Address bit 2	DDR2_DEVB_A2	SSTL-18 class I	U22-J31
U20 pin J2	Address bit 3	DDR2_DEVB_A3	SSTL-18 class I	U22-U32
U20 pin J8	Address bit 4	DDR2_DEVB_A4	SSTL-18 class I	U22-K34
U20 pin J3	Address bit 5	DDR2_DEVB_A5	SSTL-18 class I	U22-T23
U20 pin J7	Address bit 6	DDR2_DEVB_A6	SSTL-18 class I	U22-M34
U20 pin K2	Address bit 7	DDR2_DEVB_A7	SSTL-18 class I	U22-U31
U20 pin K8	Address bit 8	DDR2_DEVB_A8	SSTL-18 class I	U22-R24
U20 pin K3	Address bit 9	DDR2_DEVB_A9	SSTL-18 class I	U22-V31
U20 pin H2	Address bit 10	DDR2_DEVB_A10	SSTL-18 class I	U22-P34
U20 pin K7	Address bit 11	DDR2_DEVB_A11	SSTL-18 class I	U22-T29

**Table 2-49. DDR2 Device B Interface I/O (Part 2 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U20 pin L2	Address bit 12	DDR2_DEVB_A12	SSTL-18 class I	U22-V32
U20 pin L8	Address bit 13	DDR2_DEVB_A13	SSTL-18 class I	U22-R28
U20 pin L3	Address bit 14	DDR2_DEVB_A14	SSTL-18 class I	U22-T30
U20 pin G2	Bank address bit 0	DDR2_DEVB_BA0	SSTL-18 class I	U22-N32
U20 pin G3	Bank address bit 1	DDR2_DEVB_BA1	SSTL-18 class I	U22-N33
U20 pin G1	Bank address bit 2	DDR2_DEVB_BA2	SSTL-18 class I	U22-R30
U20 pin C8	Data bit 0	DDR2_DEVB_DQ0	SSTL-18 class I	U22-P29
U20 pin C2	Data bit 1	DDR2_DEVB_DQ1	SSTL-18 class I	U22-P32
U20 pin D7	Data bit 2	DDR2_DEVB_DQ2	SSTL-18 class I	U22-N30
U20 pin D3	Data bit 3	DDR2_DEVB_DQ3	SSTL-18 class I	U22-N31
U20 pin D1	Data bit 4	DDR2_DEVB_DQ4	SSTL-18 class I	U22-R26
U20 pin D9	Data bit 5	DDR2_DEVB_DQ5	SSTL-18 class I	U22-P28
U20 pin B1	Data bit 6	DDR2_DEVB_DQ6	SSTL-18 class I	U22-R25
U20 pin B9	Data bit 7	DDR2_DEVB_DQ7	SSTL-18 class I	U22-N29
U20 pin A8	Data strobe	DDR2_DEVB_DQS_N	SSTL-18 class I	U22-L34
U20 pin B7	Data strobe	DDR2_DEVB_DQS_P	SSTL-18 class I	U22-M33
U20 pin F8	Differential output clock	DDR2_DEVB_CK_N	SSTL-18 class I	U22-R32
U20 pin E8	Differential output clock	DDR2_DEVB_CK_P	SSTL-18 class I	U22-P31
U20 pin F2	Clock enable	DDR2_DEVB_CKE	SSTL-18 class I	U22-N34
U20 pin G8	Chip select	DDR2_DEVB_CS <sub>n</sub>	SSTL-18 class I	U22-J32
U20 pin F3	Write enable	DDR2_DEVB_WEn	SSTL-18 class I	U22-T26
U20 pin G7	Column address strobe	DDR2_DEVB_CAS <sub>n</sub>	SSTL-18 class I	U22-U25
U20 pin F7	Row address strobe	DDR2_DEVB_RAS <sub>n</sub>	SSTL-18 class I	U22-D33
U20 pin B3	Data write mask	DDR2_DEVB_DM	SSTL-18 class I	U22-M31
U20 pin F9	On-die termination control pin	DDR2_DEVB_ODT	SSTL-18 class I	U22-D34

## QDRII+ SRAM

The board uses a burst-of-4 QDRII memory device for high-speed, low-latency memory access. The interface provides addressing for a 72-Mbit device. The actual device used may be 18, 36, or 72 Mbits. Because the Stratix III device supports 18 DQ/DQS group, the board uses a ×18 QDRII or QDRII+ SRAM device. QDRII+ SRAM is needed to support a QDRII rate that is greater than 300 MHz.

QDRII has separate read and write data ports with DDR interfaces operating up to 300 MHz. QDRII+ has separate read and write data ports with DDR interfaces operating up to 350 MHz. Burst-of-2 devices have a DDR address bus allowing for different read and write addresses on every clock (two data words per clock). Burst-of-4 devices have higher data rates due to the longer sequential addressing.

For QDRII devices, the interface supports 10.8 Gbps of throughput at 300 MHz (600 Mbps × 18 pins). The QDRII bandwidth doubles to 21.6 Gbps when considering combined read and write bandwidth. For QDRII+ devices, the interface supports 12.6 Gbps of throughput at 350 MHz (700 Mbps × 18 pins). The QDRII+ bandwidth doubles to 25.2 Gbps when considering combined read and write bandwidth.

Table 2-50 lists the QDRII interface pins.

**Table 2-50. QDRII Interface Pins (Part 1 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U15 pin A9	Address bit 0	QDRII_A0	1.5-V HSTL class I	C17
U15 pin B4	Address bit 1	QDRII_A1	1.5-V HSTL class I	C14
U15 pin B8	Address bit 2	QDRII_A2	1.5-V HSTL class I	C16
U15 pin C5	Address bit 3	QDRII_A3	1.5-V HSTL class I	A14
U15 pin C7	Address bit 4	QDRII_A4	1.5-V HSTL class I	A15
U15 pin N5	Address bit 5	QDRII_A5	1.5-V HSTL class I	F14
U15 pin N6	Address bit 6	QDRII_A6	1.5-V HSTL class I	F15
U15 pin N7	Address bit 7	QDRII_A7	1.5-V HSTL class I	A13
U15 pin P4	Address bit 8	QDRII_A8	1.5-V HSTL class I	J15
U15 pin P5	Address bit 9	QDRII_A9	1.5-V HSTL class I	G16
U15 pin P7	Address bit 10	QDRII_A10	1.5-V HSTL class I	E14
U15 pin P8	Address bit 11	QDRII_A11	1.5-V HSTL class I	B14
U15 pin R3	Address bit 12	QDRII_A12	1.5-V HSTL class I	J16
U15 pin R4	Address bit 13	QDRII_A13	1.5-V HSTL class I	H16
U15 pin R5	Address bit 14	QDRII_A14	1.5-V HSTL class I	F12
U15 pin R7	Address bit 15	QDRII_A15	1.5-V HSTL class I	D14
U15 pin R8	Address bit 16	QDRII_A16	1.5-V HSTL class I	A10
U15 pin R9	Address bit 17	QDRII_A17	1.5-V HSTL class I	B13
U15 pin A3	Address bit 18	QDRII_A18	1.5-V HSTL class I	C15
U15 pin A10	Address bit 19	QDRII_A19	1.5-V HSTL class I	E17
U15 pin P10	Write data bit 0	QDRII_D0	1.5-V HSTL class I	A9
U15 pin N11	Write data bit 1	QDRII_D1	1.5-V HSTL class I	B10
U15 pin M11	Write data bit 2	QDRII_D2	1.5-V HSTL class I	B11
U15 pin K10	Write data bit 3	QDRII_D3	1.5-V HSTL class I	A11
U15 pin J11	Write data bit 4	QDRII_D4	1.5-V HSTL class I	E11
U15 pin G11	Write data bit 5	QDRII_D5	1.5-V HSTL class I	A12
U15 pin E10	Write data bit 6	QDRII_D6	1.5-V HSTL class I	C12
U15 pin D11	Write data bit 7	QDRII_D7	1.5-V HSTL class I	D12
U15 pin C11	Write data bit 8	QDRII_D8	1.5-V HSTL class I	D13
U15 pin B3	Write data bit 9	QDRII_D9	1.5-V HSTL class I	L14
U15 pin C3	Write data bit 10	QDRII_D10	1.5-V HSTL class I	K15
U15 pin D2	Write data bit 11	QDRII_D11	1.5-V HSTL class I	K13



**Table 2-50. QDRII Interface Pins (Part 2 of 2)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number
U15 pin F3	Write data bit 12	QDRII_D12	1.5-V HSTL class I	K14
U15 pin G2	Write data bit 13	QDRII_D13	1.5-V HSTL class I	G13
U15 pin J3	Write data bit 14	QDRII_D14	1.5-V HSTL class I	D10
U15 pin L3	Write data bit 15	QDRII_D15	1.5-V HSTL class I	F11
U15 pin M3	Write data bit 16	QDRII_D16	1.5-V HSTL class I	F13
U15 pin N2	Write data bit 17	QDRII_D17	1.5-V HSTL class I	G12
U15 pin P11	Read data bit 0	QDRII_Q0	1.5-V HSTL class I	A3
U15 pin M10	Read data bit 1	QDRII_Q1	1.5-V HSTL class I	B4
U15 pin L11	Read data bit 2	QDRII_Q2	1.5-V HSTL class I	A4
U15 pin K11	Read data bit 3	QDRII_Q3	1.5-V HSTL class I	A5
U15 pin J10	Read data bit 4	QDRII_Q4	1.5-V HSTL class I	C6
U15 pin F11	Read data bit 5	QDRII_Q5	1.5-V HSTL class I	F8
U15 pin E11	Read data bit 6	QDRII_Q6	1.5-V HSTL class I	G9
U15 pin C10	Read data bit 7	QDRII_Q7	1.5-V HSTL class I	F9
U15 pin B11	Read data bit 8	QDRII_Q8	1.5-V HSTL class I	G10
U15 pin B2	Read data bit 9	QDRII_Q9	1.5-V HSTL class I	J12
U15 pin D3	Read data bit 10	QDRII_Q10	1.5-V HSTL class I	J11
U15 pin E3	Read data bit 11	QDRII_Q11	1.5-V HSTL class I	G8
U15 pin F2	Read data bit 12	QDRII_Q12	1.5-V HSTL class I	G11
U15 pin G3	Read data bit 13	QDRII_Q13	1.5-V HSTL class I	B2
U15 pin K3	Read data bit 14	QDRII_Q14	1.5-V HSTL class I	B5
U15 pin L2	Read data bit 15	QDRII_Q15	1.5-V HSTL class I	F6
U15 pin N3	Read data bit 16	QDRII_Q16	1.5-V HSTL class I	C5
U15 pin P3	Read data bit 17	QDRII_Q17	1.5-V HSTL class I	D6
U15 pin B7	Byte write select bit 0	QDRII_BWSn0	1.5-V HSTL class I	C11
U15 pin A5	Byte write select bit 1	QDRII_BWSn1	1.5-V HSTL class I	D11
U15 pin A11	Echo clock	QDRII_CQ_N	1.5-V HSTL class I	C4
U15 pin A1	Echo clock	QDRII_CQ_P	1.5-V HSTL class I	H11
U15 pin A6	Write clock	QDRII_K_N	1.5-V HSTL class I	H14
U15 pin B6	Write clock	QDRII_K_P	1.5-V HSTL class I	J14
U15 pin R6	On-die termination pin for future QDRII devices.	QDRII_ODT	1.5-V HSTL class I	C3
U15 pin P6	Valid output indicator	QDRII_QVLD	1.5-V HSTL class I	A2
U15 pin A8	Read port select	QDRII_RPSn	1.5-V HSTL class I	D17
U15 pin A4	Write port select	QDRII_WPSn	1.5-V HSTL class I	K16

Table 2–51 lists the QDRII device component reference and manufacturing information.

**Table 2–51. QDRII Device Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U15	400 MHz QDRII+ burst-of-4 device for 2M × 18	Cypress Semiconductor	CY7C1263V18-400BZXCES	<a href="http://www.cypress.com">www.cypress.com</a>

## P-SRAM

The board features 8 MBytes of P-SRAM memory with a 32-bit data bus. The devices use 1.8-V CMOS signaling and are optimized for low cost and power.

The 32-bit interface comprises two ×16 devices. The Samsung part features a maximum frequency of 104 MHz (104 Mbps). The theoretical bandwidth of the entire interface is 416 Mbps.

The P-SRAM devices are part of a shared bus with connectivity to the MAX II CPLD as well as the flash memory, which is called the FSM bus. All three devices use 1.8-V CMOS signaling. Altera recommends using the 5-Ω OCT setting on the FPGA and the one-half drive setting on the SRAM.

Table 2–52 lists the P-SRAM interface signal name, description, and signal type.

**Table 2–52. P-SRAM Device Pin-Out (Part 1 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number	Other Connections
U4 and U10 pin A3	Address bus shared with flash and P-SRAM bit 1	FSM_A1	1.8 V	H23	U5 pin T8 and U9 pin B1
U4 and U10 pin A4	Address bus shared with flash and P-SRAM bit 2	FSM_A2	1.8 V	G23	U5 pin T9 and U9 pin C1
U4 and U10 pin A5	Address bus shared with flash and P-SRAM bit 3	FSM_A3	1.8 V	F23	U5 pin R9 and U9 pin D1
U4 and U10 pin B3	Address bus shared with flash and P-SRAM bit 4	FSM_A4	1.8 V	D27	U5 pin P9 and U9 pin D2
U4 and U10 pin B4	Address bus shared with flash and P-SRAM bit 5	FSM_A5	1.8 V	D28	U5 pin T10 and U9 pin A2
U4 and U10 pin C3	Address bus shared with flash and P-SRAM bit 6	FSM_A6	1.8 V	F25	U5 pin P13 and U9 pin C2
U4 and U10 pin C4	Address bus shared with flash and P-SRAM bit 7	FSM_A7	1.8 V	F26	U5 pin R10 and U9 pin A3
U4 and U10 pin D4	Address bus shared with flash and P-SRAM bit 8	FSM_A8	1.8 V	G24	U5 pin M10 and U9 pin B3
U4 and U10 pin H2	Address bus shared with flash and P-SRAM bit 9	FSM_A9	1.8 V	F24	U5 pin M11 and U9 pin C3
U4 and U10 pin H3	Address bus shared with flash and P-SRAM bit 10	FSM_A10	1.8 V	E26	U5 pin N10 and U9 pin C4

**Table 2-52. P-SRAM Device Pin-Out (Part 2 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number	Other Connections
U4 and U10 pin H4	Address bus shared with flash and P-SRAM bit 11	FSM_A11	1.8 V	D26	U5 pin R11 and U9 pin C4
U4 and U10 pin H5	Address bus shared with flash and P-SRAM bit 12	FSM_A12	1.8 V	A30	U5 pin P10 and U9 pin A12
U4 and U10 pin G3	Address bus shared with flash and P-SRAM bit 13	FSM_A13	1.8 V	A33	U5 pin T12 and U9 pin B5
U4 and U10 pin G4	Address bus shared with flash and P-SRAM bit 14	FSM_A14	1.8 V	B31	U5 pin M11 and U9 pin C5
U4 and U10 pin F3	Address bus shared with flash and P-SRAM bit 15	FSM_A15	1.8 V	A31	U5 pin R12 and U9 pin D7
U4 and U10 pin F4	Address bus shared with flash and P-SRAM bit 16	FSM_A16	1.8 V	B32	U5 pin N11 and U9 pin D8
U4 and U10 pin E4	Address bus shared with flash and P-SRAM bit 17	FSM_A17	1.8 V	A32	U5 pin T13 and U9 pin A7
U4 and U10 pin D3	Address bus shared with flash and P-SRAM bit 18	FSM_A18	1.8 V	M23	U5 pin P11 and U9 pin B7
U4 and U10 pin H1	Address bus shared with flash and P-SRAM bit 19	FSM_A19	1.8 V	L23	U5 pin R13 and U9 pin C7
U4 and U10 pin G2	Address bus shared with flash and P-SRAM bit 20	FSM_A20	1.8 V	B29	U5 pin M1 and U9 pin C8
U4 and U10 pin H6	Address bus shared with flash and P-SRAM bit 21	FSM_A21	1.8 V	C29	U5 pin R14 and U9 pin A8
U4 pin B6	Data bus shared with flash and P-SRAM bit 0	FSM_D0	1.8 V	G27	U5 pin P4 and U9 pin E4
U4 pin C5	Data bus shared with flash and P-SRAM bit 1	FSM_D1	1.8 V	F28	U5 pin R1 and U9 pin E5
U4 pin C6	Data bus shared with flash and P-SRAM bit 2	FSM_D2	1.8 V	E28	U5 pin P5 and U9 pin G5
U4 pin D5	Data bus shared with flash and P-SRAM bit 3	FSM_D3	1.8 V	D30	U5 pin T2 and U9 pin G6
U4 pin E5	Data bus shared with flash and P-SRAM bit 4	FSM_D4	1.8 V	C30	U5 pin N5 and U9 pin H7
U4 pin F5	Data bus shared with flash and P-SRAM bit 5	FSM_D5	1.8 V	F29	U5 pin R3 and U9 pin E1
U4 pin F6	Data bus shared with flash and P-SRAM bit 6	FSM_D6	1.8 V	E29	U5 pin P6 and U9 pin E3
U4 pin G6	Data bus shared with flash and P-SRAM bit 7	FSM_D7	1.8 V	J24	U5 pin R4 and U9 pin F3
U4 pin B1	Data bus shared with flash and P-SRAM bit 8	FSM_D8	1.8 V	J25	U5 pin N6 and U9 pin F4
U4 pin C1	Data bus shared with flash and P-SRAM bit 9	FSM_D9	1.8 V	A24	U5 pin T4 and U9 pin F5

Table 2-52. P-SRAM Device Pin-Out (Part 3 of 4)

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number	Other Connections
U4 pin C2	Data bus shared with flash and P-SRAM bit 10	FSM_D10	1.8 V	A26	U5 pin M6 and U9 pin H5
U4 pin D2	Data bus shared with flash and P-SRAM bit 11	FSM_D11	1.8 V	B25	U5 pin R5 and U9 pin G7
U4 pin E2	Data bus shared with flash and P-SRAM bit 12	FSM_D12	1.8 V	A25	U5 pin P7 and U9 pin E7
U4 pin F2	Data bus shared with flash and P-SRAM bit 13	FSM_D13	1.8 V	J20	U5 pin T5 and U9 pin H5
U4 pin F1	Data bus shared with flash and P-SRAM bit 14	FSM_D14	1.8 V	K20	U5 pin N7 and U9 pin G7
U4 pin G1	Data bus shared with flash and P-SRAM bit 15	FSM_D15	1.8 V	K21	U5 pin R6 and U9 pin E7
U10 pin B6	Data bus shared with flash and P-SRAM bit 16	FSM_D16	1.8 V	K22	U5 pin M7
U10 pin C5	Data bus shared with flash and P-SRAM bit 17	FSM_D17	1.8 V	C26	U5 pin T6
U10 pin C6	Data bus shared with flash and P-SRAM bit 18	FSM_D18	1.8 V	B26	U5 pin P14
U10 pin D5	Data bus shared with flash and P-SRAM bit 19	FSM_D19	1.8 V	J22	U5 pin R7
U10 pin E5	Data bus shared with flash and P-SRAM bit 20	FSM_D20	1.8 V	J21	U5 pin P8
U10 pin F5	Data bus shared with flash and P-SRAM bit 21	FSM_D21	1.8 V	C24	U5 pin T7
U10 pin F6	Data bus shared with flash and P-SRAM bit 22	FSM_D22	1.8 V	E25	U5 pin N8
U10 pin G6	Data bus shared with flash and P-SRAM bit 23	FSM_D23	1.8 V	D25	U5 pin R8
U10 pin B1	Data bus shared with flash and P-SRAM bit 24	FSM_D24	1.8 V	D24	U5 pin F12
U10 pin C1	Data bus shared with flash and P-SRAM bit 25	FSM_D25	1.8 V	A27	U5 pin D16
U10 pin C2	Data bus shared with flash and P-SRAM bit 26	FSM_D26	1.8 V	A29	U5 pin F13
U10 pin D2	Data bus shared with flash and P-SRAM bit 27	FSM_D27	1.8 V	C27	U5 pin D15
U10 pin E2	Data bus shared with flash and P-SRAM bit 28	FSM_D28	1.8 V	C28	U5 pin F14
U10 pin F2	Data bus shared with flash and P-SRAM bit 29	FSM_D29	1.8 V	E23	U5 pin D14
U10 pin F1	Data bus shared with flash and P-SRAM bit 30	FSM_D30	1.8 V	D23	U5 pin E12

**Table 2-52. P-SRAM Device Pin-Out (Part 4 of 4)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Device Pin Number	Other Connections
U10 pin G1	Data bus shared with flash and P-SRAM bit 31	FSM_D31	1.8 V	B28	U5 pin C15
U10 and U4 pin J3	Address valid	SRAM_ADVn	1.8 V	D21	—
U4 pin A1	Byte write select bit 0	SRAM_BEn0	1.8 V	D22	—
U4 pin B2	Byte write select bit 1	SRAM_BEn1	1.8 V	E22	—
U10 pin A1	Byte write select bit 2	SRAM_BEn2	1.8 V	E20	—
U10 pin B2	Byte write select bit 3	SRAM_BEn3	1.8 V	H20	—
U10 and U4 pin J2	Clock	SRAM_CLK	1.8 V	C21	—
U10 and U4 pin B5	Chip select	SRAM_CSn	1.8 V	A21	—
U10 and U4 pin A2	Output enable	SRAM_OEn	1.8 V	A22	—
U10 and U4 pin A6	Power save mode	SRAM_PSn	1.8 V	AL18	—
U4 pin J1	Data wait	SRAM_WAIT0	1.8 V	G20	—
U10 pin J1	Data wait	SRAM_WAIT1	1.8 V	F20	—
U10 and U4 pin G5	Write enable	SRAM_WEn	1.8 V	B22	—

Figure 2-17 illustrates the latency for both fixed and variable modes of operation. For asynchronous accesses, each of the two devices has its own WAIT pin wired to the Stratix III device.

For Samsung SRAM pin definitions, data sheet, and other related documentation, refer to the Samsung website at [www.samsung.com](http://www.samsung.com).

**Figure 2-17. SRAM Latency Timing Illustration**

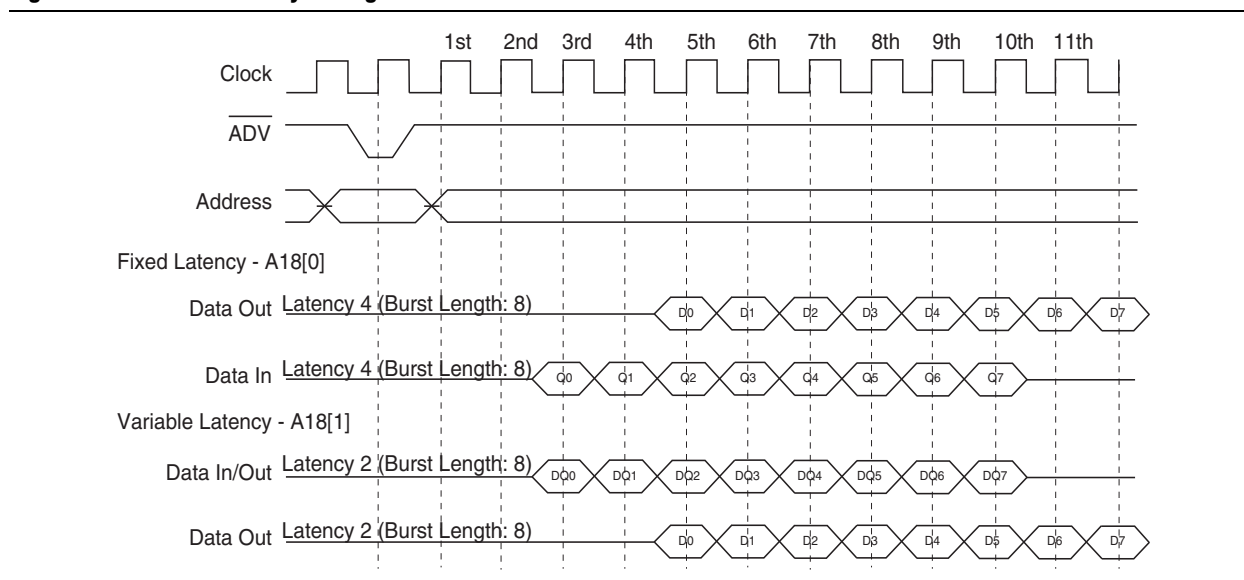


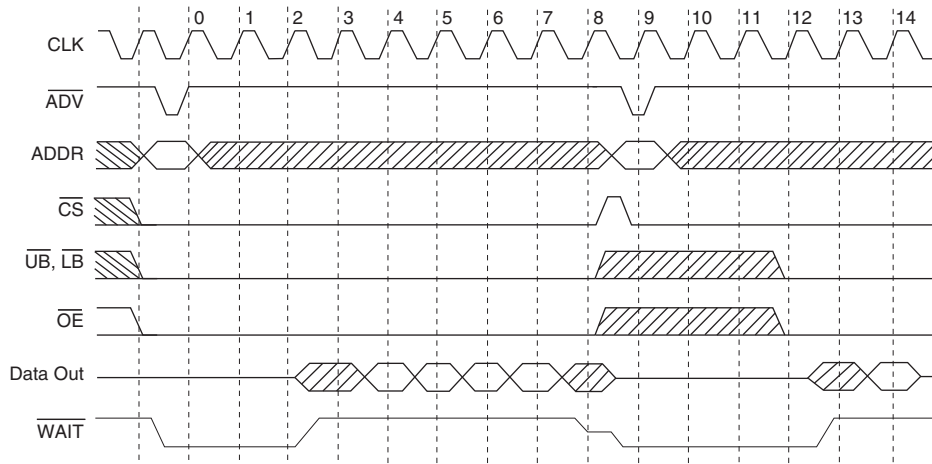
Table 2-53 lists the Samsung device latency values based on operation frequency.

**Table 2-53. SRAM Latency Vs. Frequency**

Item	Up to 66 MHz		Up to 80 MHz		Up to 104 MHz	
	Fixed	Variable	Fixed	Variable	Fixed	Variable
Latency set (A11:A10:A9)	4(0:0:1)	2(1:0:0)	5(0:1:0)	3(0:0:0)	7(1:0:1)	4(0:0:1)
Read latency (min)	4	2/4	5	3/5th	7	4/7
First read data fetch clock	5th	3rd/5th	6th	4th/6th	8th	5th/8th
Write latency (min)	2	2	3	3	4	4
First write data loading clock	3rd	3rd	3rd	4th	5th	5th

Figure 2-18 and Figure 2-19 show the Samsung device read and write access waveforms.

**Figure 2-18. SRAM Read Timing Waveforms**



**Figure 2-19. SRAM Write Timing Waveforms**

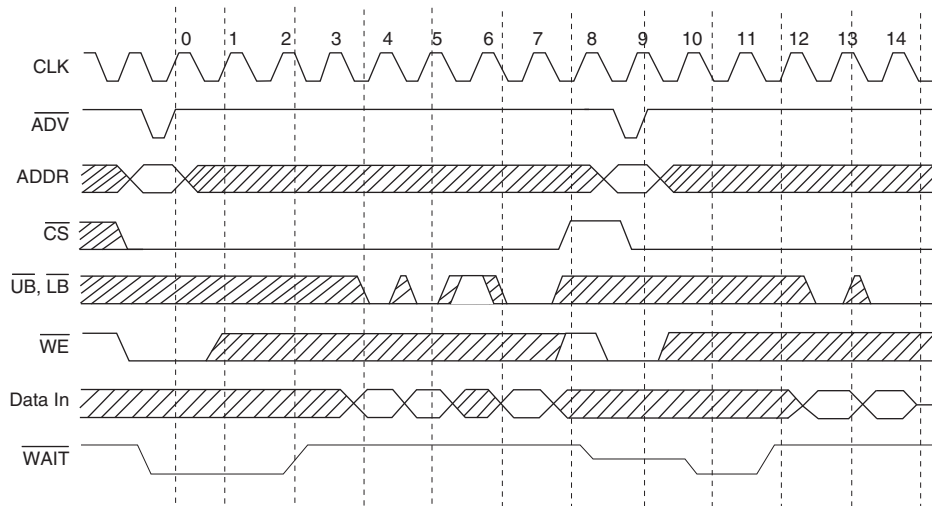


Table 2-54 lists the SRAM device component reference and manufacturing information.

**Table 2-54. SRAM Device Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U4, U10	32 MBytes (2M × 16) of SRAM	Samsung Semiconductor	K1B3216B2E-B170	<a href="http://www.samsung.com">www.samsung.com</a>

## Flash Memory

A 512-Mbit Intel P30 flash memory device is used to store configuration files for the FPGA as well as any other necessary data for the development board operation. The target device is a PC48F4400P0VB00 in a BGA package and it supports the common flash interface (CFI) commands. The flash, SSRAM, and the MAX II CPLD all support 1.8-V I/O, and all three devices share a common address and data bus. The default addressing mode is a 16-bit word mode. Byte mode requires driving BYTEn low.

Table 2-55 lists the required flash memory signals.

**Table 2-55. Flash Interface I/O (Part 1 of 3)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
U9 pin B1	Address bus shared with flash and P-SRAM bit 1	FSM_A1	1.8 V	H23	U5 pin T8 and U4 pin A3 and U10 pin A3 and U5 pin T8
U9 pin C1	Address bus shared with flash and P-SRAM bit 2	FSM_A2	1.8 V	G23	U5 pin T9 and U4 pin A4 and U10 pin A4 and U5 pin T9
U9 pin D1	Address bus shared with flash and P-SRAM bit 3	FSM_A3	1.8 V	F23	U5 pin R9 and U4 pin A5 and U10 pin A5 and U5 pin R9
U9 pin D2	Address bus shared with flash and P-SRAM bit 4	FSM_A4	1.8 V	D27	U5 pin P9 and U4 pin B3 and U10 pin B3 and U5 pin P9
U9 pin A2	Address bus shared with flash and P-SRAM bit 5	FSM_A5	1.8 V	D28	U5 pin T10 and U4 pin B4 and U10 pin B4 and U5 pin T10
U9 pin C2	Address bus shared with flash and P-SRAM bit 6	FSM_A6	1.8 V	F25	U5 pin P13 and U4 pin C3 and U10 pin C3 and U5 pin P13
U9 pin A3	Address bus shared with flash and P-SRAM bit 7	FSM_A7	1.8 V	F26	U5 pin R10 and U4 pin C4 and U10 pin C4 and U5 pin R10
U9 pin B3	Address bus shared with flash and P-SRAM bit 8	FSM_A8	1.8 V	G24	U5 pin M10 and U4 pin D4 and U10 pin D4 and U5 pin M10
U9 pin C3	Address bus shared with flash and P-SRAM bit 9	FSM_A9	1.8 V	F24	U5 pin M11 and U4 pin H2 and U10 pin H2 and U5 pin M11
U9 pin D3	Address bus shared with flash and P-SRAM bit 10	FSM_A10	1.8 V	E26	U5 pin N10 and U4 pin H3 and U10 pin H3 and U5 pin N10
U9 pin C4	Address bus shared with flash and P-SRAM bit 11	FSM_A11	1.8 V	D26	U5 pin R11 and U4 pin H4 and U10 pin H4 and U5 pin R11
U9 pin A5	Address bus shared with flash and P-SRAM bit 12	FSM_A12	1.8 V	A30	U5 pin P10 and U4 pin H5 and U10 pin H5 and U5 pin P10

Table 2-55. Flash Interface I/O (Part 2 of 3)

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
U9 pin B5	Address bus shared with flash and P-SRAM bit 13	FSM_A13	1.8 V	A33	U5 pin T12 and U4 pin G3 and U10 pin G3 and U5 pin T12
U9 pin C5	Address bus shared with flash and P-SRAM bit 14	FSM_A14	1.8 V	B31	U5 pin M11 and U4 pin G4 and U10 pin G4 and U5 pin M11
U9 pin D7	Address bus shared with flash and P-SRAM bit 15	FSM_A15	1.8 V	A31	U5 pin R12 and U4 pin F3 and U10 pin F3 and U5 pin R12
U9 pin D8	Address bus shared with flash and P-SRAM bit 16	FSM_A16	1.8 V	B32	U5 pin N11 and U4 pin F4 and U10 pin F4 and U5 pin N11
U9 pin A7	Address bus shared with flash and P-SRAM bit 17	FSM_A17	1.8 V	A32	U5 pin T13 and U4 pin E4 and U10 pin E4 and U5 pin T13
U9 pin B7	Address bus shared with flash and P-SRAM bit 18	FSM_A18	1.8 V	M23	U5 pin P11 and U4 pin D3 and U10 pin D3 and U5 pin P11
U9 pin C7	Address bus shared with flash and P-SRAM bit 19	FSM_A19	1.8 V	L23	U5 pin R13 and U4 pin H1 and U10 pin H1 and U5 pin R13
U9 pin C8	Address bus shared with flash and P-SRAM bit 20	FSM_A20	1.8 V	B29	U5 pin M1 and U4 pin G2 and U10 pin G2 and U5 pin M1
U9 pin A8	Address bus shared with flash and P-SRAM bit 21	FSM_A21	1.8 V	C29	U5 pin R14 and U4 pin H6 and U10 pin H6 and U5 pin R14
U9 pin G1	Address bus shared with flash and P-SRAM bit 22	FSM_A22	1.8 V	C31	U5 pin N12
U9 pin H8	Address bus shared with flash and P-SRAM bit 23	FSM_A23	1.8 V	D31	U5 pin T15
U9 pin B6	Address bus shared with flash and P-SRAM bit 24	FSM_A24	1.8 V	F27	U5 pin P12
U9 pin F2	Data bus shared with flash and P-SRAM bit 0	FSM_D0	1.8 V	G27	U5 pin P4 and U4 pin B6
U9 pin E2	Data bus shared with flash and P-SRAM bit 1	FSM_D1	1.8 V	F28	U5 pin R1 and U4 pin C5
U9 pin G3	Data bus shared with flash and P-SRAM bit 2	FSM_D2	1.8 V	E28	U5 pin P5 and U4 pin C6
U9 pin E4	Data bus shared with flash and P-SRAM bit 3	FSM_D3	1.8 V	D30	U5 pin T2 and U4 pin D5
U9 pin E5	Data bus shared with flash and P-SRAM bit 4	FSM_D4	1.8 V	C30	U5 pin N5 and U4 pin E5
U9 pin G5	Data bus shared with flash and P-SRAM bit 5	FSM_D5	1.8 V	F29	U5 pin R3 and U4 pin F5
U9 pin G6	Data bus shared with flash and P-SRAM bit 6	FSM_D6	1.8 V	E29	U5 pin P6 and U4 pin F6
U9 pin H7	Data bus shared with flash and P-SRAM bit 7	FSM_D7	1.8 V	J24	U5 pin R4 and U4 pin G6
U9 pin E1	Data bus shared with flash and P-SRAM bit 8	FSM_D8	1.8 V	J25	U5 pin N6 and U4 pin B1
U9 pin E3	Data bus shared with flash and P-SRAM bit 9	FSM_D9	1.8 V	A24	U5 pin T4 and U4 pin C1



**Table 2-55. Flash Interface I/O (Part 3 of 3)**

Board Reference	Description	Schematic Signal Name	I/O Standard	Stratix III Pin Number	Other Connections
U9 pin F3	Data bus shared with flash and P-SRAM bit 10	FSM_D10	1.8 V	A26	U5 pin M6 and U4 pin C2
U9 pin F4	Data bus shared with flash and P-SRAM bit 11	FSM_D11	1.8 V	B25	U5 pin R5 and U4 pin D2
U9 pin F5	Data bus shared with flash and P-SRAM bit 12	FSM_D12	1.8 V	A25	U5 pin P7 and U4 pin E2
U9 pin H5	Data bus shared with flash and P-SRAM bit 13	FSM_D13	1.8 V	J20	U5 pin T5 and U4 pin F2
U9 pin G7	Data bus shared with flash and P-SRAM bit 14	FSM_D14	1.8 V	K20	U5 pin N7 and U4 pin F1
U9 pin E7	Data bus shared with flash and P-SRAM bit 15	FSM_D15	1.8 V	K21	U5 pin R6 and U4 pin G1
U9 pin E6	Clock	FLASH_CLK	1.8 V	K24	U5 pin L15
U9 pin F6	Address valid	FLASH_ADVn	1.8 V	C7	U5 pin L13
U9 pin B4	Chip enable	FLASH_CEn	1.8 V	K25	U5 pin K14
U9 pin F8	Output enable	FLASH_OEn	1.8 V	K23	U5 pin M16
U9 pin F7	Ready/busy	FLASH_RDYBSYn	1.8 V	L16	U5 pin L11
U9 pin D4	Reset	FLASH_RESEn	1.8 V	E13	U5 pin M15
U9 pin G8	Write enable	FLASH_WEn	1.8 V	L22	U5 pin L12

Table 2-56 shows the flash on-board memory map. The memory needs to provide non-volatile storage of a minimum of eight FPGA bit streams as well as various settings data used for on-board devices such as Ethernet TCP/IP defaults, PFL configuration bits, and data on the board itself. The remaining area is designated as user flash area for storage of software binaries and other data relevant to a user FPGA design.

**Table 2-56. Flash Memory Map (Part 1 of 2)**

Name	Address
PFL option bits	0x03FE.0000
Ethernet option bits	0x03FC.0000
User space (10 MBytes)	0x03FB.FFFF 0x0350.0000

**Table 2-56. Flash Memory Map (Part 2 of 2)**

Name	Address
FPGA design 7	0x034E.FFFF 0x0000.0000
FPGA design 6	
FPGA design 5	
FPGA design 4	
FPGA design 3	
FPGA design 2	
FPGA design 1	
FPGA design 0 (Default)	
Factory design	

Table 2-57 shows the flash sector map.

**Table 2-57. Flash Sector Map—Top and Bottom Parameter Dies**

Die Stack Configuration	Size (KBytes)	512-Mbit Flash (2 × 256 Mbits with 1 CE)	
		Block	Address Range
256-Mbit Top Parameter Die	32	517	1FFC000-1FFFFFF
	...	...	...
	32	514	1FF0000-1FF3FFF
	128	513	1FE0000-1FEFFFF
	...	...	...
	128	259	1000000-100FFFF
256-Mbit Bottom Parameter Die	128	258	770000-77FFFF
	...	...	760000-76FFFF
	128	4	...
	32	3	010000-01FFFF
	...	...	000000-00FFFF
	32	0	...



For more read and write timing specification, refer to the Intel Corporation website at [www.intel.com](http://www.intel.com).

Table 2-58 lists the flash memory device component reference and manufacturing information.

**Table 2-58. Flash Memory Device Component Reference and Manufacturing Information**

Board Reference	Description	Manufacturer	Manufacturing Part Number	Manufacturer Website
U9	512 Mbit, 1.7 to 2.0 V core, 64-pin BGA	Intel Corporation	PC48F4400POVB00	<a href="http://www.intel.com">www.intel.com</a>

# Power Supply

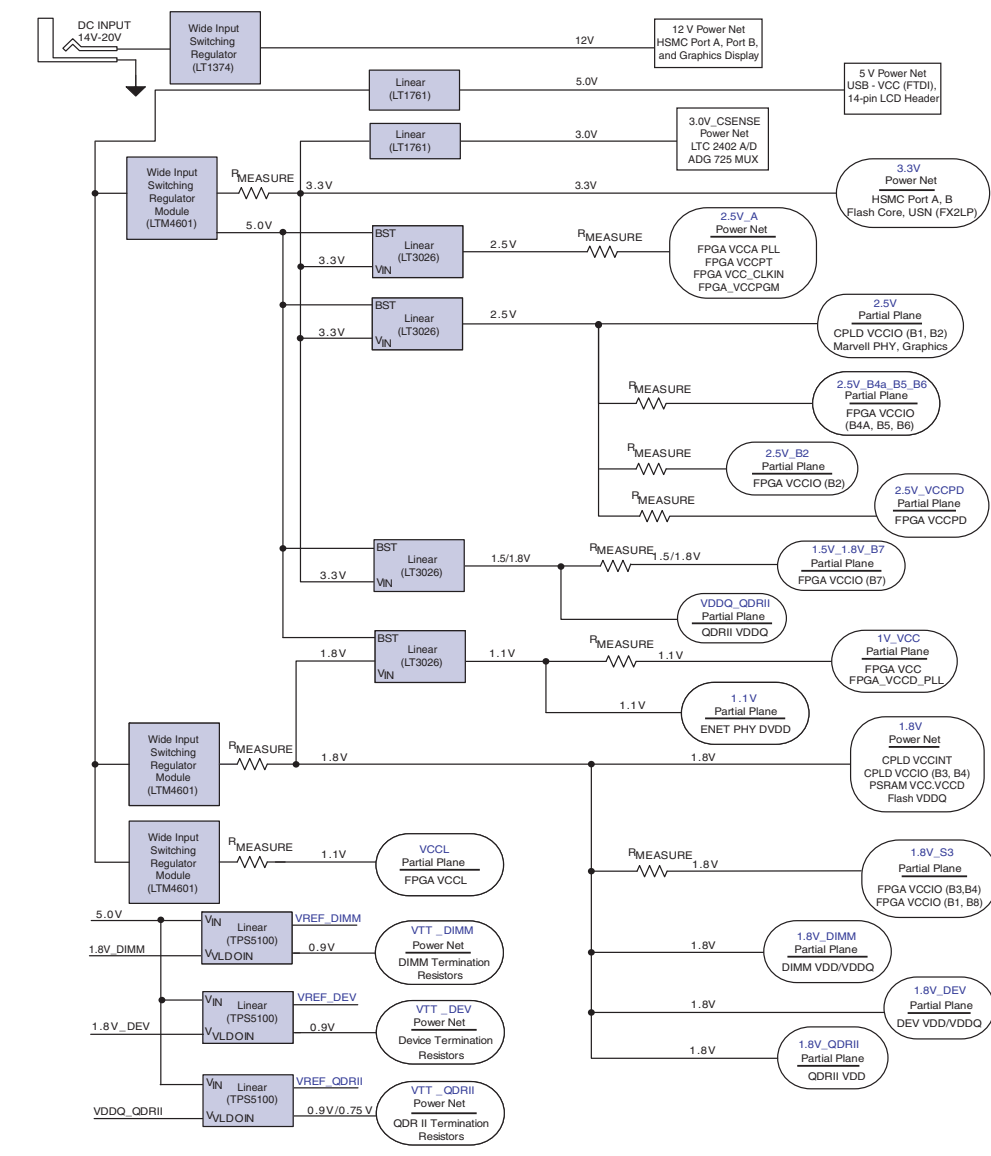
The board's power is provided through an IBM laptop style DC power input. The input voltage must be in the range of 14 V to 20 V. The DC voltage is then stepped down to the various power rails used by the components on the board and installed into the HSMC connectors.

An on-board, multi-channel A/D converter measures both voltage and current for several specific board rails. The power utilization is displayed on either the graphics display or the dedicated 7-segment display.

## Power Distribution System

Figure 2-20 shows the power distribution system, which uses current power rails. The currents shown reflect the regulator inefficiencies and regulator sharing.

Figure 2-20. Power Distribution System



## Power Measurement

Ten power supply rails have on-board voltage and current-sense capabilities. These devices and rails are split from the primary supply plane by a low-value sense resistor for the A/D converter to measure voltage and current.

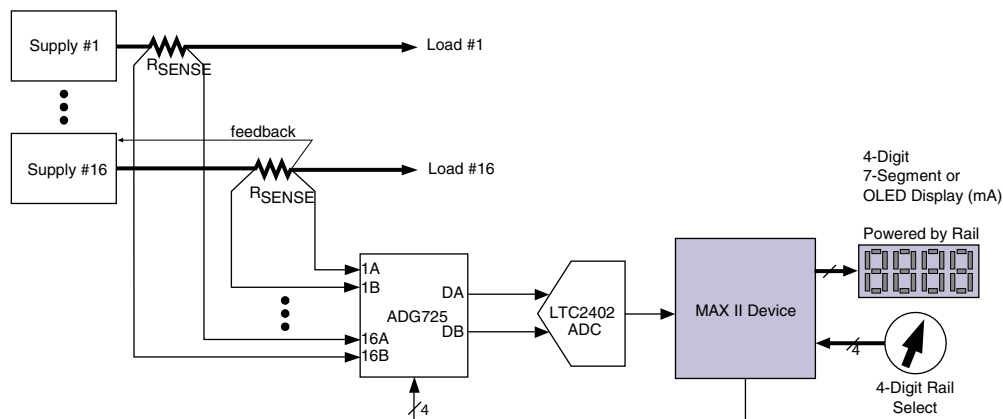
Table 2-59 shows the targeted rails where *Measured Net Name* column shows the name of the rail being measured, and the devices attached to that are listed under *Power Pin Name* and *Description* columns. If no subnet is named, then the power is the total output power for that voltage.

**Table 2-59. Power Measurement Rails**

Number	Measured Net Name	Power Pin Name	Description
1	VCCL	VCCL	FPGA core power
2	1.1V_VCC	VCC	FPGA I/O registers power
		VCCD_PLL	FPGA PLL digital power
3	2.5V_A	VCCPT	FPGA programmable power technology
		VCCA_PLL	FPGA PLL analog power
4	2.5V_VCCPD	VCCPD	Pre-driver power for I/Os
5	2.5V_VCCPGM	VCCPGM	Power for configuration I/Os
7	1.8V_S3	VCCIO1A, VCCIO1C, VCCIO8A, VCCIO8B, VCCIO8C	FPGA I/O power banks 1, 8
		VCCIO3A, VCCIO3B, VCCIO3C, VCCIO4B, VCCIO4C	FPGA I/O power banks 3, 4
8	2.5V_B2	VCCIO2A, VCCIO2C	FPGA I/O power bank 2
9	2.5V_B4A_B5_B6	VCCIO4A, VCCIO5A, VCCIO5C, VCCIO6A, VCCIO6C	FPGA I/O power banks 4a, 5, 6
10	1.5V_1.8V_B7	VCCIO7A, VCCIO7B, VCCIO7C	FPGA I/O power bank 7

This capability is realized using a 32-channel analog multiplexer to a 2-channel differential A/D converter, with a digital data bus connected to the MAX II CPLD. The CPLD contains a logic design that continually monitors the rails and displays the current in mA on the dedicated four-digit, 7-segment display or graphics display. Because only a single rail can be displayed at any time on the 7-segment display, an octal rotary switch is used to select which rail is currently being displayed. The sense resistor is large enough that it can be easily probed to confirm the display results. To see all of the currents at the same time, you can use the graphics display. Figure 2-21 illustrates the circuit.

Figure 2-21. Power Measurement System



## Security Key and Battery Backup

Stratix III devices are protected against copying, reverse engineering, and tampering using configuration bit-stream encryption. Specifically, the Stratix III devices use an advanced encryption standard (AES) algorithm with a 256-bit user-generated key. The key is stored on the Stratix III device and is used to decrypt the incoming configuration data bit-stream before configuration and initialization can begin.

This section discusses the following two methods of storing Stratix III device's 256-bit encryption key:

- Volatile
- Non-volatile

In the volatile scheme, the 256-bit key itself can be reprogrammed as needed. In this case, a 2.5-V battery is required to power the  $V_{CCBAT}$  input and maintain the key within the Stratix III device when the system is powered off.

In the non-volatile scheme, the 256-bit key is programmed once into the Stratix III device and cannot be changed. The advantage of the non-volatile scheme is that a battery is not required to power the  $V_{CCBAT}$  input.

By providing a 2.5-V coin battery connected to the  $V_{CCBAT}$  power input, the board provides support for both volatile and non-volatile keys. A battery socket is also provided to allow battery replacement as needed. Additionally, the  $V_{CCBAT}$  power input has a jumper to allow the  $V_{CCBAT}$  pin to be tied directly to GND when the battery is removed for supporting the non-volatile key mode.



## Statement of China-RoHS Compliance

Table 2-60 lists hazardous substances included with the kit.

**Table 2-60. Table of Hazardous Substances' Name and Concentration** *Notes (1), (2)*

Part Name	Lead (Pb)	Cadmium (Cd)	Hexavalent Chromium (Cr6+)	Mercury (Hg)	Polybrominated biphenyls (PBB)	Polybrominated diphenyl Ethers (PBDE)
Stratix III development board	X*	0	0	0	0	0
12 V power supply	0	0	0	0	0	0
Type A-B USB cable	0	0	0	0	0	0
User guide	0	0	0	0	0	0

**Notes to Table 2-60:**

- (1) 0 indicates that the concentration of the hazardous substance in all homogeneous materials in the parts is below the relevant threshold of the SJ/T11363-2006 standard.
- (2) X\* indicates that the concentration of the hazardous substance of at least one of all homogeneous materials in the parts is above the relevant threshold of the SJ/T11363-2006 standard, but it is exempted by EU RoHS.

This chapter provides additional information about the document and Altera.

## Document Revision History

The following table lists the revision history for this document.

Date	Version	Changes
May 2013	1.5	<ul style="list-style-type: none"> <li>■ Updated the MAX II pin assignment for FSM_A9 signal in <a href="#">Table 2-5</a>.</li> <li>■ Updated the Stratix III pin numbers for DDR2_DEVA_A12, DDR2_DEVA_A13, DDR2_DEVA_A14, DDR2_DEVA_BA0, DDR2_DEVA_BA1, DDR2_DEVA_BA2, and DDR2_DEVA_CASn signals in <a href="#">Table 2-47</a>.</li> <li>■ Updated the Stratix III pin numbers for DDR2_DEVB_DQ2 and DDR2_DEVB_DQ3 signals in <a href="#">Table 2-49</a>.</li> <li>■ Updated the document template.</li> </ul>
November 2008	1.4	<ul style="list-style-type: none"> <li>■ Updated QDRII interface pin information in <a href="#">Table 2-50</a>.</li> </ul>
November 2008	1.3	<ul style="list-style-type: none"> <li>■ Updated DDR2 DIMM board memory size.</li> <li>■ Updated Stratix III pin numbers for the differential output clock signals in <a href="#">Table 2-45</a>.</li> </ul>
August 2008	1.2	<ul style="list-style-type: none"> <li>■ Updated JTAGS settings in <a href="#">Table 2-7</a>.</li> <li>■ Updated “<a href="#">Power Select Rotary Switch</a>” section.</li> <li>■ Corrected pin description in <a href="#">Table 2-32</a>.</li> <li>■ Updated pin description in <a href="#">Table 2-39</a>.</li> <li>■ Updated “<a href="#">High-Speed Mezzanine Cards</a>” section.</li> <li>■ Corrected pin description in <a href="#">Table 2-41</a> and <a href="#">Table 2-42</a>.</li> <li>■ Corrected pin numbers in <a href="#">Table 2-47</a> and <a href="#">Table 2-49</a>.</li> </ul>
March 2008	1.1	Corrected minor errors and incorporated device errata.
December 2007	1.0	First publication

## How to Contact Altera

To locate the most up-to-date information about Altera products, refer to the following table.


Contact <sup>(1)</sup>	Contact Method	Address
Technical support	Website	<a href="http://www.altera.com/support">www.altera.com/support</a>
Technical training	Website	<a href="http://www.altera.com/training">www.altera.com/training</a>
	Email	<a href="mailto:custrain@altera.com">custrain@altera.com</a>
Product literature	Website	<a href="http://www.altera.com/literature">www.altera.com/literature</a>
Nontechnical support (general) (software licensing)	Email	<a href="mailto:nacomp@altera.com">nacomp@altera.com</a>
	Email	<a href="mailto:authorization@altera.com">authorization@altera.com</a>

**Note to Table:**








(1) You can also contact your local Altera sales office or sales representative.

## Typographic Conventions

The following table shows the typographic conventions this document uses.

Visual Cue	Meaning
<b>Bold Type with Initial Capital Letters</b>	Indicate command names, dialog box titles, dialog box options, and other GUI labels. For example, <b>Save As</b> dialog box. For GUI elements, capitalization matches the GUI.
<b>bold type</b>	Indicates directory names, project names, disk drive names, file names, file name extensions, software utility names, and GUI labels. For example, <code>\qdesigns</code> directory, <b>D:</b> drive, and <code>chiptrip.gdf</code> file.
<i>Italic Type with Initial Capital Letters</i>	Indicate document titles. For example, <i>Stratix IV Design Guidelines</i> .
<i>italic type</i>	Indicates variables. For example, $n + 1$ . Variable names are enclosed in angle brackets (< >). For example, <code>&lt;file name&gt;</code> and <code>&lt;project name&gt;.pof</code> file.
Initial Capital Letters	Indicate keyboard keys and menu names. For example, the Delete key and the Options menu.
“Subheading Title”	Quotation marks indicate references to sections in a document and titles of Quartus II Help topics. For example, “Typographic Conventions.”
Courier type	Indicates signal, port, register, bit, block, and primitive names. For example, <code>data1</code> , <code>tdi</code> , and <code>input</code> . The suffix <code>n</code> denotes an active-low signal. For example, <code>resetn</code> . Indicates command line commands and anything that must be typed exactly as it appears. For example, <code>c:\qdesigns\tutorial\chiptrip.gdf</code> . Also indicates sections of an actual file, such as a Report File, references to parts of files (for example, the AHDL keyword <code>SUBDESIGN</code> ), and logic function names (for example, <code>TRI</code> ).
↵	An angled arrow instructs you to press the Enter key.
1., 2., 3., and a., b., c., and so on	Numbered steps indicate a list of items when the sequence of the items is important, such as the steps listed in a procedure.
■ ■ ■	Bullets indicate a list of items when the sequence of the items is not important.
	The hand points to information that requires special attention.



Visual Cue	Meaning
	The question mark directs you to a software help system with related information.
	The feet direct you to another document or website with related information.
	The multimedia icon directs you to a related multimedia presentation.
 CAUTION	A caution calls attention to a condition or possible situation that can damage or destroy the product or your work.
 WARNING	A warning calls attention to a condition or possible situation that can cause you injury.
	The envelope links to the <a href="#">Email Subscription Management Center</a> page of the Altera website, where you can sign up to receive update notifications for Altera documents.
	The feedback icon allows you to submit feedback to Altera about the document. Methods for collecting feedback vary as appropriate for each document.

