# Spartan-3A DSP FPGA Family Data Sheet

DS610 October 4, 2010 **Product Specification**

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**DS610 (v3.0) October 4, 2010**

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**DS610 (v3.0) October 4, 2010**

The functionality of the Spartan®-3A DSP FPGA family is described in the following documents.

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  - Digital Clock Managers (DCMs)
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  - Configurable Logic Blocks (CLBs)
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    - SRL16 Shift Registers
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# Spartan-3A DSP FPGA Family: Introduction and Ordering Information

DS610 (v3.0) October 4, 2010 **Product Specification**

## Introduction

The Spartan®-3A DSP family of Field-Programmable Gate Arrays (FPGAs) solves the design challenges in most high- volume, cost-sensitive, high-performance DSP applications. The two-member family offers densities ranging from 1.8 to 3.4 million system gates, as shown in Table 1.

The Spartan-3A DSP family builds on the success of the Spartan-3A FPGA family by increasing the amount of memory per logic and adding XtremeDSP™ DSP48A slices. New features improve system performance and reduce the cost of configuration. These Spartan-3A DSP FPGA enhancements, combined with proven 90 nm process technology, deliver more functionality and bandwidth per dollar than ever before, setting the new standard in the programmable logic and DSP processing industry.

The Spartan-3A DSP FPGAs extend and enhance the Spartan-3A FPGA family. The XC3SD1800A and the XC3SD3400A devices are tailored for DSP applications and have additional block RAM and XtremeDSP DSP48A slices. The XtremeDSP DSP48A slices replace the 18x18 multipliers found in the Spartan-3A devices and are based on the DSP48 blocks found in the Virtex®-4 devices. The block RAMs are also enhanced to run faster by adding an output register. Both the block RAM and DSP48A slices in the Spartan-3A DSP devices run at 250 MHz in the lowest cost, standard -4 speed grade.

Because of their exceptional DSP price/performance ratio, Spartan-3A DSP FPGAs are ideally suited to a wide range of consumer electronics applications, such as broadband access, home networking, display/projection, and digital television.

The Spartan-3A DSP family is a superior alternative to mask programmed ASICs. FPGAs avoid the high initial cost, lengthy development cycles, and the inherent inflexibility of conventional ASICs. Also, FPGA programmability permits design upgrades in the field with no hardware replacement necessary, an impossibility with ASICs.

## Features

- Very low cost, high-performance DSP solution for high-volume, cost-conscious applications
- 250 MHz XtremeDSP DSP48A Slices
  - Dedicated 18-bit by 18-bit multiplier
  - Available pipeline stages for enhanced performance of at least 250 MHz in the standard -4 speed grade
  - 48-bit accumulator for multiply-accumulate (MAC) operation
  - Integrated adder for complex multiply or multiply-add operation
  - Integrated 18-bit pre-adder
  - Optional cascaded Multiply or MAC
- Hierarchical SelectRAM™ memory architecture
  - Up to 2268 Kbits of fast block RAM with byte write enables for processor applications
  - Up to 373 Kbits of efficient distributed RAM
  - Registered outputs on the block RAM with operation of at least 280 MHz in the standard -4 speed grade
- Dual-range $V_{CCAUX}$ supply simplifies 3.3V-only design
- Suspend, Hibernate modes reduce system power
- Low-power option reduces quiescent current
- Multi-voltage, multi-standard SelectIO™ interface pins
  - Up to 519 I/O pins or 227 differential signal pairs
  - LVCMOS, LVTTL, HSTL, and SSTL single-ended I/O
  - 3.3V, 2.5V, 1.8V, 1.5V, and 1.2V signaling
  - Selectable output drive, up to 24 mA per pin
  - QUIETIO standard reduces I/O switching noise
  - Full 3.3V ± 10% compatibility and hot swap compliance
  - 622+ Mb/s data transfer rate per differential I/O
  - LVDS, RSDS, mini-LVDS, HSTL/SSTL differential I/O with integrated differential termination resistors
  - Enhanced Double Data Rate (DDR) support
  - DDR/DDR2 SDRAM support up to 333 Mb/s
  - Fully compliant 32-/64-bit, 33/66 MHz PCI support
- Abundant, flexible logic resources
  - Densities up to 53712 logic cells, including optional shift register
  - Efficient wide multiplexers, wide logic, fast carry logic
  - IEEE 1149.1/1532 JTAG programming/debug port
- Eight Digital Clock Managers (DCMs)
  - Clock skew elimination (delay locked loop)
  - Frequency synthesis, multiplication, division
  - High-resolution phase shifting
  - Wide frequency range (5 MHz to over 320 MHz)
- Eight low-skew global clock networks, eight additional clocks per half device, plus abundant low-skew routing
- Configuration interface to industry-standard PROMs
  - Low-cost, space-saving SPI serial Flash PROM
  - x8 or x8/x16 BPI parallel NOR Flash PROM
  - Low-cost Xilinx® Platform Flash with JTAG
  - Unique Device DNA identifier for design authentication
  - Load multiple bitstreams under FPGA control
  - Post-configuration CRC checking
- MicroBlaze™ and PicoBlaze™ embedded processor cores
- BGA and CSP packaging with Pb-free options
  - Common footprints support easy density migration
- XA Automotive version available

*Table 1:* **Summary of Spartan-3A DSP FPGA Attributes**

| Device | System Gates | Equivalent Logic Cells | CLB Array (One CLB = Four Slices) | | | | Distributed RAM Bits(1) | Block RAM Bits(1) | DSP48As | DCMs | Maximum User I/O | Maximum Differential I/O Pairs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rows | Columns | Total CLBs | Total Slices | | | | | | |
| XC3SD1800A | 1800K | 37,440 | 88 | 48 | 4,160 | 16,640 | 260K | 1512K | 84 | 8 | 519 | 227 |
| XC3SD3400A | 3400K | 53,712 | 104 | 58 | 5,968 | 23,872 | 373K | 2268K | 126 | 8 | 469 | 213 |

**Notes:**
1. By convention, one Kb is equivalent to 1,024 bits.

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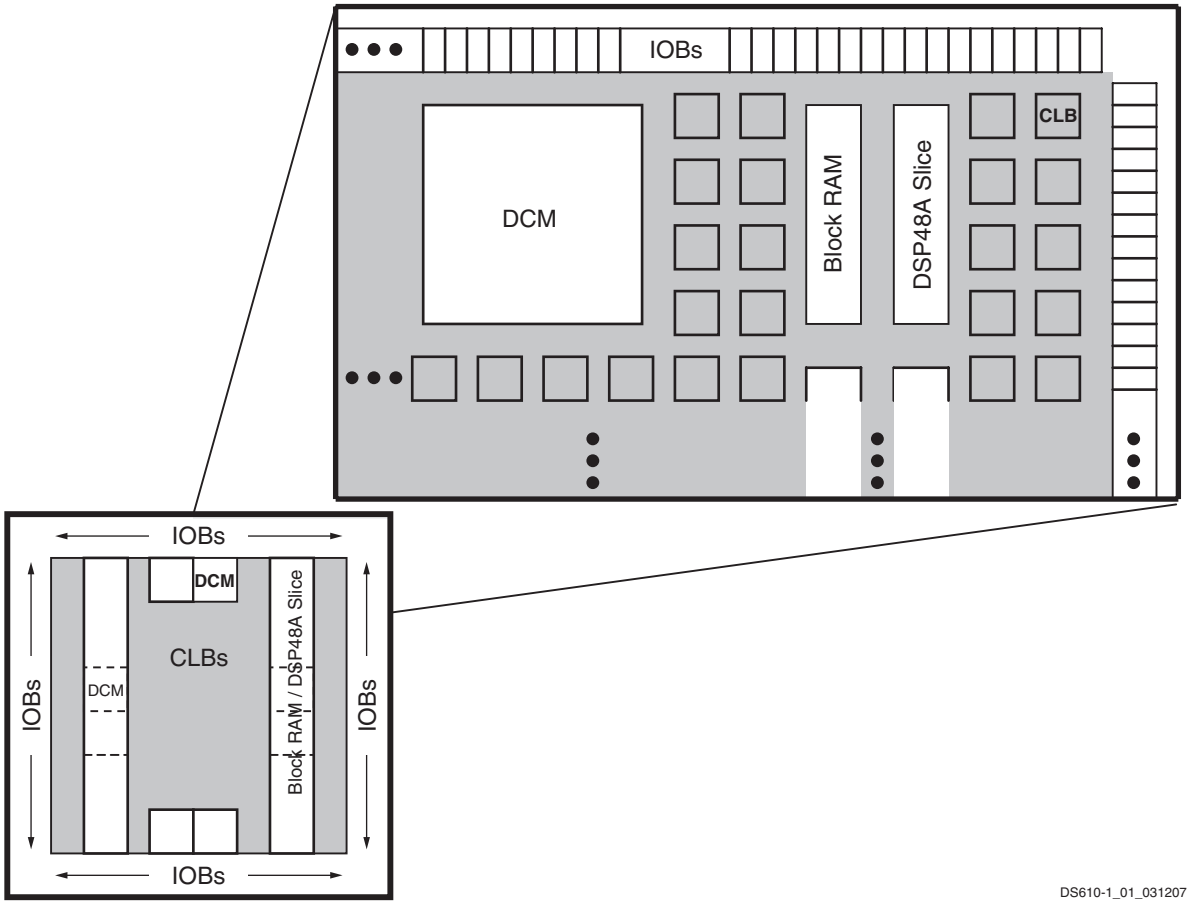
## Architectural Overview

The Spartan-3A DSP family architecture consists of five fundamental programmable functional elements:

- **XtremeDSP™ DSP48A Slice** provides an 18-bit x 18-bit multiplier, 18-bit pre-adder, 48-bit post-adder/accumulator, and cascade capabilities for various DSP applications.
- **Block RAM** provides data storage in the form of 18-Kbit dual-port blocks.
- **Configurable Logic Blocks (CLBs)** contain flexible Look-Up Tables (LUTs) that implement logic plus storage elements used as flip-flops or latches. CLBs perform a wide variety of logical functions as well as store data.
- **Input/Output Blocks (IOBs)** control the flow of data between the I/O pins and the internal logic of the device. IOBs support bidirectional data flow plus 3-state operation. Supports a variety of signal standards, including several high-performance differential standards. Double Data-Rate (DDR) registers are included.
- **Digital Clock Manager (DCM) Blocks** provide self-calibrating, fully digital solutions for distributing, delaying, multiplying, dividing, and phase-shifting clock signals.

These elements are organized as shown in Figure 1. A dual ring of staggered IOBs surrounds a regular array of CLBs. The XC3SD1800A has four columns of DSP48As, and the XC3SD3400A has five columns of DSP48As. Each DSP48A has an associated block RAM. The DCMs are positioned in the center with two at the top and two at the bottom of the device and in the two outer columns of the 4 or 5 columns of block RAM and DSP48As.

The Spartan-3A DSP family features a rich network of routing that interconnect all five functional elements, transmitting signals among them. Each functional element has an associated switch matrix that permits multiple connections to the routing.




**Notes:**

1. The XC3SD1800A and XC3SD3400A have two DCMs on both the left and right sides, as well as the two DCMs at the top and bottom of the devices. The two DCMs on the left and right of the chips are in the middle of the outer Block RAM/DSP48A columns of the 4 or 5 columns in the selected device, as shown in the diagram above.
2. A detailed diagram of the DSP48A can be found in UG431: *XtremeDSP DSP48A for Spartan-3A DSP FPGAs User Guide.*

*Figure 1:* **Spartan-3A DSP Family Architecture**

## Configuration

Spartan-3A DSP FPGAs are programmed by loading configuration data into robust, reprogrammable, static CMOS configuration latches (CCLs) that collectively control all functional elements and routing resources. The FPGA's configuration data is stored externally in a PROM or some other non-volatile medium, either on or off the board. After applying power, the configuration data is written to the FPGA using any of seven different modes:

- Master Serial from a Xilinx Platform Flash PROM
- Serial Peripheral Interface (SPI) from an industry-standard SPI serial Flash
- Byte Peripheral Interface (BPI) Up from an industry-standard x8 or x8/x16 parallel NOR Flash
- Slave Serial, typically downloaded from a processor
- Slave Parallel, typically downloaded from a processor
- Boundary Scan (JTAG), typically downloaded from a processor or system tester

Furthermore, Spartan-3A DSP FPGAs support MultiBoot configuration, allowing two or more FPGA configuration bitstreams to be stored in a single SPI serial Flash or a BPI parallel NOR Flash. The FPGA application controls which configuration to load next and when to load it.

Additionally, each Spartan-3A DSP FPGA contains a unique, factory-programmed Device DNA identifier useful for tracking purposes, anti-cloning designs, or IP protection.

## I/O Capabilities

The Spartan-3A DSP FPGA SelectIO interface supports many popular single-ended and differential standards. Table 2 shows the number of user I/Os as well as the number of differential I/O pairs available for each device/package combination. Some of the user I/Os are unidirectional input-only pins as indicated in Table 2.

Spartan-3A DSP FPGAs support the following single-ended standards:

- 3.3V low-voltage TTL (LVTTL)
- Low-voltage CMOS (LVCMOS) at 3.3V, 2.5V, 1.8V, 1.5V, or 1.2V
- 3.3V PCI at 33 MHz or 66 MHz
- HSTL I, II, and III at 1.5V and 1.8V, commonly used in memory applications
- SSTL I and II at 1.8V, 2.5V, and 3.3V, commonly used for memory applications
- Spartan-3A DSP FPGAs support the following differential standards:
- LVDS, mini-LVDS, RSDS, and PPDS I/O at 2.5V or 3.3V
- Bus LVDS I/O at 2.5V
- TMDS I/O at 3.3V
- Differential HSTL and SSTL I/O
- LVPECL inputs at 2.5V or 3.3V

*Table 2:* **Available User I/Os and Differential (Diff) I/O Pairs**

| Device | CS484<br>CSG484 | | FG676<br>FGG676 | |
|---|---|---|---|---|
| | **User** | **Diff** | **User** | **Diff** |
| XC3SD1800A | **309**(1)<br>*(60)* | **140**<br>*(78)* | **519**<br>*(110)* | **227**<br>*(131)* |
| XC3SD3400A | **309**<br>*(60)* | **140**<br>*(78)* | **469**<br>*(60)* | **213**<br>*(117)* |

**Notes:**

1. The number shown in **bold** indicates the maximum number of I/O and input-only pins. The number shown in (*italics*) indicates the number of input-only pins. The differential (Diff) input-only pin count includes both differential pairs on input-only pins and differential pairs on I/O pins within I/O banks that are restricted to differential inputs.

## Package Marking

Figure 2 shows the top marking for Spartan-3A DSP FPGAs. The "5C" and "4I" Speed Grade/Temperature Range part combinations may be dual marked as "5C/4I". Devices with the dual mark can be used as either -5C or -4I devices. Devices with a single mark are only guaranteed for the marked speed grade and temperature range.

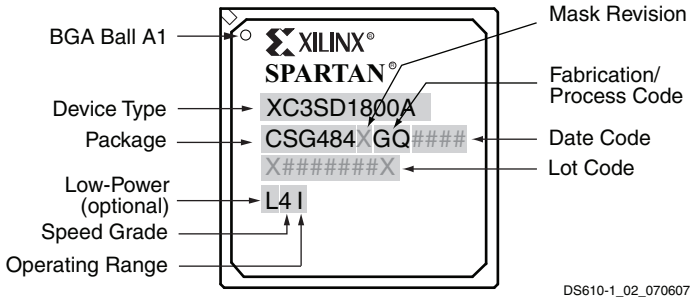
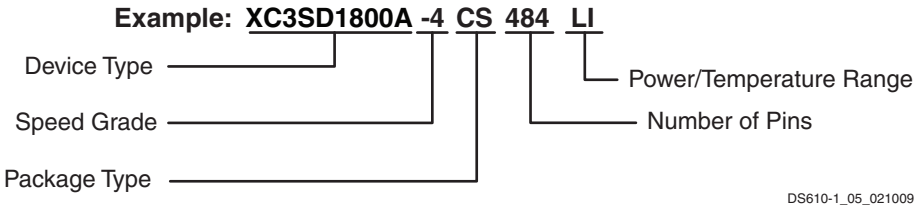



*Figure 2:* **Spartan-3A DSP FPGA Package Marking Example**

## Ordering Information

Spartan-3A DSP FPGAs are available in both standard and Pb-free packaging options for all device/package combinations. The Pb-free packages include a 'G' character in the ordering code.




| Device | Speed Grade | | Package Type / Number of Pins | | Power/Temperature Range ($T_J$) | |
|---|---|---|---|---|---|---|
| XC3SD1800A | -4 | Standard Performance | CS484/ CSG484 | 484-ball Chip-Scale Ball Grid Array (CSBGA) | C | Commercial (0°C to 85°C) |
| XC3SD3400A | -5 | High Performance(1) | FG676/ FGG676 | 676-ball Fine-Pitch Ball Grid Array (FBGA) | I | Industrial (–40°C to 100°C) |
| | | | | | LI | Low-power Industrial (–40°C to 100°C)(2) |

**Notes:**

1. The -5 speed grade is exclusively available in the Commercial temperature range.
2. The low-power option (LI) is exclusively available in the CS(G)484 package and industrial temperature range.
3. See DS705, *XA Spartan-3A DSP Automotive FPGA Family Data Sheet* for the XA Automotive Spartan-3A DSP FPGAs.

## Revision History

The following table shows the revision history for this document.

| Date | Version | Revision |
|---|---|---|
| 04/02/07 | 1.0 | Initial Xilinx release. |
| 05/25/07 | 1.0.1 | Minor edits. |
| 06/18/07 | 1.2 | Updated for Production release. |
| 07/16/07 | 2.0 | Added Low-power options. |
| 06/02/08 | 2.1 | Added reference to SCD 4103 for 750 Mbps performance. Add dual mark clarification to Package Marking. Updated links. |
| 03/11/09 | 2.2 | Simplified ordering information. Removed reference to SCD 4103. |
| 10/04/10 | 3.0 | Updated the Notice of Disclaimer section. |

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# Spartan-3A DSP FPGA Design Documentation

The functionality of the Spartan®-3A DSP FPGA family is described in the following documents. The topics covered in each guide are listed.

- DS706: E*xtended Spartan-3A Family Overview*
- UG331**:** *Spartan-3 Generation FPGA User Guide*
  - Clocking Resources
  - Digital Clock Managers (DCMs)
  - Block RAM
  - Configurable Logic Blocks (CLBs)
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  - XtremeDSP DSP48A Slices
  - XtremeDSP DSP48A Pre-Adder

For specific hardware examples, please see the Spartan-3A DSP FPGA Starter Kit board web pages.

- **XtremeDSP Starter Platform—Spartan-3A DSP 1800A Edition**
  http://www.xilinx.com/products/devkits/HW-SD1800A-DSP-SB-UNI-G.htm
- **XtremeDSP Starter Kit—Spartan-3A DSP 1800A Edition**
  http://www.xilinx.com/products/devkits/DO-SD1800A-DSP-SK-UNI-G.htm
- **XtremeDSP Video Starter Kit—Spartan-3A DSP Edition**
  http://www.xilinx.com/products/devkits/DO-S3ADSP-VIDEO-SK-UNI-G.htm
- **Embedded Development HW/SW Kit—Spartan-3A DSP S3D1800A MicroBlaze Processor Edition**
  http://www.xilinx.com/products/devkits/DO-SD1800A-EDK-DK-UNI-G.htm

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| 05/25/07 | 1.0.1 | Minor edits. |
| 06/18/07 | 1.2 | Updated for Production release. |
| 07/16/07 | 2.0 | Added Low-power options; no changes to this module. |
| 06/02/08 | 2.1 | Updated links. |
| 03/11/09 | 2.2 | Added link to DS706 on Extended Spartan-3A family. |
| 10/04/10 | 3.0 | Updated link to sign up for Alerts and updated Notice of Disclaimer. |

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# DC Electrical Characteristics

In this section, specifications may be designated as Advance, Preliminary, or Production. These terms are defined as follows:

**Advance:** Initial estimates are based on simulation, early characterization, and/or extrapolation from the characteristics of other families. Values are subject to change. Use as estimates, not for production.

**Preliminary:** Based on characterization. Further changes are not expected.

**Production:** These specifications are approved once the silicon has been characterized over numerous production lots. Parameter values are considered stable with no future changes expected.

All parameter limits are representative of worst-case supply voltage and junction temperature conditions. **Unless otherwise noted, the published parameter values apply to all Spartan®-3A DSP devices. AC and DC characteristics are specified using the same numbers for both commercial and industrial grades.**

## Absolute Maximum Ratings

Stresses beyond those listed under Table 3: Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions beyond those listed under the Recommended Operating Conditions is not implied. Exposure to absolute maximum conditions for extended periods of time adversely affects device reliability.

*Table 3:* **Absolute Maximum Ratings**

| Symbol | Description | Conditions | Min | Max | Units |
|---|---|---|---|---|---|
| $V_{CCINT}$ | Internal supply voltage | | –0.5 | 1.32 | V |
| $V_{CCAUX}$ | Auxiliary supply voltage | | –0.5 | 3.75 | V |
| $V_{CCO}$ | Output driver supply voltage | | –0.5 | 3.75 | V |
| $V_{REF}$ | Input reference voltage | | –0.5 | $V_{CCO}$ + 0.5 | V |
| $V_{IN}$ | Voltage applied to all User I/O pins and Dual-Purpose pins | Driver in a high-impedance state | –0.95 | 4.6 | V |
| | Voltage applied to all Dedicated pins | | –0.5 | 4.6 | V |
| $I_{IK}$ | Input clamp current per I/O pin | $-0.5V < V_{IN} < (V_{CCO} + 0.5V)$ (1) | – | ±100 | mA |
| $V_{ESD}$ | Electrostatic Discharge Voltage | Human body model | – | ±2000 | V |
| | | Charged device model | – | ±500 | V |
| | | Machine model | – | ±200 | V |
| $T_J$ | Junction temperature | | – | 125 | °C |
| $T_{STG}$ | Storage temperature | | –65 | 150 | °C |

**Notes:**

1. Upper clamp applies only when using PCI IOSTANDARDs.
2. For soldering guidelines, see UG112: *Device Packaging and Thermal Characteristics* and XAPP427: *Implementation and Solder Reflow Guidelines for Pb-Free Packages*.

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## Power Supply Specifications

*Table 4:* **Supply Voltage Thresholds for Power-On Reset**

| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| $V_{CCINTT}$ | Threshold for the $V_{CCINT}$ supply | 0.4 | 1.0 | V |
| $V_{CCAUXT}$ | Threshold for the $V_{CCAUX}$ supply | 1.0 | 2.0 | V |
| $V_{CCO2T}$ | Threshold for the $V_{CCO}$ Bank 2 supply | 1.0 | 2.0 | V |

**Notes:**

1. $V_{CCINT}$, $V_{CCAUX}$, and $V_{CCO}$ supplies to the FPGA can be applied in any order. However, the FPGA configuration source (Platform Flash, SPI Flash, parallel NOR Flash, microcontroller) might have specific requirements. Check the data sheet for the attached configuration source. Apply $V_{CCINT}$ last for lowest overall power consumption (see the UG331 chapter titled "Powering Spartan-3 Generation FPGAs" for more information).
2. To ensure successful power-on, $V_{CCINT}$, $V_{CCO}$ Bank 2, and $V_{CCAUX}$ supplies must rise through their respective threshold-voltage ranges with no dips at any point.

*Table 5:* **Supply Voltage Ramp Rate**

| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| $V_{CCINTR}$ | Ramp rate from GND to valid $V_{CCINT}$ supply level | 0.2 | 100 | ms |
| $V_{CCAUXR}$ | Ramp rate from GND to valid $V_{CCAUX}$ supply level | 0.2 | 100 | ms |
| $V_{CCO2R}$ | Ramp rate from GND to valid $V_{CCO}$ Bank 2 supply level | 0.2 | 100 | ms |

**Notes:**

1. $V_{CCINT}$, $V_{CCAUX}$, and $V_{CCO}$ supplies to the FPGA can be applied in any order. However, the FPGA configuration source (Platform Flash, SPI Flash, parallel NOR Flash, microcontroller) might have specific requirements. Check the data sheet for the attached configuration source. Apply $V_{CCINT}$ last for lowest overall power consumption (see the UG331 chapter titled "Powering Spartan-3 Generation FPGAs" for more information).
2. To ensure successful power-on, $V_{CCINT}$, $V_{CCO}$ Bank 2, and $V_{CCAUX}$ supplies must rise through their respective threshold-voltage ranges with no dips at any point.

*Table 6:* **Supply Voltage Levels Necessary for Preserving CMOS Configuration Latch (CCL) Contents and RAM Data**

| Symbol | Description | Min | Units |
|---|---|---|---|
| $V_{DRINT}$ | $V_{CCINT}$ level required to retain CMOS Configuration Latch (CCL) and RAM data | 1.0 | V |
| $V_{DRAUX}$ | $V_{CCAUX}$ level required to retain CMOS Configuration Latch (CCL) and RAM data | 2.0 | V |

## General Recommended Operating Conditions

*Table 7:* **General Recommended Operating Conditions**

| Symbol | Description | | | Min | Nominal | Max | Units |
|---|---|---|---|---|---|---|---|
| $T_J$ | Junction temperature | Commercial | | 0 | – | 85 | °C |
| | | Industrial | | –40 | – | 100 | °C |
| $V_{CCINT}$ | Internal supply voltage | | | 1.14 | 1.20 | 1.26 | V |
| $V_{CCO}$ (1) | Output driver supply voltage | | | 1.10 | – | 3.60 | V |
| $V_{CCAUX}$ | Auxiliary supply voltage (2) | $V_{CCAUX}$ = 2.5 | | 2.25 | 2.50 | 2.75 | V |
| | | $V_{CCAUX}$ = 3.3 | | 3.00 | 3.30 | 3.60 | V |
| $V_{IN}$ (3) | Input voltage | PCI™ IOSTANDARD | | –0.5 | – | $V_{CCO}$+0.5 | V |
| | | All other IOSTANDARDs | IP or IO_# | –0.5 | – | 4.10 | V |
| | | | IO_Lxxy_# (4) | –0.5 | – | 4.10 | V |
| $T_{IN}$ | Input signal transition time (5) | | | – | – | 500 | ns |

**Notes:**

1. This $V_{CCO}$ range spans the lowest and highest operating voltages for all supported I/O standards. Table 10 lists the recommended $V_{CCO}$ range specific to each of the single-ended I/O standards, and Table 12 lists that specific to the differential standards.
2. Define $V_{CCAUX}$ selection using CONFIG VCCAUX constraint.
3. See XAPP459, *Eliminating I/O Coupling Effects when Interfacing Large-Swing Single-Ended Signals to User I/O Pins on Spartan-3 Families*.
4. For single-ended signals that are placed on a differential-capable I/O, $V_{IN}$ of –0.2V to –0.5V is supported but can cause increased leakage between the two pins. See *Parasitic Leakage* in UG331, *Spartan-3 Generation FPGA User Guide*.
5. Measured between 10% and 90% $V_{CCO}$. Follow Signal Integrity recommendations.

## General DC Characteristics for I/O Pins

*Table 8:* **General DC Characteristics of User I/O, Dual-Purpose, and Dedicated Pins** (1)

| Symbol | Description | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $I_L$ (2) | Leakage current at User I/O, Input-only, Dual-Purpose, and Dedicated pins, FPGA powered | Driver is in a high-impedance state, $V_{IN}$ = 0V or $V_{CCO}$ max, sample-tested | | –10 | – | +10 | µA |
| $I_{HS}$ | Leakage current on pins during hot socketing, FPGA unpowered | All pins except INIT_B, PROG_B, DONE, and JTAG pins when PUDC_B = 1. | | –10 | – | +10 | µA |
| | | INIT_B, PROG_B, DONE, and JTAG pins or other pins when PUDC_B = 0. | | Add $I_{HS}$ + $I_{RPU}$ | | | µA |
| $I_{RPU}$ (3) | Current through pull-up resistor at User I/O, Dual-Purpose, Input-only, and Dedicated pins. Dedicated pins are powered by $V_{CCAUX}$. | $V_{IN}$ = GND | $V_{CCO}$ or $V_{CCAUX}$ = 3.0V to 3.6V | –151 | –315 | –710 | µA |
| | | | $V_{CCO}$ or $V_{CCAUX}$ = 2.3V to 2.7V | –82 | –182 | –437 | µA |
| | | | $V_{CCO}$ = 1.7V to 1.9V | –36 | –88 | –226 | µA |
| | | | $V_{CCO}$ = 1.4V to 1.6V | –22 | –56 | –148 | µA |
| | | | $V_{CCO}$ = 1.14V to 1.26V | –11 | –31 | –83 | µA |
| $R_{PU}$ (3) | Equivalent pull-up resistor value at User I/O, Dual-Purpose, Input-only, and Dedicated pins (based on $I_{RPU}$ per Note 2) | $V_{IN}$ = GND | $V_{CCO}$ = 3.0V to 3.6V | 5.1 | 11.4 | 23.9 | kΩ |
| | | | $V_{CCO}$ = 2.3V to 2.7V | 6.2 | 14.8 | 33.1 | kΩ |
| | | | $V_{CCO}$ = 1.7V to 1.9V | 8.4 | 21.6 | 52.6 | kΩ |
| | | | $V_{CCO}$ = 1.4V to 1.6V | 10.8 | 28.4 | 74.0 | kΩ |
| | | | $V_{CCO}$ = 1.14V to 1.26V | 15.3 | 41.1 | 119.4 | kΩ |
| $I_{RPD}$ (3) | Current through pull-down resistor at User I/O, Dual-Purpose, Input-only, and Dedicated pins | $V_{IN}$ = $V_{CCO}$ | $V_{CCAUX}$ = 3.0V to 3.6V | 167 | 346 | 659 | µA |
| | | | $V_{CCAUX}$ = 2.25V to 2.75V | 100 | 225 | 457 | µA |
| $R_{PD}$ (3) | Equivalent pull-down resistor value at User I/O, Dual-Purpose, Input-only, and Dedicated pins (based on $I_{RPD}$ per Note 2) | $V_{CCAUX}$ = 3.0V to 3.6V | $V_{IN}$ = 3.0V to 3.6V | 5.5 | 10.4 | 20.8 | kΩ |
| | | | $V_{IN}$ = 2.3V to 2.7V | 4.1 | 7.8 | 15.7 | kΩ |
| | | | $V_{IN}$ = 1.7V to 1.9V | 3.0 | 5.7 | 11.1 | kΩ |
| | | | $V_{IN}$ = 1.4V to 1.6V | 2.7 | 5.1 | 9.6 | kΩ |
| | | | $V_{IN}$ = 1.14V to 1.26V | 2.4 | 4.5 | 8.1 | kΩ |
| | | $V_{CCAUX}$ = 2.25V to 2.75V | $V_{IN}$ = 3.0V to 3.6V | 7.9 | 16.0 | 35.0 | kΩ |
| | | | $V_{IN}$ = 2.3V to 2.7V | 5.9 | 12.0 | 26.3 | kΩ |
| | | | $V_{IN}$ = 1.7V to 1.9V | 4.2 | 8.5 | 18.6 | kΩ |
| | | | $V_{IN}$ = 1.4V to 1.6V | 3.6 | 7.2 | 15.7 | kΩ |
| | | | $V_{IN}$ = 1.14V to 1.26V | 3.0 | 6.0 | 12.5 | kΩ |
| $I_{REF}$ | $V_{REF}$ current per pin | All $V_{CCO}$ levels | | –10 | – | +10 | µA |
| $C_{IN}$ | Input capacitance | – | | – | – | 10 | pF |
| $R_{DT}$ | Resistance of optional differential termination circuit within a differential I/O pair. Not available on Input-only pairs. | $V_{CCO}$ = 3.3V ± 10% | LVDS_33, MINI_LVDS_33, RSDS_33 | 90 | 100 | 115 | Ω |
| | | $V_{CCO}$ = 2.5V ± 10% | LVDS_25, MINI_LVDS_25, RSDS_25 | 90 | 110 | – | Ω |

**Notes:**

1. The numbers in this table are based on the conditions set forth in Table 7.
2. For single-ended signals that are placed on a differential-capable I/O, $V_{IN}$ of –0.2V to –0.5V is supported but can cause increased leakage between the two pins. See *Parasitic Leakage* in UG331, *Spartan-3 Generation FPGA User Guide*.
3. This parameter is based on characterization. The pull-up resistance $R_{PU}$ = $V_{CCO}$/$I_{RPU}$. The pull-down resistance $R_{PD}$ = $V_{IN}$ / $I_{RPD}$.

## Quiescent Current Requirements

*Table 9:* **Quiescent Supply Current Characteristics**[1]

| Symbol | Description | Device | Power | Typical[2] | Commercial Maximum[2] | Industrial Maximum[2] | Units |
|---|---|---|---|---|---|---|---|
| $I_{CCINTQ}$ | Quiescent $V_{CCINT}$ supply current | XC3SD1800A | C,I | 41 | 390 | 500 | mA |
| | | | LI | 36 | – | 175 | mA |
| | | XC3SD3400A | C,I | 64 | 550 | 725 | mA |
| | | | LI | 55 | – | 300 | mA |
| $I_{CCOQ}$ | Quiescent $V_{CCO}$ supply current | XC3SD1800A | C,I | 0.4 | 4 | 5 | mA |
| | | | LI | 0.2 | – | 5 | mA |
| | | XC3SD3400A | C,I | 0.4 | 4 | 5 | mA |
| | | | LI | 0.2 | – | 5 | mA |
| $I_{CCAUXQ}$ | Quiescent $V_{CCAUX}$ supply current | XC3SD1800A | C,I | 25 | 90 | 110 | mA |
| | | | LI | 24 | – | 72 | mA |
| | | XC3SD3400A | C,I | 39 | 130 | 160 | mA |
| | | | LI | 38 | – | 105 | mA |

**Notes:**

1. The numbers in this table are based on the conditions set forth in Table 7.
2. Quiescent supply current is measured with all I/O drivers in a high-impedance state and with all pull-up/pull-down resistors at the I/O pads disabled. Typical values are characterized using typical devices at room temperature ($T_J$ of 25°C at $V_{CCINT}$ = 1.2V, $V_{CCO}$ = 3.3V, and $V_{CCAUX}$ = 2.5V). The maximum limits are tested for each device at the respective maximum specified junction temperature and at maximum voltage limits with $V_{CCINT}$ = 1.26V, $V_{CCO}$ = 3.6V, and $V_{CCAUX}$ = 3.6V. The FPGA is programmed with a "blank" configuration data file (that is, a design with no functional elements instantiated). For conditions other than those described above (for example, a design including functional elements), measured quiescent current levels will be different than the values in the table.
3. For more accurate estimates for a specific design, use the Xilinx XPower tools. There are two recommended ways to estimate the total power consumption (quiescent plus dynamic) for a specific design: a) The Spartan-3A DSP FPGA XPower Estimator provides quick, approximate, typical estimates, and does not require a netlist of the design. b) XPower Analyzer uses a netlist as input to provide maximum estimates as well as more accurate typical estimates.
4. The maximum numbers in this table indicate the minimum current each power rail requires in order for the FPGA to power-on successfully.
5. For information on the power-saving Suspend mode, see XAPP480: *Using Suspend Mode in Spartan-3 Generation FPGAs*. Suspend mode typically saves 40% total power consumption compared to quiescent current.

## Single-Ended I/O Standards

*Table 10:* **Recommended Operating Conditions for User I/Os Using Single-Ended Standards**

| IOSTANDARD Attribute | $V_{CCO}$ for Drivers[2] | | | $V_{REF}$ | | | $V_{IL}$ | $V_{IH}$[3] |
|---|---|---|---|---|---|---|---|---|
| | Min (V) | Nom (V) | Max (V) | Min (V) | Nom (V) | Max (V) | Max (V) | Min (V) |
| LVTTL | 3.0 | 3.3 | 3.6 | $V_{REF}$ is not used for these I/O standards | | | 0.8 | 2.0 |
| LVCMOS33[4] | 3.0 | 3.3 | 3.6 | | | | 0.8 | 2.0 |
| LVCMOS25[4,5] | 2.3 | 2.5 | 2.7 | | | | 0.7 | 1.7 |
| LVCMOS18 | 1.65 | 1.8 | 1.95 | | | | 0.4 | 0.8 |
| LVCMOS15 | 1.4 | 1.5 | 1.6 | | | | 0.4 | 0.8 |
| LVCMOS12 | 1.1 | 1.2 | 1.3 | | | | 0.4 | 0.7 |
| PCI33_3[6] | 3.0 | 3.3 | 3.6 | | | | 0.3 • $V_{CCO}$ | 0.5 • $V_{CCO}$ |
| PCI66_3[6] | 3.0 | 3.3 | 3.6 | | | | 0.3 • $V_{CCO}$ | 0.5 • $V_{CCO}$ |
| HSTL_I | 1.4 | 1.5 | 1.6 | 0.68 | 0.75 | 0.9 | $V_{REF}$ – 0.1 | $V_{REF}$ + 0.1 |
| HSTL_III | 1.4 | 1.5 | 1.6 | – | 0.9 | – | $V_{REF}$ – 0.1 | $V_{REF}$ + 0.1 |
| HSTL_I_18 | 1.7 | 1.8 | 1.9 | 0.8 | 0.9 | 1.1 | $V_{REF}$ – 0.1 | $V_{REF}$ + 0.1 |
| HSTL_II_18 | 1.7 | 1.8 | 1.9 | – | 0.9 | – | $V_{REF}$ – 0.1 | $V_{REF}$ + 0.1 |
| HSTL_III_18 | 1.7 | 1.8 | 1.9 | – | 1.1 | – | $V_{REF}$ – 0.1 | $V_{REF}$ + 0.1 |
| SSTL18_I | 1.7 | 1.8 | 1.9 | 0.833 | 0.900 | 0.969 | $V_{REF}$ – 0.125 | $V_{REF}$ + 0.125 |
| SSTL18_II | 1.7 | 1.8 | 1.9 | 0.833 | 0.900 | 0.969 | $V_{REF}$ – 0.125 | $V_{REF}$ + 0.125 |
| SSTL2_I | 2.3 | 2.5 | 2.7 | 1.13 | 1.25 | 1.38 | $V_{REF}$ – 0.150 | $V_{REF}$ + 0.150 |
| SSTL2_II | 2.3 | 2.5 | 2.7 | 1.13 | 1.25 | 1.38 | $V_{REF}$ – 0.150 | $V_{REF}$ + 0.150 |
| SSTL3_I | 3.0 | 3.3 | 3.6 | 1.3 | 1.5 | 1.7 | $V_{REF}$ – 0.2 | $V_{REF}$ + 0.2 |
| SSTL3_II | 3.0 | 3.3 | 3.6 | 1.3 | 1.5 | 1.7 | $V_{REF}$ – 0.2 | $V_{REF}$ + 0.2 |

**Notes:**

1. Descriptions of the symbols used in this table are as follows:
   $V_{CCO}$—the supply voltage for output drivers
   $V_{REF}$—the reference voltage for setting the input switching threshold
   $V_{IL}$—the input voltage that indicates a Low logic level
   $V_{IH}$—the input voltage that indicates a High logic level
2. In general, the $V_{CCO}$ rails supply only output drivers, not input circuits. The exceptions are for LVCMOS25 inputs when $V_{CCAUX}$ = 3.3V range and for PCI I/O standards.
3. For device operation, the maximum signal voltage ($V_{IH}$ max) can be as high as $V_{IN}$ max. See Table 7.
4. There is approximately 100 mV of hysteresis on inputs using LVCMOS33 and LVCMOS25 I/O standards.
5. All Dedicated pins (PROG_B, DONE, SUSPEND, TCK, TDI, TDO, and TMS) draw power from the $V_{CCAUX}$ rail and use the LVCMOS25 or LVCMOS33 standard depending on $V_{CCAUX}$. The Dual-Purpose configuration pins use the LVCMOS standard before the User mode. When using these pins as part of a standard 2.5V configuration interface, apply 2.5V to the $V_{CCO}$ lines of Banks 0, 1, and 2 at power-on as well as throughout configuration.
6. For information on PCI IP solutions, see www.xilinx.com/pci. The PCI IOSTANDARD is not supported on input-only pins. The PCIX IOSTANDARD is available and has equivalent characteristics but no PCI-X IP is supported.

*Table 11:* **DC Characteristics of User I/Os Using Single-Ended Standards**

| IOSTANDARD Attribute | | Test Conditions | | Logic Level Characteristics | |
|---|---|---|---|---|---|
| | | $I_{OL}$ (mA) | $I_{OH}$ (mA) | $V_{OL}$ Max (V) | $V_{OH}$ Min (V) |
| LVTTL(3) | 2 | 2 | –2 | 0.4 | 2.4 |
| | 4 | 4 | –4 | | |
| | 6 | 6 | –6 | | |
| | 8 | 8 | –8 | | |
| | 12 | 12 | –12 | | |
| | 16 | 16 | –16 | | |
| | 24 | 24 | –24 | | |
| LVCMOS33(3) | 2 | 2 | –2 | 0.4 | $V_{CCO}$ – 0.4 |
| | 4 | 4 | –4 | | |
| | 6 | 6 | –6 | | |
| | 8 | 8 | –8 | | |
| | 12 | 12 | –12 | | |
| | 16 | 16 | –16 | | |
| | 24(5) | 24 | –24 | | |
| LVCMOS25(3) | 2 | 2 | –2 | 0.4 | $V_{CCO}$ – 0.4 |
| | 4 | 4 | –4 | | |
| | 6 | 6 | –6 | | |
| | 8 | 8 | –8 | | |
| | 12 | 12 | –12 | | |
| | 16(5) | 16 | –16 | | |
| | 24(5) | 24 | –24 | | |
| LVCMOS18(3) | 2 | 2 | –2 | 0.4 | $V_{CCO}$ – 0.4 |
| | 4 | 4 | –4 | | |
| | 6 | 6 | –6 | | |
| | 8 | 8 | –8 | | |
| | 12(5) | 12 | –12 | | |
| | 16(5) | 16 | –16 | | |
| LVCMOS15(3) | 2 | 2 | –2 | 0.4 | $V_{CCO}$ – 0.4 |
| | 4 | 4 | –4 | | |
| | 6 | 6 | –6 | | |
| | 8(5) | 8 | –8 | | |
| | 12(5) | 12 | –12 | | |
| LVCMOS12(3) | 2 | 2 | –2 | 0.4 | $V_{CCO}$ – 0.4 |
| | 4(5) | 4 | –4 | | |
| | 6(5) | 6 | –6 | | |

*Table 11:* **DC Characteristics of User I/Os Using Single-Ended Standards *(Cont'd)***

| IOSTANDARD Attribute | Test Conditions | | Logic Level Characteristics | |
|---|---|---|---|---|
| | $I_{OL}$ (mA) | $I_{OH}$ (mA) | $V_{OL}$ Max (V) | $V_{OH}$ Min (V) |
| PCI33_3(4) | 1.5 | –0.5 | 10% $V_{CCO}$ | 90% $V_{CCO}$ |
| PCI66_3(4) | 1.5 | –0.5 | 10% $V_{CCO}$ | 90% $V_{CCO}$ |
| HSTL_I (5) | 8 | –8 | 0.4 | $V_{CCO}$ – 0.4 |
| HSTL_III (5) | 24 | –8 | 0.4 | $V_{CCO}$ – 0.4 |
| HSTL_I_18 | 8 | –8 | 0.4 | $V_{CCO}$ – 0.4 |
| HSTL_II_18(5) | 16 | –16 | 0.4 | $V_{CCO}$ – 0.4 |
| HSTL_III_18 | 24 | –8 | 0.4 | $V_{CCO}$ – 0.4 |
| SSTL18_I | 6.7 | –6.7 | $V_{TT}$ – 0.475 | $V_{TT}$ + 0.475 |
| SSTL18_II(5) | 13.4 | –13.4 | $V_{TT}$ – 0.603 | $V_{TT}$ + 0.603 |
| SSTL2_I | 8.1 | –8.1 | $V_{TT}$ – 0.61 | $V_{TT}$ + 0.61 |
| SSTL2_II(5) | 16.2 | –16.2 | $V_{TT}$ – 0.81 | $V_{TT}$ + 0.81 |
| SSTL3_I | 8 | –8 | $V_{TT}$ – 0.6 | $V_{TT}$ + 0.6 |
| SSTL3_II(5) | 16 | –16 | $V_{TT}$ – 0.8 | $V_{TT}$ + 0.8 |

**Notes:**

1. The numbers in this table are based on the conditions set forth in Table 7 and Table 10.
2. Descriptions of the symbols used in this table are as follows:
   $I_{OL}$—the output current condition under which VOL is tested
   $I_{OH}$—the output current condition under which VOH is tested
   $V_{OL}$— the output voltage that indicates a Low logic level
   $V_{OH}$—the output voltage that indicates a High logic level
   $V_{CCO}$—the supply voltage for output drivers
   $V_{TT}$—the voltage applied to a resistor termination
3. For the LVCMOS and LVTTL standards: the same $V_{OL}$ and $V_{OH}$ limits apply for the Fast, Slow, and QUIETIO slew attributes.
4. Tested according to the relevant PCI specifications. For information on PCI IP solutions, see www.xilinx.com/products/design_resources/conn_central/protocols/pci_pcix.htm. The PCIX IOSTANDARD is available and has equivalent characteristics but no PCI-X IP is supported.
5. These higher-drive output standards are supported only on FPGA banks 1 and 3. Inputs are unrestricted. See the *Using I/O Resources* chapter in UG331.

# Differential I/O Standards

## Differential Input Pairs

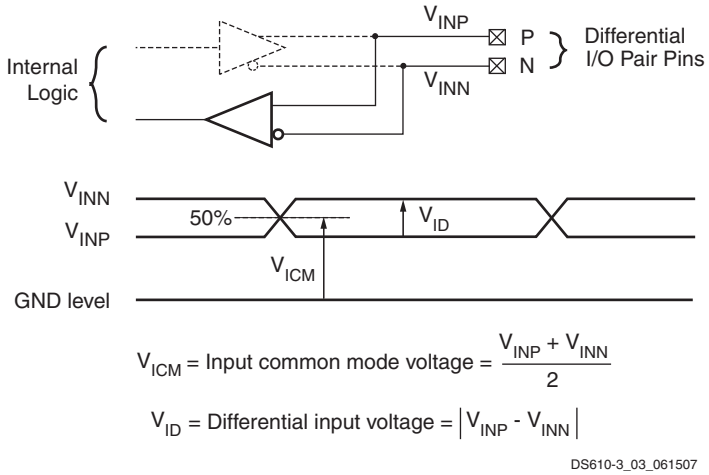



*Figure 3:* **Differential Input Voltages**

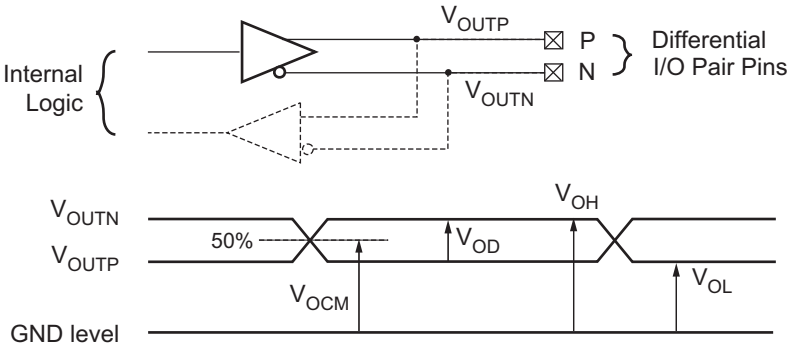
*Table 12:* **Recommended Operating Conditions for User I/Os Using Differential Signal Standards**

| IOSTANDARD Attribute | $V_{CCO}$ for Drivers[1] | | | $V_{ID}$ | | | $V_{ICM}$[2] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min (V) | Nom (V) | Max (V) | Min (mV) | Nom (mV) | Max (mV) | Min (V) | Nom (V) | Max (V) |
| LVDS_25[3] | 2.25 | 2.5 | 2.75 | 100 | 350 | 600 | 0.3 | 1.25 | 2.35 |
| LVDS_33[3] | 3.0 | 3.3 | 3.6 | 100 | 350 | 600 | 0.3 | 1.25 | 2.35 |
| BLVDS_25[4] | 2.25 | 2.5 | 2.75 | 100 | 300 | – | 0.3 | 1.3 | 2.35 |
| MINI_LVDS_25[3] | 2.25 | 2.5 | 2.75 | 200 | – | 600 | 0.3 | 1.2 | 1.95 |
| MINI_LVDS_33[3] | 3.0 | 3.3 | 3.6 | 200 | – | 600 | 0.3 | 1.2 | 1.95 |
| LVPECL_25[5] | Inputs Only | | | 100 | 800 | 1000 | 0.3 | 1.2 | 1.95 |
| LVPECL_33[5] | Inputs Only | | | 100 | 800 | 1000 | 0.3 | 1.2 | 2.8[6] |
| RSDS_25[3] | 2.25 | 2.5 | 2.75 | 100 | 200 | – | 0.3 | 1.2 | 1.5 |
| RSDS_33[3] | 3.0 | 3.3 | 3.6 | 100 | 200 | – | 0.3 | 1.2 | 1.5 |
| TMDS_33[3,4,7] | 3.14 | 3.3 | 3.47 | 150 | – | 1200 | 2.7 | – | 3.23 |
| PPDS_25[3] | 2.25 | 2.5 | 2.75 | 100 | – | 400 | 0.2 | – | 2.3 |
| PPDS_33[3] | 3.0 | 3.3 | 3.6 | 100 | – | 400 | 0.2 | – | 2.3 |
| DIFF_HSTL_I_18 | 1.7 | 1.8 | 1.9 | 100 | – | – | 0.8 | – | 1.1 |
| DIFF_HSTL_II_18[8] | 1.7 | 1.8 | 1.9 | 100 | – | – | 0.8 | – | 1.1 |
| DIFF_HSTL_III_18 | 1.7 | 1.8 | 1.9 | 100 | – | – | 0.8 | – | 1.1 |
| DIFF_HSTL_I | 1.4 | 1.5 | 1.6 | 100 | – | – | 0.68 | – | 0.9 |
| DIFF_HSTL_III | 1.4 | 1.5 | 1.6 | 100 | – | – | – | 0.9 | – |
| DIFF_SSTL18_I | 1.7 | 1.8 | 1.9 | 100 | – | – | 0.7 | – | 1.1 |
| DIFF_SSTL18_II[8] | 1.7 | 1.8 | 1.9 | 100 | – | – | 0.7 | – | 1.1 |
| DIFF_SSTL2_I | 2.3 | 2.5 | 2.7 | 100 | – | – | 1.0 | – | 1.5 |
| DIFF_SSTL2_II[8] | 2.3 | 2.5 | 2.7 | 100 | – | – | 1.0 | – | 1.5 |
| DIFF_SSTL3_I | 3.0 | 3.3 | 3.6 | 100 | – | – | 1.1 | – | 1.9 |
| DIFF_SSTL3_II | 3.0 | 3.3 | 3.6 | 100 | – | – | 1.1 | – | 1.9 |

**Notes:**

1. The $V_{CCO}$ rails supply only differential output drivers, not input circuits.
2. $V_{ICM}$ must be less than $V_{CCAUX}$.
3. These true differential output standards are supported only on FPGA banks 0 and 2. Inputs are unrestricted. See the chapter "Using I/O Resources" in UG331.
4. See "External Termination Requirements for Differential I/O."
5. LVPECL is supported on inputs only, not outputs. LVPECL_33 requires $V_{CCAUX}$ = 3.3V ± 10%.
6. LVPECL_33 maximum $V_{ICM}$ = the lower of 2.8V or $V_{CCAUX} - (V_{ID}/2)$.
7. Requires $V_{CCAUX}$ = 3.3V ±10%. ($V_{CCAUX}$ - 300 mV) ≤ $V_{ICM}$ ≤ ($V_{CCAUX}$ - 37 mV).
8. These higher-drive output standards are supported only on FPGA banks 1 and 3. Inputs are unrestricted. See the chapter "Using I/O Resources" in UG331.
9. All standards except for LVPECL and TMDS can have VCCAUX at either 2.5V or 3.3V. Define your VCCAUX level using the CONFIG VCCAUX constraint.

## Differential Output Pairs




$V_{OCM}$ = Output common mode voltage = $\frac{V_{OUTP} + V_{OUTN}}{2}$

$V_{OD}$ = Output differential voltage = $|V_{OUTP} - V_{OUTN}|$

$V_{OH}$ = Output voltage indicating a High logic level

$V_{OL}$ = Output voltage indicating a Low logic level

DS312-3_03_090510

*Figure 4:* **Differential Output Voltages**

*Table 13:* **DC Characteristics of User I/Os Using Differential Signal Standards**

| IOSTANDARD Attribute | $V_{OD}$ | | | $V_{OCM}$ | | | $V_{OH}$ | $V_{OL}$ |
|---|---|---|---|---|---|---|---|---|
| | Min (mV) | Typ (mV) | Max (mV) | Min (V) | Typ (V) | Max (V) | Min (V) | Max (V) |
| LVDS_25 | 247 | 350 | 454 | 1.125 | – | 1.375 | – | – |
| LVDS_33 | 247 | 350 | 454 | 1.125 | – | 1.375 | – | – |
| BLVDS_25 | 240 | 350 | 460 | – | 1.30 | – | – | – |
| MINI_LVDS_25 | 300 | – | 600 | 1.0 | – | 1.4 | – | – |
| MINI_LVDS_33 | 300 | – | 600 | 1.0 | – | 1.4 | – | – |
| RSDS_25 | 100 | – | 400 | 1.0 | – | 1.4 | – | – |
| RSDS_33 | 100 | – | 400 | 1.0 | – | 1.4 | – | – |
| TMDS_33 | 400 | – | 800 | $V_{CCO}$ – 0.405 | – | $V_{CCO}$ – 0.190 | – | – |
| PPDS_25 | 100 | – | 400 | 0.5 | 0.8 | 1.4 | – | – |
| PPDS_33 | 100 | – | 400 | 0.5 | 0.8 | 1.4 | – | – |
| DIFF_HSTL_I_18 | – | – | – | – | – | – | $V_{CCO}$ – 0.4 | 0.4 |
| DIFF_HSTL_II_18 | – | – | – | – | – | – | $V_{CCO}$ – 0.4 | 0.4 |
| DIFF_HSTL_III_18 | – | – | – | – | – | – | $V_{CCO}$ – 0.4 | 0.4 |
| DIFF_HSTL_I | – | – | – | – | – | – | $V_{CCO}$ – 0.4 | 0.4 |
| DIFF_HSTL_III | – | – | – | – | – | – | $V_{CCO}$ – 0.4 | 0.4 |
| DIFF_SSTL18_I | – | – | – | – | – | – | $V_{TT}$ + 0.475 | $V_{TT}$ – 0.475 |
| DIFF_SSTL18_II | – | – | – | – | – | – | $V_{TT}$ + 0.603 | $V_{TT}$ – 0.603 |
| DIFF_SSTL2_I | – | – | – | – | – | – | $V_{TT}$ + 0.61 | $V_{TT}$ – 0.61 |
| DIFF_SSTL2_II | – | – | – | – | – | – | $V_{TT}$ + 0.81 | $V_{TT}$ – 0.81 |
| DIFF_SSTL3_I | – | – | – | – | – | – | $V_{TT}$ + 0.6 | $V_{TT}$ - 0.6 |
| DIFF_SSTL3_II | – | – | – | – | – | – | $V_{TT}$ + 0.8 | $V_{TT}$ - 0.8 |

**Notes:**

1. The numbers in this table are based on the conditions set forth in Table 7 and Table 12.
2. See "External Termination Requirements for Differential I/O."
3. Output voltage measurements for all differential standards are made with a termination resistor ($R_T$) of 100Ω across the N and P pins of the differential signal pair.
4. At any given time, no more than two of the following differential output standards can be assigned to an I/O bank: LVDS_25, RSDS_25, MINI_LVDS_25, PPDS_25 when $V_{CCO}$=2.5V, or LVDS_33, RSDS_33, MINI_LVDS_33, TMDS_33, PPDS_33 when $V_{CCO}$ = 3.3V

## External Termination Requirements for Differential I/O

### *LVDS, RSDS, MINI_LVDS, and PPDS I/O Standards*

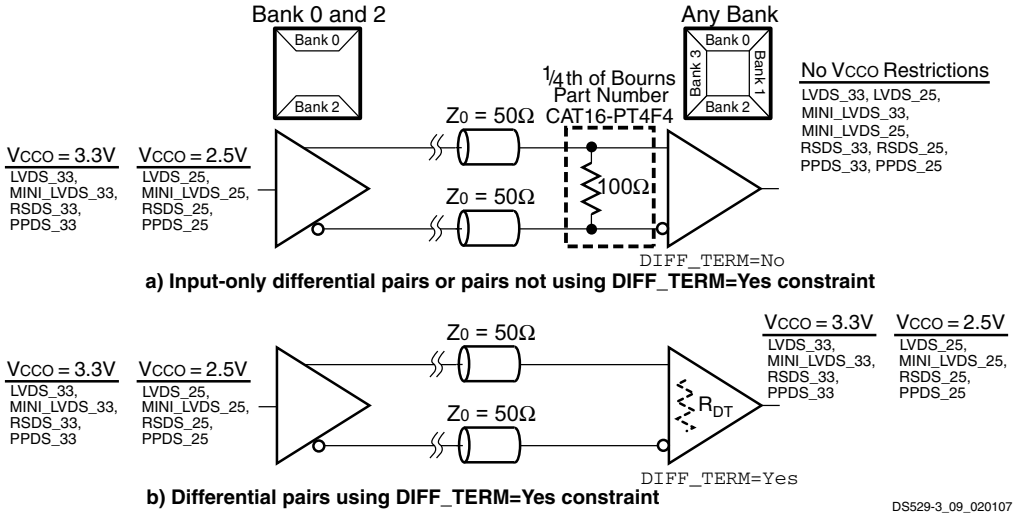



*Figure 5:* **External Input Termination for LVDS, RSDS, MINI_LVDS, and PPDS I/O Standards**

### *BLVDS_25 I/O Standard*

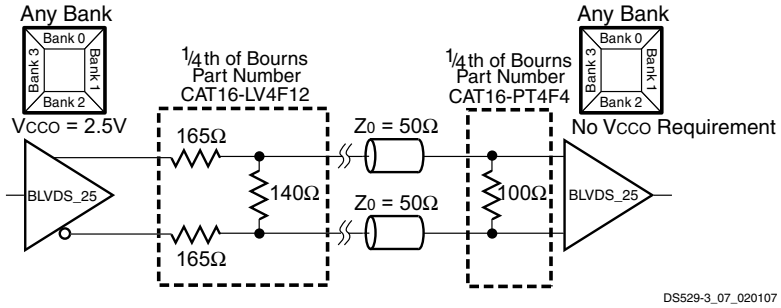



*Figure 6:* **External Output and Input Termination Resistors for BLVDS_25 I/O Standard**

### *TMDS_33 I/O Standard*

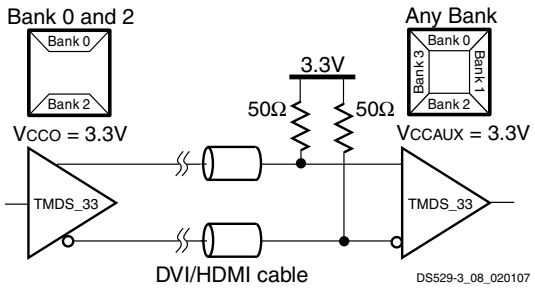



*Figure 7:* **External Input Resistors Required for TMDS_33 I/O Standard**

## Device DNA Read Endurance

*Table 14:* **Device DNA Identifier Memory Characteristics**

| Symbol | Description | Minimum | Units |
|---|---|---|---|
| DNA_CYCLES | Number of READ operations or JTAG ISC_DNA read operations. Unaffected by HOLD or SHIFT operations. | 30,000,000 | Read cycles |

## Switching Characteristics

All Spartan-3A DSP FPGAs ship in two speed grades: –4 and the higher performance –5. Switching characteristics in this document are designated as Advance, Preliminary, or Production, as shown in Table 15. Each category is defined as follows:

**Advance**: These specifications are based on simulations only and are typically available soon after establishing FPGA specifications. Although speed grades with this designation are considered relatively stable and conservative, some under-reporting might still occur.

**Preliminary**: These specifications are based on complete early silicon characterization. Devices and speed grades with this designation are intended to give a better indication of the expected performance of production silicon. The probability of under-reporting preliminary delays is greatly reduced compared to Advance data.

**Production**: These specifications are approved once enough production silicon of a particular device family member has been characterized to provide full correlation between speed files and devices over numerous production lots. There is no under-reporting of delays, and customers receive formal notification of any subsequent changes. Typically, the slowest speed grades transition to Production before faster speed grades.

## Software Version Requirements

Production-quality systems must use FPGA designs compiled using a speed file designated as PRODUCTION status. FPGAs designs using a less mature speed file designation should only be used during system prototyping or pre-production qualification. FPGA designs with speed files designated as Preview, Advance, or Preliminary should not be used in a production-quality system.

Whenever a speed file designation changes, as a device matures toward Production status, rerun the latest Xilinx® ISE® software on the FPGA design to ensure that the FPGA design incorporates the latest timing information and software updates.

Production designs will require updating the Xilinx ISE development software with a future version and/or Service Pack.

All parameter limits are representative of worst-case supply voltage and junction temperature conditions. **Unless otherwise noted, the published parameter values apply to all Spartan-3A DSP devices. AC and DC characteristics are specified using the same numbers for both commercial and industrial grades.**

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Timing parameters and their representative values are selected for inclusion below either because they are important as general design requirements or they indicate fundamental device performance characteristics. The Spartan-3A DSP FPGA speed files (v1.32), part of the Xilinx Development Software, are the original source for many but not all of the values. The speed grade designations for these files are shown in Table 15. For more complete, more precise, and worst-case data, use the values reported by the Xilinx static timing analyzer (TRACE in the Xilinx development software) and back-annotated to the simulation netlist.

*Table 15:* **Spartan-3A DSP v1.32 Speed Grade Designations**

| Device | Advance | Preliminary | Production |
|---|---|---|---|
| XC3SD1800A | | | -4, -5 |
| XC3SD3400A | | | -4, -5 |

Table 16 provides the recent history of the Spartan-3A DSP FPGA speed files.

*Table 16:* **Spartan-3A DSP Speed File Version History**

| Version | ISE Release | Description |
|---|---|---|
| 1.32 | ISE 10.1.02 | Updated DSP timing model to reflect higher performance for some implementations |
| 1.31 | ISE 10.1 | Added Automotive support |
| 1.30 | ISE 9.2.03i | Added absolute minimum values |
| 1.29 | ISE 9.2.01i | Production Speed Files for -4 and -5 speed grades |
| 1.28 | ISE 9.2i | Minor updates |
| 1.27 | ISE 9.1.03i | Advance Speed Files for -4 speed grade |

# I/O Timing

## Pin-to-Pin Clock-to-Output Times

*Table 17:* **Pin-to-Pin Clock-to-Output Times for the IOB Output Path**

| Symbol | Description | Conditions | Device | Speed Grade | | Units |
|---|---|---|---|---|---|---|
| | | | | -5 | -4 | |
| | | | | Max | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{ICKOFDCM}$ | When reading from the Output Flip-Flop (OFF), the time from the active transition on the Global Clock pin to data appearing at the Output pin. The DCM is in use. | LVCMOS25(2), 12 mA output drive, Fast slew rate, with DCM(3) | XC3SD1800A | 3.28 | 3.51 | ns |
| | | | XC3SD3400A | 3.36 | 3.82 | ns |
| $T_{ICKOF}$ | When reading from OFF, the time from the active transition on the Global Clock pin to data appearing at the Output pin. The DCM is not in use. | LVCMOS25(2), 12 mA output drive, Fast slew rate, without DCM | XC3SD1800A | 5.23 | 5.58 | ns |
| | | | XC3SD3400A | 5.51 | 6.13 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7 and Table 10.
2. This clock-to-output time requires adjustment whenever a signal standard other than LVCMOS25 is assigned to the Global Clock Input or a standard other than LVCMOS25 with 12 mA drive and Fast slew rate is assigned to the data Output. If the former is true, *add* the appropriate Input adjustment from Table 22. If the latter is true, *add* the appropriate Output adjustment from Table 25.
3. DCM output jitter is included in all measurements.

## Pin-to-Pin Setup and Hold Times

*Table 18:* **Pin-to-Pin Setup and Hold Times for the IOB Input Path (System Synchronous)**

| Symbol | Description | Conditions | Device | Speed Grade | | Units |
|---|---|---|---|---|---|---|
| | | | | -5 | -4 | |
| | | | | Max | Max | |
| **Setup Times** | | | | | | |
| $T_{PSDCM}$ | When writing to the Input Flip-Flop (IFF), the time from the setup of data at the Input pin to the active transition at a Global Clock pin. The DCM is in use. No Input Delay is programmed. | LVCMOS25(2), IFD_DELAY_VALUE = 0, with DCM(4) | XC3SD1800A | 2.65 | 3.11 | ns |
| | | | XC3SD3400A | 2.25 | 2.49 | ns |
| $T_{PSFD}$ | When writing to IFF, the time from the setup of data at the Input pin to an active transition at the Global Clock pin. The DCM is not in use. The Input Delay is programmed. | LVCMOS25(2), IFD_DELAY_VALUE = 6, without DCM | XC3SD1800A | 2.98 | 3.39 | ns |
| | | | XC3SD3400A | 2.78 | 3.08 | ns |
| **Hold Times** | | | | | | |
| $T_{PHDCM}$ | When writing to IFF, the time from the active transition at the Global Clock pin to the point when data must be held at the Input pin. The DCM is in use. No Input Delay is programmed. | LVCMOS25(3), IFD_DELAY_VALUE = 0, with DCM(4) | XC3SD1800A | –0.38 | –0.38 | ns |
| | | | XC3SD3400A | –0.26 | –0.26 | ns |
| $T_{PHFD}$ | When writing to IFF, the time from the active transition at the Global Clock pin to the point when data must be held at the Input pin. The DCM is not in use. The Input Delay is programmed. | LVCMOS25(3), IFD_DELAY_VALUE = 6, without DCM | XC3SD1800A | –0.71 | –0.71 | ns |
| | | | XC3SD3400A | –0.65 | –0.65 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7 and Table 10.
2. This setup time requires adjustment whenever a signal standard other than LVCMOS25 is assigned to the Global Clock Input or the data Input. If this is true of the Global Clock Input, subtract the appropriate adjustment from Table 22. If this is true of the data Input, add the appropriate Input adjustment from the same table.
3. This hold time requires adjustment whenever a signal standard other than LVCMOS25 is assigned to the Global Clock Input or the data Input. If this is true of the Global Clock Input, add the appropriate Input adjustment from Table 22. If this is true of the data Input, subtract the appropriate Input adjustment from the same table. When the hold time is negative, it is possible to change the data before the clock's active edge.
4. DCM output jitter is included in all measurements.

## Input Setup and Hold Times

*Table 19:* **Setup and Hold Times for the IOB Input Path**

| Symbol | Description | Conditions | DELAY_ VALUE | Device | Speed | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | -5 | -4 | |
| | | | | | Min | Min | |
| **Setup Times** | | | | | | | |
| $T_{IOPICK}$ | Time from the setup of data at the Input pin to the active transition at the ICLK input of the Input Flip-Flop (IFF). No Input Delay is programmed. | LVCMOS25(2) | IFD_DELAY_VALUE=0 | XC3SD1800A | 1.65 | 1.81 | ns |
| | | | | XC3SD3400A | 1.51 | 1.88 | ns |
| $T_{IOPICKD}$ | Time from the setup of data at the Input pin to the active transition at the ICLK input of the Input Flip-Flop (IFF). The Input Delay is programmed. | LVCMOS25(2) | 1 | XC3SD1800A | 2.09 | 2.24 | ns |
| | | | 2 | | 2.67 | 2.83 | ns |
| | | | 3 | | 3.25 | 3.64 | ns |
| | | | 4 | | 3.75 | 4.20 | ns |
| | | | 5 | | 3.69 | 4.16 | ns |
| | | | 6 | | 4.47 | 5.09 | ns |
| | | | 7 | | 5.27 | 6.02 | ns |
| | | | 8 | | 5.79 | 6.63 | ns |
| | | | 1 | XC3SD3400A | 2.07 | 2.44 | ns |
| | | | 2 | | 2.57 | 3.02 | ns |
| | | | 3 | | 3.44 | 3.81 | ns |
| | | | 4 | | 4.01 | 4.39 | ns |
| | | | 5 | | 3.89 | 4.26 | ns |
| | | | 6 | | 4.43 | 5.08 | ns |
| | | | 7 | | 5.20 | 5.95 | ns |
| | | | 8 | | 5.70 | 6.55 | ns |
| **Hold Times** | | | | | | | |
| $T_{IOICKP}$ | Time from the active transition at the ICLK input of the Input Flip-Flop (IFF) to the point where data must be held at the Input pin. No Input Delay is programmed. | LVCMOS25(3) | 0 | XC3SD1800A | –0.63 | –0.52 | ns |
| | | | | XC3SD3400A | –0.56 | –0.56 | ns |

*Table 19:* **Setup and Hold Times for the IOB Input Path *(Cont'd)***

| Symbol | Description | Conditions | DELAY_ VALUE | Device | Speed | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | -5 | -4 | |
| | | | | | Min | Min | |
| $T_{IOICKPD}$ | Time from the active transition at the ICLK input of the Input Flip-Flop (IFF) to the point where data must be held at the Input pin. The Input Delay is programmed. | LVCMOS25(3) | 1 | XC3SD1800A | –1.40 | –1.40 | ns |
| | | | 2 | | –2.11 | –2.11 | ns |
| | | | 3 | | –2.48 | –2.48 | ns |
| | | | 4 | | –2.77 | –2.77 | ns |
| | | | 5 | | –2.62 | –2.62 | ns |
| | | | 6 | | –3.06 | –3.06 | ns |
| | | | 7 | | –3.42 | –3.42 | ns |
| | | | 8 | | –3.65 | –3.65 | ns |
| | | | 1 | XC3SD3400A | –1.31 | –1.31 | ns |
| | | | 2 | | –1.88 | –1.88 | ns |
| | | | 3 | | –2.44 | –2.44 | ns |
| | | | 4 | | –2.89 | –2.89 | ns |
| | | | 5 | | –2.83 | –2.83 | ns |
| | | | 6 | | –3.33 | –3.33 | ns |
| | | | 7 | | –3.63 | –3.63 | ns |
| | | | 8 | | –3.96 | –3.96 | ns |
| **Set/Reset Pulse Width** | | | | | | | |
| $T_{RPW_IOB}$ | Minimum pulse width to SR control input on IOB | – | – | All | 1.33 | 1.61 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7 and Table 10.
2. This setup time requires adjustment whenever a signal standard other than LVCMOS25 is assigned to the data Input. If this is true, add the appropriate Input adjustment from Table 22.
3. These hold times require adjustment whenever a signal standard other than LVCMOS25 is assigned to the data Input. If this is true, subtract the appropriate Input adjustment from Table 22. When the hold time is negative, it is possible to change the data before the clock's active edge.

*Table 20:* **Sample Window (Source Synchronous)**

| Symbol | Description | Max | Units |
|---|---|---|---|
| $T_{SAMP}$ | Setup and hold capture window of an IOB flip-flop. | The input capture sample window value is highly specific to a particular application, device, package, I/O standard, I/O placement, DCM usage, and clock buffer. Please consult the appropriate Xilinx Answer Record for application-specific values.<br>• Answer Record 30879 | ps |

## Input Propagation Times

*Table 21:* **Propagation Times for the IOB Input Path**

| Symbol | Description | Conditions | DELAY_VALUE | Device | Speed Grade | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | -5 | -4 | |
| | | | | | Max | Max | |
| **Propagation Times** | | | | | | | |
| $T_{IOPI}$ | The time it takes for data to travel from the Input pin to the I output with no input delay programmed | LVCMOS25[2] | IBUF_DELAY_VALUE=0 | XC3SD1800A | 0.51 | 0.53 | ns |
| | | | | XC3SD3400A | 0.73 | 0.93 | ns |
| $T_{IOPID}$ | The time it takes for data to travel from the Input pin to the I output with the input delay programmed | LVCMOS25[2] | 1 | XC3SD1800A | 1.29 | 1.62 | ns |
| | | | 2 | | 1.67 | 2.08 | ns |
| | | | 3 | | 1.92 | 2.36 | ns |
| | | | 4 | | 2.38 | 2.89 | ns |
| | | | 5 | | 2.61 | 3.17 | ns |
| | | | 6 | | 2.98 | 3.55 | ns |
| | | | 7 | | 3.30 | 3.92 | ns |
| | | | 8 | | 3.63 | 4.37 | ns |
| | | | 9 | | 3.31 | 4.02 | ns |
| | | | 10 | | 3.69 | 4.47 | ns |
| | | | 11 | | 3.94 | 4.77 | ns |
| | | | 12 | | 4.41 | 5.27 | ns |
| | | | 13 | | 4.67 | 5.56 | ns |
| | | | 14 | | 5.03 | 5.94 | ns |
| | | | 15 | | 5.36 | 6.31 | ns |
| | | | 16 | | 5.64 | 6.73 | ns |
| | | | 1 | XC3SD3400A | 1.56 | 1.99 | ns |
| | | | 2 | | 1.92 | 2.44 | ns |
| | | | 3 | | 2.18 | 2.72 | ns |
| | | | 4 | | 2.66 | 3.19 | ns |
| | | | 5 | | 2.91 | 3.43 | ns |
| | | | 6 | | 3.27 | 3.81 | ns |
| | | | 7 | | 3.59 | 4.17 | ns |
| | | | 8 | | 3.87 | 4.58 | ns |
| | | | 9 | | 3.52 | 4.22 | ns |
| | | | 10 | | 3.87 | 4.65 | ns |
| | | | 11 | | 4.14 | 4.94 | ns |
| | | | 12 | | 4.68 | 5.40 | ns |
| | | | 13 | | 4.93 | 5.66 | ns |
| | | | 14 | | 5.29 | 6.06 | ns |
| | | | 15 | | 5.61 | 6.43 | ns |
| | | | 16 | | 5.88 | 6.80 | ns |

*Table 21:* **Propagation Times for the IOB Input Path *(Cont'd)***

| Symbol | Description | Conditions | DELAY_VALUE | Device | Speed Grade | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | -5 | -4 | |
| | | | | | Max | Max | |
| $T_{IOPLI}$ | The time it takes for data to travel from the Input pin through the IFF latch to the I output with no input delay programmed | LVCMOS25(2) | 0 | XC3SD1800A | 1.79 | 2.04 | ns |
| | | | | XC3SD3400A | 1.65 | 2.11 | ns |
| $T_{IOPLID}$ | The time it takes for data to travel from the Input pin through the IFF latch to the I output with the input delay programmed | LVCMOS25(2) | 1 | XC3SD1800A | 2.23 | 2.47 | ns |
| | | | 2 | | 2.81 | 3.06 | ns |
| | | | 3 | | 3.39 | 3.86 | ns |
| | | | 4 | | 3.89 | 4.43 | ns |
| | | | 5 | | 3.83 | 4.39 | ns |
| | | | 6 | | 4.61 | 5.32 | ns |
| | | | 7 | | 5.40 | 6.24 | ns |
| | | | 8 | | 5.93 | 6.86 | ns |
| | | | 1 | XC3SD3400A | 2.21 | 2.67 | ns |
| | | | 2 | | 2.71 | 3.25 | ns |
| | | | 3 | | 3.58 | 4.04 | ns |
| | | | 4 | | 4.15 | 4.62 | ns |
| | | | 5 | | 4.03 | 4.49 | ns |
| | | | 6 | | 4.57 | 5.31 | ns |
| | | | 7 | | 5.34 | 6.18 | ns |
| | | | 8 | | 5.84 | 6.78 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7 and Table 10.
2. This propagation time requires adjustment whenever a signal standard other than LVCMOS25 is assigned to the data Input. When this is true, *add* the appropriate Input adjustment from Table 22.

## Input Timing Adjustments

*Table 22:* **Input Timing Adjustments by IOSTANDARD**

| Convert Input Time from LVCMOS25 to the Following Signal Standard (IOSTANDARD) | Add the Adjustment Below | | Units |
|---|---|---|---|
| | Speed Grade | | |
| | -5 | -4 | |
| **Single-Ended Standards** | | | |
| LVTTL | 0.62 | 0.62 | ns |
| LVCMOS33 | 0.54 | 0.54 | ns |
| LVCMOS25 | 0.00 | 0.00 | ns |
| LVCMOS18 | 0.83 | 0.83 | ns |
| LVCMOS15 | 0.60 | 0.60 | ns |
| LVCMOS12 | 0.31 | 0.31 | ns |
| PCI33_3 | 0.41 | 0.41 | ns |
| PCI66_3 | 0.41 | 0.41 | ns |
| HSTL_I | 0.72 | 0.72 | ns |
| HSTL_III | 0.77 | 0.77 | ns |
| HSTL_I_18 | 0.69 | 0.69 | ns |
| HSTL_II_18 | 0.69 | 0.69 | ns |
| HSTL_III_18 | 0.79 | 0.79 | ns |
| SSTL18_I | 0.71 | 0.71 | ns |
| SSTL18_II | 0.71 | 0.71 | ns |
| SSTL2_I | 0.68 | 0.68 | ns |
| SSTL2_II | 0.68 | 0.68 | ns |
| SSTL3_I | 0.78 | 0.78 | ns |
| SSTL3_II | 0.78 | 0.78 | ns |

*Table 22:* **Input Timing Adjustments by IOSTANDARD**

| Convert Input Time from LVCMOS25 to the Following Signal Standard (IOSTANDARD) | Add the Adjustment Below | | Units |
|---|---|---|---|
| | Speed Grade | | |
| | -5 | -4 | |
| **Differential Standards** | | | |
| LVDS_25 | 0.76 | 0.76 | ns |
| LVDS_33 | 0.79 | 0.79 | ns |
| BLVDS_25 | 0.79 | 0.79 | ns |
| MINI_LVDS_25 | 0.78 | 0.78 | ns |
| MINI_LVDS_33 | 0.79 | 0.79 | ns |
| LVPECL_25 | 0.78 | 0.78 | ns |
| LVPECL_33 | 0.79 | 0.79 | ns |
| RSDS_25 | 0.79 | 0.79 | ns |
| RSDS_33 | 0.77 | 0.77 | ns |
| TMDS_33 | 0.79 | 0.79 | ns |
| PPDS_25 | 0.79 | 0.79 | ns |
| PPDS_33 | 0.79 | 0.79 | ns |
| DIFF_HSTL_I_18 | 0.74 | 0.74 | ns |
| DIFF_HSTL_II_18 | 0.72 | 0.72 | ns |
| DIFF_HSTL_III_18 | 1.05 | 1.05 | ns |
| DIFF_HSTL_I | 0.72 | 0.72 | ns |
| DIFF_HSTL_III | 1.05 | 1.05 | ns |
| DIFF_SSTL18_I | 0.71 | 0.71 | ns |
| DIFF_SSTL18_II | 0.71 | 0.71 | ns |
| DIFF_SSTL2_I | 0.74 | 0.74 | ns |
| DIFF_SSTL2_II | 0.75 | 0.75 | ns |
| DIFF_SSTL3_I | 1.06 | 1.06 | ns |
| DIFF_SSTL3_II | 1.06 | 1.06 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7, Table 10, and Table 12.
2. These adjustments are used to convert input path times originally specified for the LVCMOS25 standard to times that correspond to other signal standards.

## Output Propagation Times

*Table 23:* **Timing for the IOB Output Path**

| Symbol | Description | Conditions | Device | Speed Grade | | Units |
|---|---|---|---|---|---|---|
| | | | | -5 | -4 | |
| | | | | Max | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{IOCKP}$ | When reading from the Output Flip-Flop (OFF), the time from the active transition at the OCLK input to data appearing at the Output pin | LVCMOS25(2), 12 mA output drive, Fast slew rate | All | 2.87 | 3.13 | ns |
| **Propagation Times** | | | | | | |
| $T_{IOOP}$ | The time it takes for data to travel from the IOB's O input to the Output pin | LVCMOS25(2), 12 mA output drive, Fast slew rate | All | 2.78 | 2.91 | ns |
| **Set/Reset Times** | | | | | | |
| $T_{IOSRP}$ | Time from asserting the OFF's SR input to setting/resetting data at the Output pin | LVCMOS25(2), 12 mA output drive, Fast slew rate | All | 3.63 | 3.89 | ns |
| $T_{IOGSRQ}$ | Time from asserting the Global Set Reset (GSR) input on the STARTUP_SPARTAN3A primitive to setting/resetting data at the Output pin | | | 8.62 | 9.65 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7 and Table 10.
2. This time requires adjustment whenever a signal standard other than LVCMOS25 with 12 mA drive and Fast slew rate is assigned to the data Output. When this is true, *add* the appropriate Output adjustment from Table 25.

## Three-State Output Propagation Times

*Table 24:* **Timing for the IOB Three-State Path**

| Symbol | Description | Conditions | Device | Speed Grade | | Units |
|---|---|---|---|---|---|---|
| | | | | -5 | -4 | |
| | | | | Max | Max | |
| **Synchronous Output Enable/Disable Times** | | | | | | |
| $T_{IOCKHZ}$ | Time from the active transition at the OTCLK input of the Three-state Flip-Flop (TFF) to when the Output pin enters the high-impedance state | LVCMOS25, 12 mA output drive, Fast slew rate | All | 1.13 | 1.39 | ns |
| $T_{IOCKON}$ (2) | Time from the active transition at TFF's OTCLK input to when the Output pin drives valid data | | All | 3.08 | 3.35 | ns |
| **Asynchronous Output Enable/Disable Times** | | | | | | |
| $T_{GTS}$ | Time from asserting the Global Three State (GTS) input on the STARTUP_SPARTAN3A primitive to when the Output pin enters the high-impedance state | LVCMOS25, 12 mA output drive, Fast slew rate | All | 9.47 | 10.36 | ns |
| **Set/Reset Times** | | | | | | |
| $T_{IOSRHZ}$ | Time from asserting TFF's SR input to when the Output pin enters a high-impedance state | LVCMOS25, 12 mA output drive, Fast slew rate | All | 1.61 | 1.86 | ns |
| $T_{IOSRON}$ (2) | Time from asserting TFF's SR input at TFF to when the Output pin drives valid data | | All | 3.57 | 3.82 | ns |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7 and Table 10.
2. This time requires adjustment whenever a signal standard other than LVCMOS25 with 12 mA drive and Fast slew rate is assigned to the data Output. When this is true, *add* the appropriate Output adjustment from Table 25.

## Output Timing Adjustments

*Table 25:* **Output Timing Adjustments for IOB**

| Convert Output Time from LVCMOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | | | Add the Adjustment Below | | Units |
|---|---|---|---|---|---|
| | | | Speed Grade | | |
| | | | -5 | -4 | |
| **Single-Ended Standards** | | | | | |
| LVTTL | Slow | 2 mA | 5.58 | 5.58 | ns |
| | | 4 mA | 3.16 | 3.16 | ns |
| | | 6 mA | 3.17 | 3.17 | ns |
| | | 8 mA | 2.09 | 2.09 | ns |
| | | 12 mA | 1.62 | 1.62 | ns |
| | | 16 mA | 1.24 | 1.24 | ns |
| | | 24 mA | 2.74(3) | 2.74(3) | ns |
| | Fast | 2 mA | 3.03 | 3.03 | ns |
| | | 4 mA | 1.71 | 1.71 | ns |
| | | 6 mA | 1.71 | 1.71 | ns |
| | | 8 mA | 0.53 | 0.53 | ns |
| | | 12 mA | 0.53 | 0.53 | ns |
| | | 16 mA | 0.59 | 0.59 | ns |
| | | 24 mA | 0.60 | 0.60 | ns |
| | QuietIO | 2 mA | 27.67 | 27.67 | ns |
| | | 4 mA | 27.67 | 27.67 | ns |
| | | 6 mA | 27.67 | 27.67 | ns |
| | | 8 mA | 16.71 | 16.71 | ns |
| | | 12 mA | 16.67 | 16.67 | ns |
| | | 16 mA | 16.22 | 16.22 | ns |
| | | 24 mA | 12.11 | 12.11 | ns |

*Table 25:* **Output Timing Adjustments for IOB *(Cont'd)***

| Convert Output Time from LVCMOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | | | Add the Adjustment Below | | Units |
|---|---|---|---|---|---|
| | | | Speed Grade | | |
| | | | -5 | -4 | |
| LVCMOS33 | Slow | 2 mA | 5.58 | 5.58 | ns |
| | | 4 mA | 3.17 | 3.17 | ns |
| | | 6 mA | 3.17 | 3.17 | ns |
| | | 8 mA | 2.09 | 2.09 | ns |
| | | 12 mA | 1.24 | 1.24 | ns |
| | | 16 mA | 1.15 | 1.15 | ns |
| | | 24 mA | 2.55(3) | 2.55(3) | ns |
| | Fast | 2 mA | 3.02 | 3.02 | ns |
| | | 4 mA | 1.71 | 1.71 | ns |
| | | 6 mA | 1.72 | 1.72 | ns |
| | | 8 mA | 0.53 | 0.53 | ns |
| | | 12 mA | 0.59 | 0.59 | ns |
| | | 16 mA | 0.59 | 0.59 | ns |
| | | 24 mA | 0.51 | 0.51 | ns |
| | QuietIO | 2 mA | 27.67 | 27.67 | ns |
| | | 4 mA | 27.67 | 27.67 | ns |
| | | 6 mA | 27.67 | 27.67 | ns |
| | | 8 mA | 16.71 | 16.71 | ns |
| | | 12 mA | 16.29 | 16.29 | ns |
| | | 16 mA | 16.18 | 16.18 | ns |
| | | 24 mA | 12.11 | 12.11 | ns |

*Table 25:* **Output Timing Adjustments for IOB *(Cont'd)***

| Convert Output Time from LVCMOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | | | Add the Adjustment Below | | Units |
|---|---|---|---|---|---|
| | | | Speed Grade | | |
| | | | -5 | -4 | |
| LVCMOS25 | Slow | 2 mA | 5.33 | 5.33 | ns |
| | | 4 mA | 2.81 | 2.81 | ns |
| | | 6 mA | 2.82 | 2.82 | ns |
| | | 8 mA | 1.14 | 1.14 | ns |
| | | 12 mA | 1.10 | 1.10 | ns |
| | | 16 mA | 0.83 | 0.83 | ns |
| | | 24 mA | 2.26(3) | 2.26(3) | ns |
| | Fast | 2 mA | 4.36 | 4.36 | ns |
| | | 4 mA | 1.76 | 1.76 | ns |
| | | 6 mA | 1.25 | 1.25 | ns |
| | | 8 mA | 0.38 | 0.38 | ns |
| | | 12 mA | 0.00 | 0.00 | ns |
| | | 16 mA | 0.01 | 0.01 | ns |
| | | 24 mA | 0.01 | 0.01 | ns |
| | QuietIO | 2 mA | 25.92 | 25.92 | ns |
| | | 4 mA | 25.92 | 25.92 | ns |
| | | 6 mA | 25.92 | 25.92 | ns |
| | | 8 mA | 15.57 | 15.57 | ns |
| | | 12 mA | 15.59 | 15.59 | ns |
| | | 16 mA | 14.27 | 14.27 | ns |
| | | 24 mA | 11.37 | 11.37 | ns |

*Table 25:* **Output Timing Adjustments for IOB *(Cont'd)***

| Convert Output Time from LVCMOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | | | Add the Adjustment Below | | Units |
|---|---|---|---|---|---|
| | | | Speed Grade | | |
| | | | -5 | -4 | |
| LVCMOS18 | Slow | 2 mA | 4.48 | 4.48 | ns |
| | | 4 mA | 3.69 | 3.69 | ns |
| | | 6 mA | 2.91 | 2.91 | ns |
| | | 8 mA | 1.99 | 1.99 | ns |
| | | 12 mA | 1.57 | 1.57 | ns |
| | | 16 mA | 1.19 | 1.19 | ns |
| | Fast | 2 mA | 3.96 | 3.96 | ns |
| | | 4 mA | 2.57 | 2.57 | ns |
| | | 6 mA | 1.90 | 1.90 | ns |
| | | 8 mA | 1.06 | 1.06 | ns |
| | | 12 mA | 0.83 | 0.83 | ns |
| | | 16 mA | 0.63 | 0.63 | ns |
| | QuietIO | 2 mA | 24.97 | 24.97 | ns |
| | | 4 mA | 24.97 | 24.97 | ns |
| | | 6 mA | 24.08 | 24.08 | ns |
| | | 8 mA | 16.43 | 16.43 | ns |
| | | 12 mA | 14.52 | 14.52 | ns |
| | | 16 mA | 13.41 | 13.41 | ns |
| LVCMOS15 | Slow | 2 mA | 5.82 | 5.82 | ns |
| | | 4 mA | 3.97 | 3.97 | ns |
| | | 6 mA | 3.21 | 3.21 | ns |
| | | 8 mA | 2.53 | 2.53 | ns |
| | | 12 mA | 2.06 | 2.06 | ns |
| | Fast | 2 mA | 5.23 | 5.23 | ns |
| | | 4 mA | 3.05 | 3.05 | ns |
| | | 6 mA | 1.95 | 1.95 | ns |
| | | 8 mA | 1.60 | 1.60 | ns |
| | | 12 mA | 1.30 | 1.30 | ns |
| | QuietIO | 2 mA | 34.11 | 34.11 | ns |
| | | 4 mA | 25.66 | 25.66 | ns |
| | | 6 mA | 24.64 | 24.64 | ns |
| | | 8 mA | 22.06 | 22.06 | ns |
| | | 12 mA | 20.64 | 20.64 | ns |

*Table 25:* **Output Timing Adjustments for IOB *(Cont'd)***

| Convert Output Time from LVCMOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | | | Add the Adjustment Below | | Units |
|---|---|---|---|---|---|
| | | | Speed Grade | | |
| | | | -5 | -4 | |
| LVCMOS12 | Slow | 2 mA | 7.14 | 7.14 | ns |
| | | 4 mA | 4.87 | 4.87 | ns |
| | | 6 mA | 5.67 | 5.67 | ns |
| | Fast | 2 mA | 6.77 | 6.77 | ns |
| | | 4 mA | 5.02 | 5.02 | ns |
| | | 6 mA | 4.09 | 4.09 | ns |
| | QuietIO | 2 mA | 50.76 | 50.76 | ns |
| | | 4 mA | 43.17 | 43.17 | ns |
| | | 6 mA | 37.31 | 37.31 | ns |
| PCI33_3 | | | 0.34 | 0.34 | ns |
| PCI66_3 | | | 0.34 | 0.34 | ns |
| HSTL_I | | | 0.78 | 0.78 | ns |
| HSTL_III | | | 1.16 | 1.16 | ns |
| HSTL_I_18 | | | 0.35 | 0.35 | ns |
| HSTL_II_18 | | | 0.30 | 0.30 | ns |
| HSTL_III_18 | | | 0.47 | 0.47 | ns |
| SSTL18_I | | | 0.40 | 0.40 | ns |
| SSTL18_II | | | 0.30 | 0.30 | ns |
| SSTL2_I | | | 0.00 | 0.00 | ns |
| SSTL2_II | | | –0.05 | –0.05 | ns |
| SSTL3_I | | | 0.00 | 0.00 | ns |
| SSTL3_II | | | 0.17 | 0.17 | ns |

*Table 25:* **Output Timing Adjustments for IOB *(Cont'd)***

| Convert Output Time from LVCMOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | Add the Adjustment Below | | Units |
|---|---|---|---|
| | Speed Grade | | |
| | -5 | -4 | |
| **Differential Standards** | | | |
| LVDS_25 | 1.16 | 1.16 | ns |
| LVDS_33 | 0.46 | 0.46 | ns |
| BLVDS_25 | 0.11 | 0.11 | ns |
| MINI_LVDS_25 | 0.75 | 0.75 | ns |
| MINI_LVDS_33 | 0.40 | 0.40 | ns |
| LVPECL_25 | Inputs Only | | |
| LVPECL_33 | | | |
| RSDS_25 | 1.42 | 1.42 | ns |
| RSDS_33 | 0.58 | 0.58 | ns |
| TMDS_33 | 0.46 | 0.46 | ns |
| PPDS_25 | 1.07 | 1.07 | ns |
| PPDS_33 | 0.63 | 0.63 | ns |
| DIFF_HSTL_I_18 | 0.43 | 0.43 | ns |
| DIFF_HSTL_II_18 | 0.41 | 0.41 | ns |
| DIFF_HSTL_III_18 | 0.36 | 0.36 | ns |
| DIFF_HSTL_I | 1.01 | 1.01 | ns |
| DIFF_HSTL_III | 0.54 | 0.54 | ns |
| DIFF_SSTL18_I | 0.49 | 0.49 | ns |
| DIFF_SSTL18_II | 0.41 | 0.41 | ns |
| DIFF_SSTL2_I | 0.82 | 0.82 | ns |
| DIFF_SSTL2_II | 0.09 | 0.09 | ns |
| DIFF_SSTL3_I | 1.16 | 1.16 | ns |
| DIFF_SSTL3_II | 0.28 | 0.28 | ns |

**Notes:**

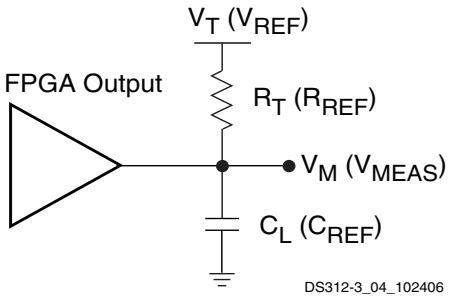
1. The numbers in this table are tested using the methodology presented in Table 26 and are based on the operating conditions set forth in Table 7, Table 10, and Table 12.
2. These adjustments are used to convert output- and three-state-path times originally specified for the LVCMOS25 standard with 12 mA drive and Fast slew rate to times that correspond to other signal standards. Do not adjust times that measure when outputs go into a high-impedance state.
3. Note that 16 mA drive is faster than 24 mA drive for the Slow slew rate.

## Timing Measurement Methodology

When measuring timing parameters at the programmable I/Os, different signal standards call for different test conditions. Table 26 lists the conditions to use for each standard.

The method for measuring Input timing is as follows: A signal that swings between a Low logic level of $V_L$ and a High logic level of $V_H$ is applied to the Input under test. Some standards also require the application of a bias voltage to the $V_{REF}$ pins of a given bank to properly set the input-switching threshold. The measurement point of the Input signal ($V_M$) is commonly located halfway between $V_L$ and $V_H$.

The Output test setup is shown in Figure 8. A termination voltage $V_T$ is applied to the termination resistor $R_T$, the other end of which is connected to the Output. For each standard, $R_T$ and $V_T$ generally take on the standard values recommended for minimizing signal reflections. If the standard does not ordinarily use terminations (for example, LVCMOS, LVTTL), then $R_T$ is set to 1MΩ to indicate an open connection, and $V_T$ is set to zero. The same measurement point ($V_M$) that was used at the Input is also used at the Output.




**Notes:**

1. The names shown in parentheses are used in the IBIS file.

*Figure 8:* **Output Test Setup**

*Table 26:* **Test Methods for Timing Measurement at I/Os**

| Signal Standard (IOSTANDARD) | | Inputs | | | Outputs[2] | | Inputs and Outputs |
|---|---|---|---|---|---|---|---|
| | | $V_{REF}$ (V) | $V_L$ (V) | $V_H$ (V) | $R_T$ (Ω) | $V_T$ (V) | $V_M$ (V) |
| **Single-Ended** | | | | | | | |
| LVTTL | | – | 0 | 3.3 | 1M | 0 | 1.4 |
| LVCMOS33 | | – | 0 | 3.3 | 1M | 0 | 1.65 |
| LVCMOS25 | | – | 0 | 2.5 | 1M | 0 | 1.25 |
| LVCMOS18 | | – | 0 | 1.8 | 1M | 0 | 0.9 |
| LVCMOS15 | | – | 0 | 1.5 | 1M | 0 | 0.75 |
| LVCMOS12 | | – | 0 | 1.2 | 1M | 0 | 0.6 |
| PCI33_3 | Rising | – | Note 3 | Note 3 | 25 | 0 | 0.94 |
| | Falling | | | | 25 | 3.3 | 2.03 |
| PCI66_3 | Rising | – | Note 3 | Note 3 | 25 | 0 | 0.94 |
| | Falling | | | | 25 | 3.3 | 2.03 |
| HSTL_I | | 0.75 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 50 | 0.75 | $V_{REF}$ |
| HSTL_III | | 0.9 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 50 | 1.5 | $V_{REF}$ |
| HSTL_I_18 | | 0.9 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 50 | 0.9 | $V_{REF}$ |
| HSTL_II_18 | | 0.9 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 25 | 0.9 | $V_{REF}$ |
| HSTL_III_18 | | 1.1 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 50 | 1.8 | $V_{REF}$ |
| SSTL18_I | | 0.9 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 50 | 0.9 | $V_{REF}$ |
| SSTL18_II | | 0.9 | $V_{REF}$ – 0.5 | $V_{REF}$ + 0.5 | 25 | 0.9 | $V_{REF}$ |
| SSTL2_I | | 1.25 | $V_{REF}$ – 0.75 | $V_{REF}$ + 0.75 | 50 | 1.25 | $V_{REF}$ |
| SSTL2_II | | 1.25 | $V_{REF}$ – 0.75 | $V_{REF}$ + 0.75 | 25 | 1.25 | $V_{REF}$ |
| SSTL3_I | | 1.5 | $V_{REF}$ – 0.75 | $V_{REF}$ + 0.75 | 50 | 1.5 | $V_{REF}$ |
| SSTL3_II | | 1.5 | $V_{REF}$ – 0.75 | $V_{REF}$ + 0.75 | 25 | 1.5 | $V_{REF}$ |

*Table 26:* **Test Methods for Timing Measurement at I/Os *(Cont'd)***

| Signal Standard (IOSTANDARD) | Inputs | | | Outputs[2] | | Inputs and Outputs |
|---|---|---|---|---|---|---|
| | $V_{REF}$ (V) | $V_L$ (V) | $V_H$ (V) | $R_T$ (Ω) | $V_T$ (V) | $V_M$ (V) |
| **Differential** | | | | | | |
| LVDS_25 | – | $V_{ICM}$ – 0.125 | $V_{ICM}$ + 0.125 | 50 | 1.2 | $V_{ICM}$ |
| LVDS_33 | – | $V_{ICM}$ – 0.125 | $V_{ICM}$ + 0.125 | 50 | 1.2 | $V_{ICM}$ |
| BLVDS_25 | – | $V_{ICM}$ – 0.125 | $V_{ICM}$ + 0.125 | 1M | 0 | $V_{ICM}$ |
| MINI_LVDS_25 | – | $V_{ICM}$ – 0.125 | $V_{ICM}$ + 0.125 | 50 | 1.2 | $V_{ICM}$ |
| MINI_LVDS_33 | – | $V_{ICM}$ – 0.125 | $V_{ICM}$ + 0.125 | 50 | 1.2 | $V_{ICM}$ |
| LVPECL_25 | – | $V_{ICM}$ – 0.3 | $V_{ICM}$ + 0.3 | N/A | N/A | $V_{ICM}$ |
| LVPECL_33 | – | $V_{ICM}$ – 0.3 | $V_{ICM}$ + 0.3 | N/A | N/A | $V_{ICM}$ |
| RSDS_25 | – | $V_{ICM}$ – 0.1 | $V_{ICM}$ + 0.1 | 50 | 1.2 | $V_{ICM}$ |
| RSDS_33 | – | $V_{ICM}$ – 0.1 | $V_{ICM}$ + 0.1 | 50 | 1.2 | $V_{ICM}$ |
| TMDS_33 | – | $V_{ICM}$ – 0.1 | $V_{ICM}$ + 0.1 | 50 | 3.3 | $V_{ICM}$ |
| PPDS_25 | – | $V_{ICM}$ – 0.1 | $V_{ICM}$ + 0.1 | 50 | 0.8 | $V_{ICM}$ |
| PPDS_33 | – | $V_{ICM}$ – 0.1 | $V_{ICM}$ + 0.1 | 50 | 0.8 | $V_{ICM}$ |
| DIFF_HSTL_I_18 | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 0.9 | $V_{ICM}$ |
| DIFF_HSTL_II_18 | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 0.9 | $V_{ICM}$ |
| DIFF_HSTL_III_18 | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 1.8 | $V_{ICM}$ |
| DIFF_HSTL_I | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 0.9 | $V_{ICM}$ |
| DIFF_HSTL_III | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 0.9 | $V_{ICM}$ |
| DIFF_SSTL18_I | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 0.9 | $V_{ICM}$ |
| DIFF_SSTL18_II | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 0.9 | $V_{ICM}$ |
| DIFF_SSTL2_I | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 1.25 | $V_{ICM}$ |
| DIFF_SSTL2_II | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 1.25 | $V_{ICM}$ |
| DIFF_SSTL3_I | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 1.5 | $V_{ICM}$ |
| DIFF_SSTL3_II | – | $V_{ICM}$ – 0.5 | $V_{ICM}$ + 0.5 | 50 | 1.5 | $V_{ICM}$ |

**Notes:**

1. Descriptions of the relevant symbols are:
   $V_{REF}$ – The reference voltage for setting the input switching threshold
   $V_{ICM}$ – The common mode input voltage
   $V_M$ – Voltage of measurement point on signal transition
   $V_L$ – Low-level test voltage at Input pin
   $V_H$ – High-level test voltage at Input pin
   $R_T$ – Effective termination resistance, which takes on a value of 1 MΩ when no parallel termination is required
   $V_T$ – Termination voltage
2. The load capacitance ($C_L$) at the Output pin is 0 pF for all signal standards.
3. According to the PCI specification. For information on PCI IP solutions, see www.xilinx.com/pci. The PCIX IOSTANDARD is available and has equivalent characteristics but no PCI-X IP is supported.

The capacitive load ($C_L$) is connected between the output and GND. *The Output timing for all standards, as published in the speed files and the data sheet, is always based on a $C_L$ value of zero.* High-impedance probes (less than 1 pF) are used for all measurements. Any delay that the test fixture might contribute to test measurements is subtracted from those measurements to produce the final timing numbers as published in the speed files and data sheet.

## Using IBIS Models to Simulate Load Conditions in Application

IBIS models permit the most accurate prediction of timing delays for a given application. The parameters found in the IBIS model ($V_{REF}$, $R_{REF}$, and $V_{MEAS}$) correspond directly with the parameters used in Table 26 ($V_T$, $R_T$, and $V_M$). Do not confuse $V_{REF}$ (the termination voltage) from the IBIS model with $V_{REF}$ (the input-switching threshold) from the table. A fourth parameter, $C_{REF}$, is always zero. The four parameters describe all relevant output test conditions. IBIS models are found in the Xilinx development software as well as at the following link:

www.xilinx.com/support/download/index.htm

Delays for a given application are simulated according to its specific load conditions as follows:

1. Simulate the desired signal standard with the output driver connected to the test setup shown in Figure 8. Use parameter values $V_T$, $R_T$, and $V_M$ from Table 26. $C_{REF}$ is zero.
2. Record the time to $V_M$.
3. Simulate the same signal standard with the output driver connected to the PCB trace with load. Use the appropriate IBIS model (including $V_{REF}$, $R_{REF}$, $C_{REF}$, and $V_{MEAS}$ values) or capacitive value to represent the load.
4. Record the time to $V_{MEAS}$.
5. Compare the results of steps 2 and 4. Add (or subtract) the increase (or decrease) in delay to (or from) the appropriate Output standard adjustment (Table 25) to yield the worst-case delay of the PCB trace.

## Simultaneously Switching Output Guidelines

This section provides guidelines for the recommended maximum allowable number of Simultaneous Switching Outputs (SSOs). These guidelines describe the maximum number of user I/O pins of a given output signal standard that should simultaneously switch in the same direction, while maintaining a safe level of switching noise. Meeting these guidelines for the stated test conditions ensures that the FPGA operates free from the adverse effects of ground and power bounce.

Ground or power bounce occurs when a large number of outputs simultaneously switch in the same direction. The output drive transistors all conduct current to a common voltage rail. Low-to-High transitions conduct to the $V_{CCO}$ rail; High-to-Low transitions conduct to the GND rail. The resulting cumulative current transient induces a voltage difference across the inductance that exists between the die pad and the power supply or ground return. The inductance is associated with bonding wires, the package lead frame, and any other signal routing inside the package. Other variables contribute to SSO noise levels, including stray inductance on the PCB as well as capacitive loading at receivers. Any SSO-induced voltage consequently affects internal switching noise margins and ultimately signal quality.

Table 27 and Table 28 provide the essential SSO guidelines. For each device/package combination, Table 27 provides the number of equivalent $V_{CCO}$/GND pairs. The equivalent number of pairs is based on characterization and may not match the physical number of pairs. For each output signal standard and drive strength, Table 28 recommends the maximum number of SSOs, switching in the same direction, allowed per $V_{CCO}$/GND pair within an I/O bank. The guidelines in Table 28 are categorized by package style, slew rate, and output drive current. Furthermore, the number of SSOs is specified by I/O bank. Generally, the left and right I/O banks (Banks 1 and 3) support higher output drive current.

Multiply the appropriate numbers from Table 27 and Table 28 to calculate the maximum number of SSOs allowed within an I/O bank. Exceeding these SSO guidelines might result in increased power or ground bounce, degraded signal integrity, or increased system jitter.

$SSO_{MAX}$/IO Bank = Table 27 x Table 28

The recommended maximum SSO values assumes that the FPGA is soldered on the printed circuit board and that the board uses sound design practices. The SSO values do not apply for FPGAs mounted in sockets, due to the lead inductance introduced by the socket.

The SSO values assume that the $V_{CCAUX}$ is powered at 3.3V. Setting $V_{CCAUX}$ to 2.5V provides better SSO characteristics.

*Table 27:* **Equivalent $V_{CCO}$/GND Pairs per Bank**

| Device | Package Style *(including Pb-free)* | |
|---|---|---|
| | CS484 | FG676 |
| XC3SD1800A | 6 | 9 |
| XC3SD3400A | 6 | 10 |

*Table 28:* **Recommended Simultaneously Switching Outputs per $V_{CCO}$/GND Pair ($V_{CCAUX}$ = 3.3V)**

| Signal Standard (IOSTANDARD) | | | Package Type | |
|---|---|---|---|---|
| | | | CS484, FG676 | |
| | | | Top, Bottom (Banks 0, 2) | Left, Right (Banks 1, 3) |
| **Single-Ended Standards** | | | | |
| LVTTL | Slow | 2 | 60 | 60 |
| | | 4 | 41 | 41 |
| | | 6 | 29 | 29 |
| | | 8 | 22 | 22 |
| | | 12 | 13 | 13 |
| | | 16 | 11 | 11 |
| | | 24 | 9 | 9 |
| | Fast | 2 | 10 | 10 |
| | | 4 | 6 | 6 |
| | | 6 | 5 | 5 |
| | | 8 | 3 | 3 |
| | | 12 | 3 | 3 |
| | | 16 | 3 | 3 |
| | | 24 | 2 | 2 |
| | QuietIO | 2 | 80 | 80 |
| | | 4 | 48 | 48 |
| | | 6 | 36 | 36 |
| | | 8 | 27 | 27 |
| | | 12 | 16 | 16 |
| | | 16 | 13 | 13 |
| | | 24 | 12 | 12 |

*Table 28:* **Recommended Simultaneously Switching Outputs per $V_{CCO}$/GND Pair ($V_{CCAUX}$ = 3.3V) *(Cont'd)***

| Signal Standard (IOSTANDARD) | | | Package Type | |
|---|---|---|---|---|
| | | | CS484, FG676 | |
| | | | Top, Bottom (Banks 0, 2) | Left, Right (Banks 1, 3) |
| LVCMOS33 | Slow | 2 | 76 | 76 |
| | | 4 | 46 | 46 |
| | | 6 | 27 | 27 |
| | | 8 | 20 | 20 |
| | | 12 | 13 | 13 |
| | | 16 | 10 | 10 |
| | | 24 | – | 9 |
| | Fast | 2 | 10 | 10 |
| | | 4 | 8 | 8 |
| | | 6 | 5 | 5 |
| | | 8 | 4 | 4 |
| | | 12 | 4 | 4 |
| | | 16 | 2 | 2 |
| | | 24 | – | 2 |
| | QuietIO | 2 | 76 | 76 |
| | | 4 | 46 | 46 |
| | | 6 | 32 | 32 |
| | | 8 | 26 | 26 |
| | | 12 | 18 | 18 |
| | | 16 | 14 | 14 |
| | | 24 | – | 10 |

*Table 28:* **Recommended Simultaneously Switching Outputs per $V_{CCO}$/GND Pair ($V_{CCAUX}$ = 3.3V) *(Cont'd)***

| Signal Standard (IOSTANDARD) | | | Package Type | |
|---|---|---|---|---|
| | | | CS484, FG676 | |
| | | | Top, Bottom (Banks 0, 2) | Left, Right (Banks 1, 3) |
| LVCMOS25 | Slow | 2 | 76 | 76 |
| | | 4 | 46 | 46 |
| | | 6 | 33 | 33 |
| | | 8 | 24 | 24 |
| | | 12 | 18 | 18 |
| | | 16 | – | 11 |
| | | 24 | – | 7 |
| | Fast | 2 | 18 | 18 |
| | | 4 | 14 | 14 |
| | | 6 | 6 | 6 |
| | | 8 | 6 | 6 |
| | | 12 | 3 | 3 |
| | | 16 | – | 3 |
| | | 24 | – | 2 |
| | QuietIO | 2 | 76 | 76 |
| | | 4 | 60 | 60 |
| | | 6 | 48 | 48 |
| | | 8 | 36 | 36 |
| | | 12 | 36 | 36 |
| | | 16 | – | 36 |
| | | 24 | – | 8 |

*Table 28:* **Recommended Simultaneously Switching Outputs per $V_{CCO}$/GND Pair ($V_{CCAUX}$ = 3.3V) *(Cont'd)***

| Signal Standard (IOSTANDARD) | | | Package Type | |
|---|---|---|---|---|
| | | | CS484, FG676 | |
| | | | Top, Bottom (Banks 0, 2) | Left, Right (Banks 1, 3) |
| LVCMOS18 | Slow | 2 | 64 | 64 |
| | | 4 | 34 | 34 |
| | | 6 | 22 | 22 |
| | | 8 | 18 | 18 |
| | | 12 | – | 13 |
| | | 16 | – | 10 |
| | Fast | 2 | 18 | 18 |
| | | 4 | 9 | 9 |
| | | 6 | 7 | 7 |
| | | 8 | 4 | 4 |
| | | 12 | – | 4 |
| | | 16 | – | 3 |
| | QuietIO | 2 | 64 | 64 |
| | | 4 | 64 | 64 |
| | | 6 | 48 | 48 |
| | | 8 | 36 | 36 |
| | | 12 | – | 36 |
| | | 16 | – | 24 |
| LVCMOS15 | Slow | 2 | 55 | 55 |
| | | 4 | 31 | 31 |
| | | 6 | 18 | 18 |
| | | 8 | – | 15 |
| | | 12 | – | 10 |
| | Fast | 2 | 25 | 25 |
| | | 4 | 10 | 10 |
| | | 6 | 6 | 6 |
| | | 8 | – | 4 |
| | | 12 | – | 3 |
| | QuietIO | 2 | 70 | 70 |
| | | 4 | 40 | 40 |
| | | 6 | 31 | 31 |
| | | 8 | – | 31 |
| | | 12 | – | 20 |

*Table 28:* **Recommended Simultaneously Switching Outputs per $V_{CCO}$/GND Pair ($V_{CCAUX}$ = 3.3V) *(Cont'd)***

| Signal Standard (IOSTANDARD) | | | Package Type CS484, FG676 | |
|---|---|---|---|---|
| | | | Top, Bottom (Banks 0, 2) | Left, Right (Banks 1, 3) |
| LVCMOS12 | Slow | 2 | 40 | 40 |
| | | 4 | – | 25 |
| | | 6 | – | 18 |
| | Fast | 2 | 31 | 31 |
| | | 4 | – | 13 |
| | | 6 | – | 9 |
| | QuietIO | 2 | 55 | 55 |
| | | 4 | – | 36 |
| | | 6 | – | 36 |
| PCI33_3 | | | 16 | 16 |
| PCI66_3 | | | – | 13 |
| HSTL_I | | | – | 20 |
| HSTL_III | | | – | 8 |
| HSTL_I_18 | | | 17 | 17 |
| HSTL_II_18 | | | – | 5 |
| HSTL_III_18 | | | 10 | 8 |
| SSTL18_I | | | 7 | 15 |
| SSTL18_II | | | – | 9 |
| SSTL2_I | | | 18 | 18 |
| SSTL2_II | | | – | 9 |
| SSTL3_I | | | 8 | 10 |
| SSTL3_II | | | 6 | 7 |

*Table 28:* **Recommended Simultaneously Switching Outputs per $V_{CCO}$/GND Pair ($V_{CCAUX}$ = 3.3V) *(Cont'd)***

| Signal Standard (IOSTANDARD) | Package Type CS484, FG676 | |
|---|---|---|
| | Top, Bottom (Banks 0, 2) | Left, Right (Banks 1, 3) |
| **Differential Standards (Number of I/O Pairs or Channels)** | | |
| LVDS_25 | 22 | – |
| LVDS_33 | 27 | – |
| BLVDS_25 | 4 | 4 |
| MINI_LVDS_25 | 22 | – |
| MINI_LVDS_33 | 27 | – |
| LVPECL_25 | Inputs Only | |
| LVPECL_33 | Inputs Only | |
| RSDS_25 | 22 | – |
| RSDS_33 | 27 | – |
| TMDS_33 | 27 | – |
| PPDS_25 | 22 | – |
| PPDS_33 | 27 | – |
| DIFF_HSTL_I_18 | 8 | 8 |
| DIFF_HSTL_II_18 | – | 2 |
| DIFF_HSTL_III_18 | 5 | 4 |
| DIFF_HSTL_I | – | 10 |
| DIFF_HSTL_III | – | 4 |
| DIFF_SSTL18_I | 3 | 7 |
| DIFF_SSTL18_II | – | 4 |
| DIFF_SSTL2_I | 9 | 9 |
| DIFF_SSTL2_II | – | 4 |
| DIFF_SSTL3_I | 4 | 5 |
| DIFF_SSTL3_II | 3 | 3 |

**Notes:**

1. Not all I/O standards are supported on all I/O banks. The left and right banks (I/O banks 1 and 3) support higher output drive current than the top and bottom banks (I/O banks 0 and 2). Similarly, true differential output standards, such as LVDS, RSDS, PPDS, miniLVDS, and TMDS, are only supported in top or bottom banks (I/O banks 0 and 2). Refer to UG331: *Spartan-3 Generation FPGA User Guide* for additional information.
2. The numbers in this table are recommendations that assume sound board lay out practice. This table assumes the following parasitic factors: combined PCB trace and land inductance per $V_{CCO}$ and GND pin of 1.0 nH, receiver capacitive load of 15 pF. Test limits are the $V_{IL}/V_{IH}$ voltage limits for the respective I/O standard.
3. If more than one signal standard is assigned to the I/Os of a given bank, refer to XAPP689: *Managing Ground Bounce in Large FPGAs* for information on how to perform weighted average SSO calculations.

## Configurable Logic Block (CLB) Timing

*Table 29:* **CLB (SLICEM) Timing**

| Symbol | Description | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|
| | | -5 | | -4 | | |
| | | Min | Max | Min | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{CKO}$ | When reading from the FFX (FFY) Flip-Flop, the time from the active transition at the CLK input to data appearing at the XQ (YQ) output | – | 0.60 | – | 0.68 | ns |
| **Setup Times** | | | | | | |
| $T_{AS}$ | Time from the setup of data at the F or G input to the active transition at the CLK input of the CLB | 0.18 | – | 0.36 | – | ns |
| $T_{DICK}$ | Time from the setup of data at the BX or BY input to the active transition at the CLK input of the CLB | 1.58 | – | 1.88 | – | ns |
| **Hold Times** | | | | | | |
| $T_{AH}$ | Time from the active transition at the CLK input to the point where data is last held at the F or G input | 0.00 | – | 0.00 | – | ns |
| $T_{CKDI}$ | Time from the active transition at the CLK input to the point where data is last held at the BX or BY input | 0.00 | – | 0.00 | – | ns |
| **Clock Timing** | | | | | | |
| $T_{CH}$ | The High pulse width of the CLB's CLK signal | 0.63 | – | 0.75 | – | ns |
| $T_{CL}$ | The Low pulse width of the CLK signal | 0.63 | – | 0.75 | – | ns |
| $F_{TOG}$ | Toggle frequency (for export control) | 0 | 770 | 0 | 667 | MHz |
| **Propagation Times** | | | | | | |
| $T_{ILO}$ | The time it takes for data to travel from the CLB's F (G) input to the X (Y) output | – | 0.62 | – | 0.71 | ns |
| **Set/Reset Pulse Width** | | | | | | |
| $T_{RPW_CLB}$ | The minimum allowable pulse width, High or Low, to the CLB's SR input | 1.33 | – | 1.61 | – | ns |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7.

*Table 30:* **CLB Distributed RAM Switching Characteristics**

| Symbol | Description | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|
| | | -5 | | -4 | | |
| | | Min | Max | Min | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{SHCKO}$ | Time from the active edge at the CLK input to data appearing on the distributed RAM output | – | 1.44 | – | 1.72 | ns |
| **Setup Times** | | | | | | |
| $T_{DS}$ | Setup time of data at the BX or BY input before the active transition at the CLK input of the distributed RAM | –0.07 | – | –0.02 | – | ns |
| $T_{AS}$ | Setup time of the F/G address inputs before the active transition at the CLK input of the distributed RAM | 0.18 | – | 0.36 | – | ns |
| $T_{WS}$ | Setup time of the write enable input before the active transition at the CLK input of the distributed RAM | 0.30 | – | 0.59 | – | ns |
| **Hold Times** | | | | | | |
| $T_{DH}$ | Hold time of the BX and BY data inputs after the active transition at the CLK input of the distributed RAM | 0.13 | – | 0.13 | – | ns |
| $T_{AH}$, $T_{WH}$ | Hold time of the F/G address inputs or the write enable input after the active transition at the CLK input of the distributed RAM | 0.01 | – | 0.01 | – | ns |
| **Clock Pulse Width** | | | | | | |
| $T_{WPH}$, $T_{WPL}$ | Minimum High or Low pulse width at CLK input | 0.88 | – | 1.01 | – | ns |

*Table 31:* **CLB Shift Register Switching Characteristics**

| Symbol | Description | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|
| | | -5 | | -4 | | |
| | | Min | Max | Min | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{REG}$ | Time from the active edge at the CLK input to data appearing on the shift register output | – | 4.11 | – | 4.82 | ns |
| **Setup Times** | | | | | | |
| $T_{SRLDS}$ | Setup time of data at the BX or BY input before the active transition at the CLK input of the shift register | 0.13 | – | 0.18 | – | ns |
| **Hold Times** | | | | | | |
| $T_{SRLDH}$ | Hold time of the BX or BY data input after the active transition at the CLK input of the shift register | 0.16 | – | 0.16 | – | ns |
| **Clock Pulse Width** | | | | | | |
| $T_{WPH}$, $T_{WPL}$ | Minimum High or Low pulse width at CLK input | 0.90 | – | 1.01 | – | ns |

## Clock Buffer/Multiplexer Switching Characteristics

*Table 32:* **Clock Distribution Switching Characteristics**

| Symbol | Description | Minimum | Maximum | | Units |
|---|---|---|---|---|---|
| | | | Speed Grade | | |
| | | | -5 | -4 | |
| $T_{GIO}$ | Global clock buffer (BUFG, BUFGMUX, BUFGCE) I input to O-output delay | – | 0.22 | 0.23 | ns |
| $T_{GSI}$ | Global clock multiplexer (BUFGMUX) select S-input setup to I0 and I1 inputs. Same as BUFGCE enable CE-input | – | 0.56 | 0.63 | ns |
| $F_{BUFG}$ | Frequency of signals distributed on global buffers (all sides) | 0 | 350 | 334 | MHz |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7.

## Block RAM Timing

*Table 33:* **Block RAM Timing**

| Symbol | Description | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|
| | | -5 | | -4 | | |
| | | Min | Max | Min | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{RCKO_DOA_NC}$ | When reading from block RAM, the delay from the active transition at the CLK input to data appearing at the DOUT output | – | 2.38 | – | 2.80 | ns |
| $T_{RCKO_DOA}$ | Clock CLK to DOUT output (with output register) | – | 1.24 | – | 1.45 | ns |
| **Setup Times** | | | | | | |
| $T_{RCCK_ADDR}$ | Setup time for the ADDR inputs before the active transition at the CLK input of the block RAM | 0.40 | – | 0.46 | – | ns |
| $T_{RDCK_DIB}$ | Setup time for data at the DIN inputs before the active transition at the CLK input of the block RAM | 0.29 | – | 0.33 | – | ns |
| $T_{RCCK_ENB}$ | Setup time for the EN input before the active transition at the CLK input of the block RAM | 0.51 | – | 0.60 | – | ns |
| $T_{RCCK_WEB}$ | Setup time for the WE input before the active transition at the CLK input of the block RAM | 0.64 | – | 0.75 | – | ns |
| $T_{RCCK_REGCE}$ | Setup time for the CE input before the active transition at the CLK input of the block RAM | 0.34 | – | 0.40 | – | ns |
| $T_{RCCK_RST}$ | Setup time for the RST input before the active transition at the CLK input of the block RAM | 0.22 | – | 0.25 | – | ns |
| **Hold Times** | | | | | | |
| $T_{RCKC_ADDR}$ | Hold time on the ADDR inputs after the active transition at the CLK input | 0.09 | – | 0.10 | – | ns |
| $T_{RCKC_DIB}$ | Hold time on the DIN inputs after the active transition at the CLK input | 0.09 | – | 0.10 | – | ns |
| $T_{RCKC_ENB}$ | Hold time on the EN input after the active transition at the CLK input | 0.09 | – | 0.10 | – | ns |
| $T_{RCKC_WEB}$ | Hold time on the WE input after the active transition at the CLK input | 0.09 | – | 0.10 | – | ns |
| $T_{RCKC_REGCE}$ | Hold time on the CE input after the active transition at the CLK input | 0.09 | – | 0.10 | – | ns |
| $T_{RCKC_RST}$ | Hold time on the RST input after the active transition at the CLK input | 0.09 | – | 0.10 | – | ns |
| **Clock Timing** | | | | | | |
| $T_{BPWH}$ | High pulse width of the CLK signal | 1.56 | – | 1.79 | – | ns |
| $T_{BPWL}$ | Low pulse width of the CLK signal | 1.56 | – | 1.79 | – | ns |
| **Clock Frequency** | | | | | | |
| $F_{BRAM}$ | Block RAM clock frequency | 0 | 320 | 0 | 280 | MHz |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7.

## DSP48A Timing

To reference the DSP48A block diagram, see UG431: *XtremeDSP DSP48A for Spartan-3A DSP FPGA User Guide*.

*Table 34:* **Setup Times for the DSP48A**

| Symbol | Description | Pre-adder | Multiplier | Post-adder | Speed Grade | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | -5 | -4 | |
| | | | | | Min | Min | |
| **Setup Times of Data/Control Pins to the Input Register Clock** | | | | | | | |
| $T_{DSPDCK_AA}$ | A input to A register CLK | – | – | – | 0.04 | 0.04 | ns |
| $T_{DSPDCK_DB}$ | D input to B register CLK | Yes | – | – | 1.64 | 1.88 | ns |
| $T_{DSPDCK_CC}$ | C input to C register CLK | – | – | – | 0.05 | 0.05 | ns |
| $T_{DSPDCK_DD}$ | D input to D register CLK | – | – | – | 0.04 | 0.04 | ns |
| $T_{DSPDCK_OPB}$ | OPMODE input to B register CLK | Yes | – | – | 0.37 | 0.42 | ns |
| $T_{DSPDCK_OPOP}$ | OPMODE input to OPMODE register CLK | – | – | – | 0.06 | 0.06 | ns |
| **Setup Times of Data Pins to the Pipeline Register Clock** | | | | | | | |
| $T_{DSPDCK_AM}$ | A input to M register CLK | – | Yes | – | 3.30 | 3.79 | ns |
| $T_{DSPDCK_BM}$ | B input to M register CLK | Yes | Yes | – | 4.33 | 4.97 | ns |
| | | No | Yes | – | 3.30 | 3.79 | ns |
| $T_{DSPDCK_DM}$ | D input to M register CLK | Yes | Yes | – | 4.41 | 5.06 | ns |
| $T_{DSPDCK_OPM}$ | OPMODE to M register CLK | Yes | Yes | – | 4.72 | 5.42 | ns |
| **Setup Times of Data/Control Pins to the Output Register Clock** | | | | | | | |
| $T_{DSPDCK_AP}$ | A input to P register CLK | – | Yes | Yes | 4.78 | 5.49 | ns |
| $T_{DSPDCK_BP}$ | B input to P register CLK | Yes | Yes | Yes | 5.87 | 6.74 | ns |
| | | No | Yes | Yes | 4.77 | 5.48 | ns |
| $T_{DSPDCK_DP}$ | D input to P register CLK | Yes | Yes | Yes | 5.95 | 6.83 | ns |
| $T_{DSPDCK_CP}$ | C input to P register CLK | – | – | Yes | 1.90 | 2.18 | ns |
| $T_{DSPDCK_OPP}$ | OPMODE input to P register CLK | Yes | Yes | Yes | 6.25 | 7.18 | ns |

**Notes:**

1. "Yes" means that the component is in the path. "No" means that the component is being bypassed. "–" means that no path exists, so it is not applicable.
2. The numbers in this table are based on the operating conditions set forth in Table 7.

*Table 35:* **Clock to Out, Propagation Delays, and Maximum Frequency for the DSP48A**

| Symbol | Description | Pre-adder | Multiplier | Post-adder | Speed Grade | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | -5 | -4 | |
| | | | | | Max | Max | |
| **Clock to Out from Output Register Clock to Output Pin** | | | | | | | |
| $T_{DSPCKO_PP}$ | CLK (PREG) to P output | – | – | – | 1.26 | 1.44 | ns |
| **Clock to Out from Pipeline Register Clock to Output Pins** | | | | | | | |
| $T_{DSPCKO_PM}$ | CLK (MREG) to P output | – | Yes | Yes | 3.16 | 3.63 | ns |
| | | – | Yes | No | 1.94 | 2.23 | ns |
| **Clock to Out from Input Register Clock to Output Pins** | | | | | | | |
| $T_{DSPCKO_PA}$ | CLK (AREG) to P output | – | Yes | Yes | 6.33 | 7.27 | ns |
| $T_{DSPCKO_PB}$ | CLK (BREG) to P output | Yes | Yes | Yes | 7.45 | 8.56 | ns |
| $T_{DSPCKO_PC}$ | CLK (CREG) to P output | – | – | Yes | 3.37 | 3.87 | ns |
| $T_{DSPCKO_PD}$ | CLK (DREG) to P output | Yes | Yes | Yes | 7.33 | 8.42 | ns |
| **Combinatorial Delays from Input Pins to Output Pins** | | | | | | | |
| $T_{DSPDO_AP}$ $T_{DSPDO_BP}$ | A or B input to P output | – | No | Yes | 2.78 | 3.19 | ns |
| | | – | Yes | No | 4.60 | 5.28 | ns |
| | | – | Yes | Yes | 5.65 | 6.49 | ns |
| $T_{DSPDO_BP}$ | B input to P output | Yes | No | No | 3.49 | 4.01 | ns |
| | | Yes | Yes | No | 5.79 | 6.65 | ns |
| | | Yes | Yes | Yes | 6.74 | 7.74 | ns |
| $T_{DSPDO_CP}$ | C input to P output | – | – | Yes | 2.76 | 3.17 | ns |
| $T_{DSPDO_DP}$ | D input to P output | Yes | Yes | Yes | 6.81 | 7.82 | ns |
| $T_{DSPDO_OPP}$ | OPMODE input to P output | Yes | Yes | Yes | 7.12 | 8.18 | ns |
| **Maximum Frequency** | | | | | | | |
| $F_{MAX}$ | All registers used | Yes | Yes | Yes | 287 | 250 | MHz |

**Notes:**

1. To reference the DSP48A block diagram, see UG431: *XtremeDSP DSP48A for Spartan-3A DSP FPGA User Guide*.
2. "Yes" means that the component is in the path. "No" means that the component is being bypassed. "–" means that no path exists, so it is not applicable.
3. The numbers in this table are based on the operating conditions set forth in Table 7.

## Digital Clock Manager (DCM) Timing

For specification purposes, the DCM consists of three key components: the Delay-Locked Loop (DLL), the Digital Frequency Synthesizer (DFS), and the Phase Shifter (PS).

Aspects of DLL operation play a role in all DCM applications. All such applications inevitably use the CLKIN and the CLKFB inputs connected to either the CLK0 or the CLK2X feedback, respectively. Thus, specifications in the DLL tables (Table 36 and Table 37) apply to any application that only employs the DLL component. When the DFS and/or the PS components are used together with the DLL, then the specifications listed in the DFS and PS tables (Table 38 through Table 41) supersede any corresponding ones in the DLL tables. DLL specifications that do not change with the addition of DFS or PS functions are presented in Table 36 and Table 37.

Period jitter and cycle-cycle jitter are two of many different ways of specifying clock jitter. Both specifications describe statistical variation from a mean value.

Period jitter is the worst-case deviation from the ideal clock period over a collection of millions of samples. In a histogram of period jitter, the mean value is the clock period.

Cycle-cycle jitter is the worst-case difference in clock period between adjacent clock cycles in the collection of clock periods sampled. In a histogram of cycle-cycle jitter, the mean value is zero.

### Spread Spectrum

DCMs accept typical spread spectrum clocks as long as they meet the input requirements. The DLL will track the frequency changes created by the spread spectrum clock to drive the global clocks to the FPGA logic. See XAPP469: *Spread-Spectrum Clocking Reception for Displays* for details.

### Delay-Locked Loop (DLL)

*Table 36:* **Recommended Operating Conditions for the DLL**

| Symbol | | Description | | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | -5 | | -4 | | |
| | | | | Min | Max | Min | Max | |
| **Input Frequency Ranges** | | | | | | | | |
| $F_{CLKIN}$ | CLKIN_FREQ_DLL | Frequency of the CLKIN clock input | | 5(2) | 280(3) | 5(2) | 250(3) | MHz |
| **Input Pulse Requirements** | | | | | | | | |
| CLKIN_PULSE | | CLKIN pulse width as a percentage of the CLKIN period | $F_{CLKIN} \le 150$ MHz | 40% | 60% | 40% | 60% | – |
| | | | $F_{CLKIN} > 150$ MHz | 45% | 55% | 45% | 55% | – |
| **Input Clock Jitter Tolerance and Delay Path Variation(4)** | | | | | | | | |
| CLKIN_CYC_JITT_DLL_LF | | Cycle-to-cycle jitter at the CLKIN input | $F_{CLKIN} \le 150$ MHz | – | ±300 | – | ±300 | ps |
| CLKIN_CYC_JITT_DLL_HF | | | $F_{CLKIN} > 150$ MHz | – | ±150 | – | ±150 | ps |
| CLKIN_PER_JITT_DLL | | Period jitter at the CLKIN input | | – | ±1 | – | ±1 | ns |
| CLKFB_DELAY_VAR_EXT | | Allowable variation of off-chip feedback delay from the DCM output to the CLKFB input | | – | ±1 | – | ±1 | ns |

**Notes:**

1. DLL specifications apply when any of the DLL outputs (CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, or CLKDV) are in use.
2. The DFS, when operating independently of the DLL, supports lower FCLKIN frequencies. See Table 38.
3. To support double the maximum effective FCLKIN limit, set the CLKIN_DIVIDE_BY_2 attribute to TRUE. This attribute divides the incoming clock frequency by two as it enters the DCM. The CLK2X output reproduces the clock frequency provided on the CLKIN input.
4. CLKIN input jitter beyond these limits might cause the DCM to lose lock.
5. The DCM specifications are guaranteed when both adjacent DCMs are locked.

*Table 37:* **Switching Characteristics for the DLL**

| Symbol | Description | | Device | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | -5 | | -4 | | |
| | | | | Min | Max | Min | Max | |
| **Output Frequency Ranges** | | | | | | | | |
| CLKOUT_FREQ_CLK0 | Frequency for the CLK0 and CLK180 outputs | | All | 5 | 280 | 5 | 250 | MHz |
| CLKOUT_FREQ_CLK90 | Frequency for the CLK90 and CLK270 outputs | | | 5 | 200 | 5 | 200 | MHz |
| CLKOUT_FREQ_2X | Frequency for the CLK2X and CLK2X180 outputs | | | 10 | 334 | 10 | 334 | MHz |
| CLKOUT_FREQ_DV | Frequency for the CLKDV output | | | 0.3125 | 186 | 0.3125 | 166 | MHz |
| **Output Clock Jitter** (2)(3)(4) | | | | | | | | |
| CLKOUT_PER_JITT_0 | Period jitter at the CLK0 output | | All | – | ±100 | – | ±100 | ps |
| CLKOUT_PER_JITT_90 | Period jitter at the CLK90 output | | | – | ±150 | – | ±150 | ps |
| CLKOUT_PER_JITT_180 | Period jitter at the CLK180 output | | | – | ±150 | – | ±150 | ps |
| CLKOUT_PER_JITT_270 | Period jitter at the CLK270 output | | | – | ±150 | – | ±150 | ps |
| CLKOUT_PER_JITT_2X | Period jitter at the CLK2X and CLK2X180 outputs | | | – | ±[0.5% of CLKIN period + 100] | – | ±[0.5% of CLKIN period + 100] | ps |
| CLKOUT_PER_JITT_DV1 | Period jitter at the CLKDV output when performing integer division | | | – | ±150 | – | ±150 | ps |
| CLKOUT_PER_JITT_DV2 | Period jitter at the CLKDV output when performing non-integer division | | | – | ±[0.5% of CLKIN period + 100] | – | ±[0.5% of CLKIN period + 100] | ps |
| **Duty Cycle** (4) | | | | | | | | |
| CLKOUT_DUTY_CYCLE_DLL | Duty cycle variation for the CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, and CLKDV outputs, including the BUFGMUX and clock tree duty-cycle distortion | | All | – | ±[1% of CLKIN period + 350] | – | ±[1% of CLKIN period + 350] | ps |
| **Phase Alignment** (4) | | | | | | | | |
| CLKIN_CLKFB_PHASE | Phase offset between the CLKIN and CLKFB inputs | | All | – | ±150 | – | ±150 | ps |
| CLKOUT_PHASE_DLL | Phase offset between DLL outputs | CLK0 to CLK2X (not CLK2X180) | | – | ±[1% of CLKIN period + 100] | – | ±[1% of CLKIN period + 100] | ps |
| | | All others | | – | ±[1% of CLKIN period + 150] | – | ±[1% of CLKIN period + 150] | ps |
| **Lock Time** | | | | | | | | |
| LOCK_DLL(3) | When using the DLL alone: The time from deassertion at the DCM's Reset input to the rising transition at its LOCKED output. When the DCM is locked, the CLKIN and CLKFB signals are in phase | 5 MHz < FCLKIN < 15 MHz | All | – | 5 | – | 5 | ms |
| | | FCLKIN > 15 MHz | | – | 600 | – | 600 | µs |

*Table 37:* **Switching Characteristics for the DLL *(Cont'd)***

| Symbol | Description | Device | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|---|
| | | | -5 | | -4 | | |
| | | | Min | Max | Min | Max | |
| **Delay Lines** | | | | | | | |
| DCM_DELAY_STEP(5) | Finest delay resolution, averaged over all steps | All | 15 | 35 | 15 | 35 | ps |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7 and Table 36.
2. Indicates the maximum amount of output jitter that the DCM adds to the jitter on the CLKIN input.
3. For optimal jitter tolerance and faster lock time, use the CLKIN_PERIOD attribute.
4. Some jitter and duty-cycle specifications include 1% of input clock period or 0.01 UI. For example, the data sheet specifies a maximum jitter of ±[1% of CLKIN period + 150]. Assume the CLKIN frequency is 100 MHz. The equivalent CLKIN period is 10 ns and 1% of 10 ns is 0.1 ns or 100 ps. According to the data sheet, the maximum jitter is ±[100 ps + 150 ps] = ±250 ps, averaged over all steps.
5. The typical delay step size is 23 ps.

## Digital Frequency Synthesizer (DFS)

*Table 38:* **Recommended Operating Conditions for the DFS**

| Symbol | | Description | | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | -5 | | -4 | | |
| | | | | Min | Max | Min | Max | |
| **Input Frequency Ranges(2)** | | | | | | | | |
| $F_{CLKIN}$ | CLKIN_FREQ_FX | Frequency for the CLKIN input | | 0.2 | 333(5) | 0.2 | 333(5) | MHz |
| **Input Clock Jitter Tolerance(3)** | | | | | | | | |
| CLKIN_CYC_JITT_FX_LF | | Cycle-to-cycle jitter at the CLKIN input, based on CLKFX output frequency | $F_{CLKFX} \leq 150$ MHz | – | ±300 | – | ±300 | ps |
| CLKIN_CYC_JITT_FX_HF | | | $F_{CLKFX} > 150$ MHz | – | ±150 | – | ±150 | ps |
| CLKIN_PER_JITT_FX | | Period jitter at the CLKIN input | | – | ±1 | – | ±1 | ns |

**Notes:**

1. DFS specifications apply when either of the DFS outputs (CLKFX or CLKFX180) are used.
2. If both DFS and DLL outputs are used on the same DCM, follow the more restrictive CLKIN_FREQ_DLL specifications in Table 36.
3. CLKIN input jitter beyond these limits may cause the DCM to lose lock.
4. The DCM specifications are guaranteed when both adjacent DCMs are locked.
5. To support double the maximum effective $F_{CLKIN}$ limit, set the CLKIN_DIVIDE_BY_2 attribute to TRUE. This attribute divides the incoming clock frequency by two as it enters the DCM.

*Table 39:* **Switching Characteristics for the DFS**

| Symbol | Description | | Device | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | -5 | | -4 | | |
| | | | | Min | Max | Min | Max | |
| **Output Frequency Ranges** | | | | | | | | |
| CLKOUT_FREQ_FX(2) | Frequency for the CLKFX and CLKFX180 outputs | | All | 5 | 350 | 5 | 311 | MHz |
| **Output Clock Jitter (3)(4)** | | | | | | | | |
| CLKOUT_PER_JITT_FX | Period jitter at the CLKFX and CLKFX180 outputs. | CLKIN ≤ 20 MHz | All | Typ | Max | Typ | Max | |
| | | | | Use the Spartan-3A Jitter Calculator: www.xilinx.com/support/documentation/data_sheets/s3a_jitter_calc.zip | | | | ps |
| | | CLKIN > 20 MHz | | ±[1% of CLKFX period + 100] | ±[1% of CLKFX period + 200] | ±[1% of CLKFX period + 100] | ±[1% of CLKFX period + 200] | ps |
| **Duty Cycle(5)(6)** | | | | | | | | |
| CLKOUT_DUTY_CYCLE_FX | Duty cycle precision for the CLKFX and CLKFX180 outputs, including the BUFGMUX and clock tree duty-cycle distortion | | All | – | ±[1% of CLKFX period + 350] | – | ±[1% of CLKFX period + 350] | ps |
| **Phase Alignment(6)** | | | | | | | | |
| CLKOUT_PHASE_FX | Phase offset between the DFS CLKFX output and the DLL CLK0 output when both the DFS and DLL are used | | All | – | ±200 | – | ±200 | ps |
| CLKOUT_PHASE_FX180 | Phase offset between the DFS CLKFX180 output and the DLL CLK0 output when both the DFS and DLL are used | | All | – | ±[1% of CLKFX period + 200] | – | ±[1% of CLKFX period + 200] | ps |
| **Lock Time** | | | | | | | | |
| LOCK_FX(2)(3) | The time from deassertion at the DCM's Reset input to the rising transition at its LOCKED output. The DFS asserts LOCKED when the CLKFX and CLKFX180 signals are valid. If using both the DLL and the DFS, use the longer locking time. | 5 MHz ≤ $F_{CLKIN}$ ≤ 15 MHz | All | – | 5 | – | 5 | ms |
| | | $F_{CLKIN}$ > 15 MHz | | – | 450 | – | 450 | µs |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7 and Table 38.
2. DFS performance requires the additional logic automatically added by ISE 9.1i and later software revisions.
3. For optimal jitter tolerance and faster lock time, use the CLKIN_PERIOD attribute.
4. Maximum output jitter is characterized within a reasonable noise environment (150 ps input period jitter, 40 SSOs and 25% CLB switching) on an FPGA. Output jitter strongly depends on the environment, including the number of SSOs, the output drive strength, CLB utilization, CLB switching activities, switching frequency, power supply and PCB design. The actual maximum output jitter depends on the system application.
5. The CLKFX and CLKFX180 outputs always have an approximate 50% duty cycle.
6. Some duty-cycle and alignment specifications include a percentage of the CLKFX output period. For example, the data sheet specifies a maximum CLKFX jitter of "±[1% of CLKFX period + 200]". Assume the CLKFX output frequency is 100 MHz. The equivalent CLKFX period is 10 ns and 1% of 10 ns is 0.1 ns or 100 ps. According to the data sheet, the maximum jitter is ±[100 ps + 200 ps] = ±300 ps.

## Phase Shifter (PS)

*Table 40:* **Recommended Operating Conditions for the PS in Variable Phase Mode**

| Symbol | Description | Speed Grade | | | | Units |
|---|---|---|---|---|---|---|
| | | -5 | | -4 | | |
| | | Min | Max | Min | Max | |
| **Operating Frequency Ranges** | | | | | | |
| PSCLK_FREQ (FPSCLK) | Frequency for the PSCLK input | 1 | 167 | 1 | 167 | MHz |
| **Input Pulse Requirements** | | | | | | |
| PSCLK_PULSE | PSCLK pulse width as a percentage of the PSCLK period | 40% | 60% | 40% | 60% | – |

*Table 41:* **Switching Characteristics for the PS in Variable Phase Mode**

| Symbol | Description | | Phase Shift Amount | Units |
|---|---|---|---|---|
| **Phase Shifting Range** | | | | |
| MAX_STEPS(2,3) | Maximum allowed number of DCM_DELAY_STEP steps for a given CLKIN clock period, where T = CLKIN clock period in ns. If using CLKIN_DIVIDE_BY_2 = TRUE, double the effective clock period. | CLKIN < 60 MHz | ±[INTEGER(10 • ($T_{CLKIN}$ – 3 ns))] | steps |
| | | CLKIN ≥ 60 MHz | ±[INTEGER(15 • ($T_{CLKIN}$ – 3 ns))] | |
| FINE_SHIFT_RANGE_MIN | Minimum guaranteed delay for variable phase shifting | | ±[MAX_STEPS • DCM_DELAY_STEP_MIN] | ns |
| FINE_SHIFT_RANGE_MAX | Maximum guaranteed delay for variable phase shifting | | ±[MAX_STEPS • DCM_DELAY_STEP_MAX] | ns |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7 and Table 40.
2. The maximum variable phase shift range, MAX_STEPS, is only valid when the DCM is has no initial fixed phase shifting, that is, the PHASE_SHIFT attribute is set to 0.
3. The DCM_DELAY_STEP values are provided at the bottom of Table 37.

## Miscellaneous DCM Timing

*Table 42:* **Miscellaneous DCM Timing**

| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| DCM_RST_PW_MIN | Minimum duration of a RST pulse width | 3 | – | CLKIN cycles |

## DNA Port Timing

*Table 43:* **DNA_PORT Interface Timing**

| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| $T_{DNASSU}$ | Setup time on SHIFT before the rising edge of CLK | 1.0 | – | ns |
| $T_{DNASH}$ | Hold time on SHIFT after the rising edge of CLK | 0.5 | – | ns |
| $T_{DNADSU}$ | Setup time on DIN before the rising edge of CLK | 1.0 | – | ns |
| $T_{DNADH}$ | Hold time on DIN after the rising edge of CLK | 0.5 | – | ns |
| $T_{DNARSU}$ | Setup time on READ before the rising edge of CLK | 5.0 | 10,000 | ns |
| $T_{DNARH}$ | Hold time on READ after the rising edge of CLK | 0.0 | – | ns |
| $T_{DNADCKO}$ | Clock-to-output delay on DOUT after rising edge of CLK | 0.5 | 1.5 | ns |
| $T_{DNACLKF}$ | CLK frequency | 0.0 | 100 | MHz |
| $T_{DNACLKH}$ | CLK High time | 1.0 | ∞ | ns |
| $T_{DNACLKL}$ | CLK Low time | 1.0 | ∞ | ns |

**Notes:**

1. The minimum READ pulse width is 5 ns, and the maximum READ pulse width is 10 µs.

## Suspend Mode Timing

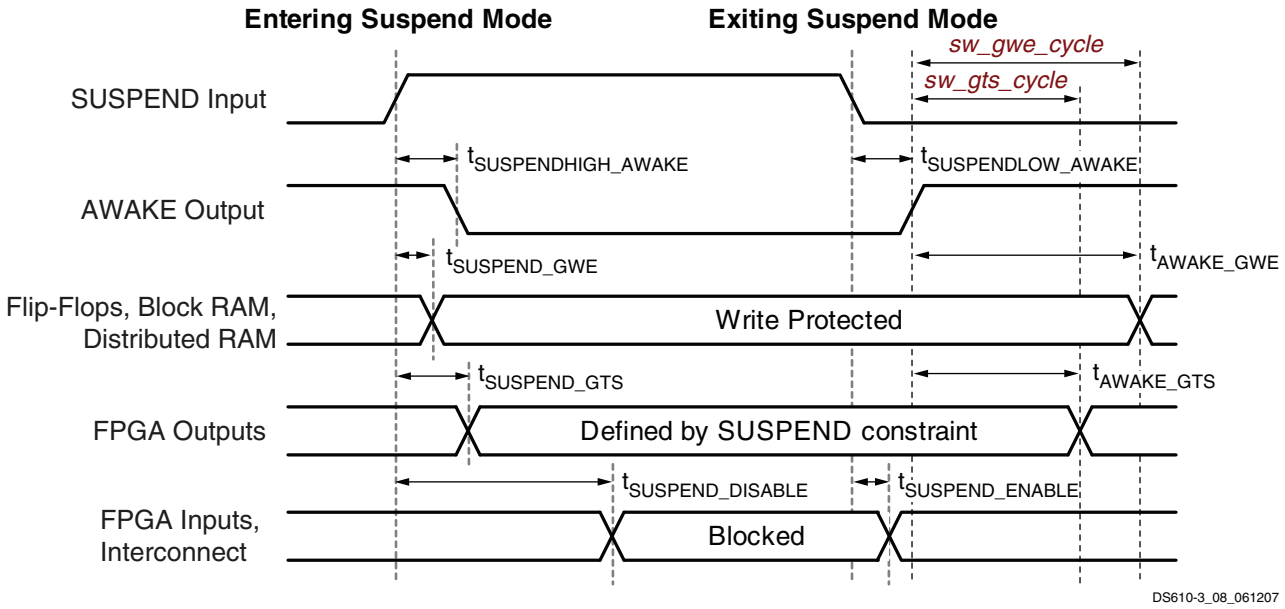



*Figure 9:* **Suspend Mode Timing**

*Table 44:* **Suspend Mode Timing Parameters**

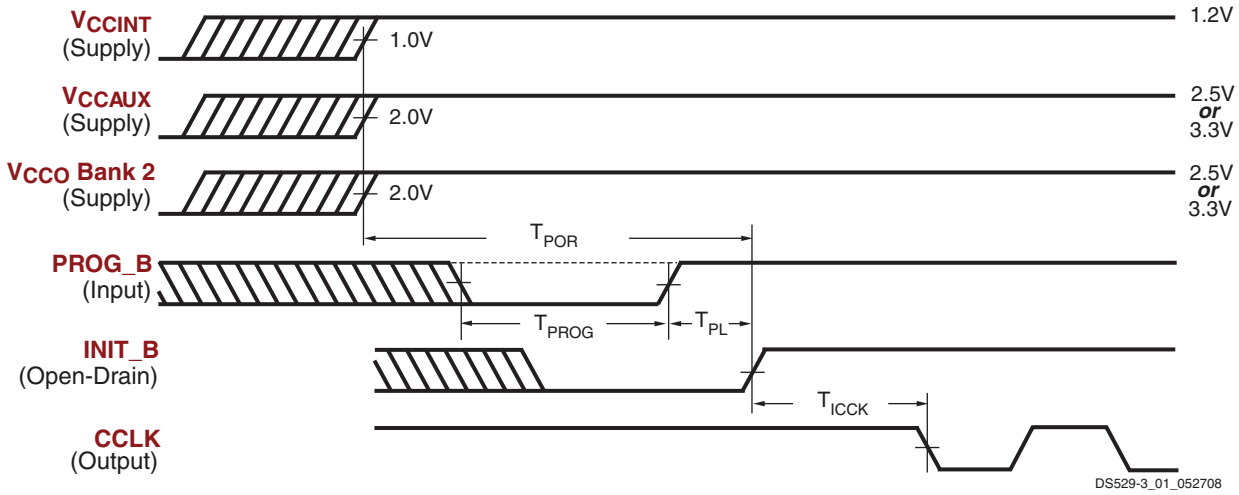
| Symbol | Description | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **Entering Suspend Mode** | | | | | |
| $T_{SUSPENDHIGH_AWAKE}$ | Rising edge of SUSPEND pin to falling edge of AWAKE pin without glitch filter (***suspend_filter:No***) | – | 7 | – | ns |
| $T_{SUSPENDFILTER}$ | Adjustment to SUSPEND pin rising edge parameters when glitch filter enabled (***suspend_filter:Yes***) | +160 | +300 | +600 | ns |
| $T_{SUSPEND_GTS}$ | Rising edge of SUSPEND pin until FPGA output pins drive their defined SUSPEND constraint behavior | – | 10 | – | ns |
| $T_{SUSPEND_GWE}$ | Rising edge of SUSPEND pin to write-protect lock on all writable clocked elements | – | <5 | – | ns |
| $T_{SUSPEND_DISABLE}$ | Rising edge of the SUSPEND pin to FPGA input pins and interconnect disabled | – | 340 | – | ns |
| **Exiting Suspend Mode** | | | | | |
| $T_{SUSPENDLOW_AWAKE}$ | Falling edge of the SUSPEND pin to rising edge of the AWAKE pin. Does not include DCM lock time. | – | 4 to 108 | – | µs |
| $T_{SUSPEND_ENABLE}$ | Falling edge of the SUSPEND pin to FPGA input pins and interconnect re-enabled | – | 3.7 to 109 | – | µs |
| $T_{AWAKE_GWE1}$ | Rising edge of the AWAKE pin until write-protect lock released on all writable clocked elements, using ***sw_clk:InternalClock*** and ***sw_gwe_cycle:1***. | – | 67 | – | ns |
| $T_{AWAKE_GWE512}$ | Rising edge of the AWAKE pin until write-protect lock released on all writable clocked elements, using ***sw_clk:InternalClock*** and ***sw_gwe_cycle:512***. | – | 14 | – | µs |
| $T_{AWAKE_GTS1}$ | Rising edge of the AWAKE pin until outputs return to the behavior described in the FPGA application, using ***sw_clk:InternalClock*** and ***sw_gts_cycle:1***. | – | 57 | – | ns |
| $T_{AWAKE_GTS512}$ | Rising edge of the AWAKE pin until outputs return to the behavior described in the FPGA application, using ***sw_clk:InternalClock*** and ***sw_gts_cycle:512***. | – | 14 | – | µs |

**Notes:**

1. These parameters based on characterization.
2. For information on using the Spartan-3A DSP Suspend feature, see XAPP480: *Using Suspend Mode in Spartan-3 Generation FPGAs*.

# Configuration and JTAG Timing

## General Configuration Power-On/Reconfigure Timing




**Notes:**

1. The $V_{CCINT}$, $V_{CCAUX}$, and $V_{CCO}$ supplies can be applied in any order.
2. The Low-going pulse on PROG_B is optional after power-on but necessary for reconfiguration without a power cycle.
3. The rising edge of INIT_B samples the voltage levels applied to the mode pins (M0 - M2).

*Figure 10:* **Waveforms for Power-On and the Beginning of Configuration**

*Table 45:* **Power-On Timing and the Beginning of Configuration**

| Symbol | Description | Device | All Speed Grades | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| $T_{POR}$[2] | The time from the application of $V_{CCINT}$, $V_{CCAUX}$, and $V_{CCO}$ Bank 2 supply voltage ramps (whichever occurs last) to the rising transition of the INIT_B pin | All | – | 18 | ms |
| $T_{PROG}$ | The width of the low-going pulse on the PROG_B pin | All | 0.5 | – | µs |
| $T_{PL}$[2] | The time from the rising edge of the PROG_B pin to the rising transition on the INIT_B pin | All | – | 2 | ms |
| $T_{INIT}$ | Minimum Low pulse width on INIT_B output | All | 300 | – | ns |
| $T_{ICCK}$[3] | The time from the rising edge of the INIT_B pin to the generation of the configuration clock signal at the CCLK output pin | All | 0.5 | 4 | µs |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7. This means power must be applied to all $V_{CCINT}$, $V_{CCO}$, and $V_{CCAUX}$ lines.
2. Power-on reset and the clearing of configuration memory occurs during this period.
3. This specification applies only to the Master Serial, SPI, and BPI modes.
4. For details on configuration, see UG332 *Spartan-3 Generation Configuration User Guide*.

## Configuration Clock (CCLK) Characteristics

*Table 46:* **Master Mode CCLK Output Period by *ConfigRate* Option Setting**

| Symbol | Description | *ConfigRate* Setting[1] | Temperature Range | Minimum | Maximum | Units |
|---|---|---|---|---|---|---|
| $T_{CCLK1}$ | CCLK clock period by ***ConfigRate*** setting | 1 *(power-on value)* | Commercial | 1,254 | 2,500 | ns |
| | | | Industrial | 1,180 | | ns |
| $T_{CCLK3}$ | | 3 | Commercial | 413 | 833 | ns |
| | | | Industrial | 390 | | ns |
| $T_{CCLK6}$ | | 6 (default) | Commercial | 207 | 417 | ns |
| | | | Industrial | 195 | | ns |
| $T_{CCLK7}$ | | 7 | Commercial | 178 | 357 | ns |
| | | | Industrial | 168 | | ns |
| $T_{CCLK8}$ | | 8 | Commercial | 156 | 313 | ns |
| | | | Industrial | 147 | | ns |
| $T_{CCLK10}$ | | 10 | Commercial | 123 | 250 | ns |
| | | | Industrial | 116 | | ns |
| $T_{CCLK12}$ | | 12 | Commercial | 103 | 208 | ns |
| | | | Industrial | 97 | | ns |
| $T_{CCLK13}$ | | 13 | Commercial | 93 | 192 | ns |
| | | | Industrial | 88 | | ns |
| $T_{CCLK17}$ | | 17 | Commercial | 72 | 147 | ns |
| | | | Industrial | 68 | | ns |
| $T_{CCLK22}$ | | 22 | Commercial | 54 | 114 | ns |
| | | | Industrial | 51 | | ns |
| $T_{CCLK25}$ | | 25 | Commercial | 47 | 100 | ns |
| | | | Industrial | 45 | | ns |
| $T_{CCLK27}$ | | 27 | Commercial | 44 | 93 | ns |
| | | | Industrial | 42 | | ns |
| $T_{CCLK33}$ | | 33 | Commercial | 36 | 76 | ns |
| | | | Industrial | 34 | | ns |
| $T_{CCLK44}$ | | 44 | Commercial | 26 | 57 | ns |
| | | | Industrial | 25 | | ns |
| $T_{CCLK50}$ | | 50 | Commercial | 22 | 50 | ns |
| | | | Industrial | 21 | | ns |
| $T_{CCLK100}$ | | 100 | Commercial | 11.2 | 25 | ns |
| | | | Industrial | 10.6 | | ns |

**Notes:**

1. Set the ***ConfigRate*** option value when generating a configuration bitstream.

*Table 47:* **Master Mode CCLK Output Frequency by *ConfigRate* Option Setting**

| Symbol | Description | *ConfigRate* Setting | Temperature Range | Minimum | Maximum | Units |
|---|---|---|---|---|---|---|
| $F_{CCLK1}$ | Equivalent CCLK clock frequency by ***ConfigRate*** setting | 1 *(power-on value)* | Commercial | 0.400 | 0.797 | MHz |
| | | | Industrial | | 0.847 | MHz |
| $F_{CCLK3}$ | | 3 | Commercial | 1.20 | 2.42 | MHz |
| | | | Industrial | | 2.57 | MHz |
| $F_{CCLK6}$ | | 6 (default) | Commercial | 2.40 | 4.83 | MHz |
| | | | Industrial | | 5.13 | MHz |
| $F_{CCLK7}$ | | 7 | Commercial | 2.80 | 5.61 | MHz |
| | | | Industrial | | 5.96 | MHz |
| $F_{CCLK8}$ | | 8 | Commercial | 3.20 | 6.41 | MHz |
| | | | Industrial | | 6.81 | MHz |
| $F_{CCLK10}$ | | 10 | Commercial | 4.00 | 8.12 | MHz |
| | | | Industrial | | 8.63 | MHz |
| $F_{CCLK12}$ | | 12 | Commercial | 4.80 | 9.70 | MHz |
| | | | Industrial | | 10.31 | MHz |
| $F_{CCLK13}$ | | 13 | Commercial | 5.20 | 10.69 | MHz |
| | | | Industrial | | 11.37 | MHz |
| $F_{CCLK17}$ | | 17 | Commercial | 6.80 | 13.74 | MHz |
| | | | Industrial | | 14.61 | MHz |
| $F_{CCLK22}$ | | 22 | Commercial | 8.80 | 18.44 | MHz |
| | | | Industrial | | 19.61 | MHz |
| $F_{CCLK25}$ | | 25 | Commercial | 10.00 | 20.90 | MHz |
| | | | Industrial | | 22.23 | MHz |
| $F_{CCLK27}$ | | 27 | Commercial | 10.80 | 22.39 | MHz |
| | | | Industrial | | 23.81 | MHz |
| $F_{CCLK33}$ | | 33 | Commercial | 13.20 | 27.48 | MHz |
| | | | Industrial | | 29.23 | MHz |
| $F_{CCLK44}$ | | 44 | Commercial | 17.60 | 37.60 | MHz |
| | | | Industrial | | 40.00 | MHz |
| $F_{CCLK50}$ | | 50 | Commercial | 20.00 | 44.80 | MHz |
| | | | Industrial | | 47.66 | MHz |
| $F_{CCLK100}$ | | 100 | Commercial | 40.00 | 88.68 | MHz |
| | | | Industrial | | 94.34 | MHz |

*Table 48:* **Master Mode CCLK Output Minimum Low and High Time**

| Symbol | Description | | *ConfigRate* Setting | | | | | | | | | | | | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 3 | 6 | 7 | 8 | 10 | 12 | 13 | 17 | 22 | 25 | 27 | 33 | 44 | 50 | 100 | |
| $T_{MCCL}$, $T_{MCCH}$ | Master Mode CCLK Minimum Low and High Time | Commercial | 595 | 196 | 98.3 | 84.5 | 74.1 | 58.4 | 48.9 | 44.1 | 34.2 | 25.6 | 22.3 | 20.9 | 17.1 | 12.3 | 10.4 | 5.3 | ns |
| | | Industrial | 560 | 185 | 92.6 | 79.8 | 69.8 | 55.0 | 46.0 | 41.8 | 32.3 | 24.2 | 21.4 | 20.0 | 16.2 | 11.9 | 10.0 | 5.0 | ns |

*Table 49:* **Slave Mode CCLK Input Low and High Time**

| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| $T_{SCCL}$ $T_{SCCH}$ | CCLK Low and High time | 5 | ∞ | ns |

## Master Serial and Slave Serial Mode Timing

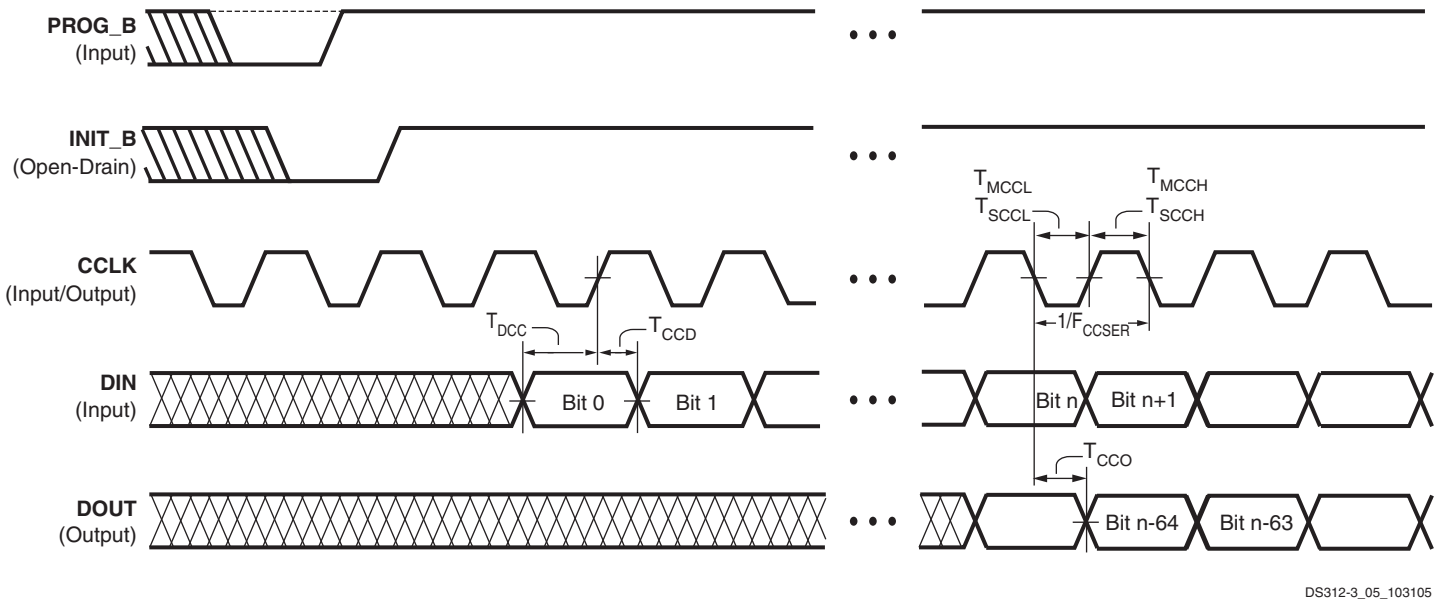



*Figure 11:* **Waveforms for Master Serial and Slave Serial Configuration**

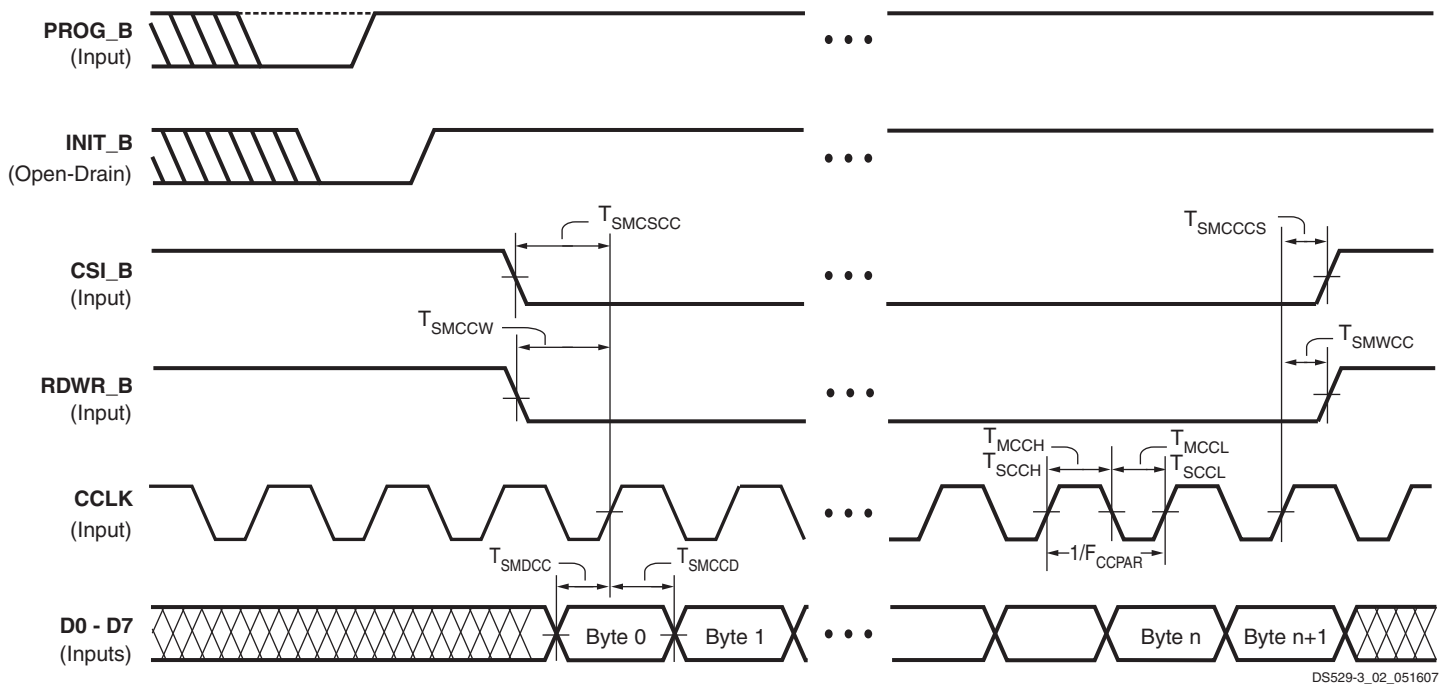
*Table 50:* **Timing for the Master Serial and Slave Serial Configuration Modes**

| Symbol | Description | | Slave/ Master | All Speed Grades | | Units |
|---|---|---|---|---|---|---|
| | | | | Min | Max | |
| **Clock-to-Output Times** | | | | | | |
| $T_{CCO}$ | The time from the falling transition on the CCLK pin to data appearing at the DOUT pin | | Both | 1.5 | 10 | ns |
| **Setup Times** | | | | | | |
| $T_{DCC}$ | The time from the setup of data at the DIN pin to the rising transition at the CCLK pin | | Both | 7 | – | ns |
| **Hold Times** | | | | | | |
| $T_{CCD}$ | The time from the rising transition at the CCLK pin to the point when data is last held at the DIN pin | | Master | 0.0 | – | ns |
| | | | Slave | 1.0 | – | ns |
| **Clock Timing** | | | | | | |
| $T_{CCH}$ | High pulse width at the CCLK input pin | | Master | See Table 48 | | |
| | | | Slave | See Table 49 | | |
| $T_{CCL}$ | Low pulse width at the CCLK input pin | | Master | See Table 48 | | |
| | | | Slave | See Table 49 | | |
| $F_{CCSER}$ | Frequency of the clock signal at the CCLK input pin(2) | No bitstream compression | Slave | 0 | 100 | MHz |
| | | With bitstream compression | | 0 | 100 | MHz |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7.
2. For serial configuration with a daisy-chain of multiple FPGAs, the maximum limit is 25 MHz.

## Slave Parallel Mode Timing




**Notes:**

1. It is possible to abort configuration by pulling CSI_B Low in a given CCLK cycle, then switching RDWR_B Low or High in any subsequent cycle for which CSI_B remains Low. The RDWR_B pin asynchronously controls the driver impedance of the D0–D7 bus. When RDWR_B switches High, be careful to avoid contention on the D0–D7 bus.
2. To pause configuration, pause CCLK instead of de-asserting CSI_B. See UG332, Chapter 7, section "Non-Continuous SelectMAP Data Loading" for more details.

*Figure 12:* **Waveforms for Slave Parallel Configuration**

*Table 51:* **Timing for the Slave Parallel Configuration Mode**

| Symbol | Description | | All Speed Grades | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| **Setup Times** | | | | | |
| $T_{SMDCC}$(2) | The time from the setup of data at the D0-D7 pins to the rising transition at the CCLK pin | | 7 | – | ns |
| $T_{SMCSCC}$ | Setup time on the CSI_B pin before the rising transition at the CCLK pin | | 7 | – | ns |
| $T_{SMCCW}$ | Setup time on the RDWR_B pin before the rising transition at the CCLK pin | | 17 | – | ns |
| **Hold Times** | | | | | |
| $T_{SMCCD}$ | The time from the rising transition at the CCLK pin to the point when data is last held at the D0-D7 pins | | 1 | – | ns |
| $T_{SMCCCS}$ | The time from the rising transition at the CCLK pin to the point when a logic level is last held at the CSO_B pin | | 0 | – | ns |
| $T_{SMWCC}$ | The time from the rising transition at the CCLK pin to the point when a logic level is last held at the RDWR_B pin | | 0 | – | ns |
| **Clock Timing** | | | | | |
| $T_{CCH}$ | The High pulse width at the CCLK input pin | | 5 | – | ns |
| $T_{CCL}$ | The Low pulse width at the CCLK input pin | | 5 | – | ns |
| $F_{CCPAR}$ | Frequency of the clock signal at the CCLK input pin | No bitstream compression | 0 | 80 | MHz |
| | | With bitstream compression | 0 | 80 | MHz |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7.
2. Some Xilinx documents refer to Parallel modes as "SelectMAP" modes.

## Serial Peripheral Interface (SPI) Configuration Timing

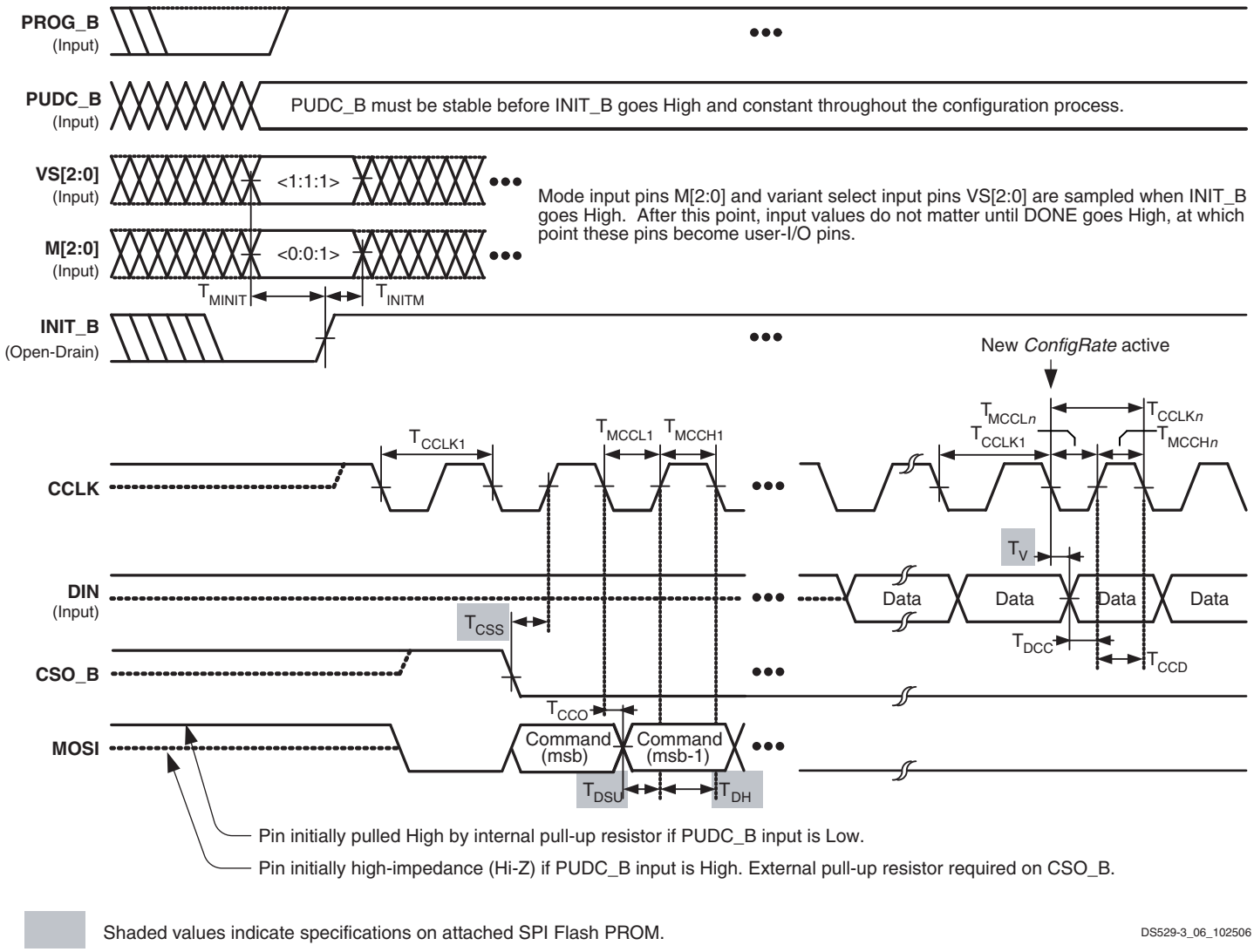



*Figure 13:* **Waveforms for Serial Peripheral Interface (SPI) Configuration**

*Table 52:* **Timing for Serial Peripheral Interface (SPI) Configuration Mode**

| Symbol | Description | Minimum | Maximum | Units |
|---|---|---|---|---|
| $T_{CCLK1}$ | Initial CCLK clock period | See Table 46 | | |
| $T_{CCLKn}$ | CCLK clock period after FPGA loads ConfigRate setting | See Table 46 | | |
| $T_{MINIT}$ | Setup time on VS[2:0] variant-select pins and M[2:0] mode pins before the rising edge of INIT_B | 50 | – | ns |
| $T_{INITM}$ | Hold time on VS[2:0] variant-select pins and M[2:0] mode pins after the rising edge of INIT_B | 0 | – | ns |
| $T_{CCO}$ | MOSI output valid delay after CCLK falling edge | See Table 50 | | |
| $T_{DCC}$ | Setup time on DIN data input before CCLK rising edge | See Table 50 | | |
| $T_{CCD}$ | Hold time on DIN data input after CCLK rising edge | See Table 50 | | |

*Table 53:* **Configuration Timing Requirements for Attached SPI Serial Flash**

| Symbol | Description | Requirement | Units |
|---|---|---|---|
| $T_{CCS}$ | SPI serial Flash PROM chip-select time | $T_{CCS} \leq T_{MCCL1} - T_{CCO}$ | ns |
| $T_{DSU}$ | SPI serial Flash PROM data input setup time | $T_{DSU} \leq T_{MCCL1} - T_{CCO}$ | ns |
| $T_{DH}$ | SPI serial Flash PROM data input hold time | $T_{DH} \leq T_{MCCH1}$ | ns |
| $T_V$ | SPI serial Flash PROM data clock-to-output time | $T_V \leq T_{MCCLn} - T_{DCC}$ | ns |
| $f_C$ or $f_R$ | Maximum SPI serial Flash PROM clock frequency (also depends on specific read command used) | $f_C \geq \frac{1}{T_{CCLKn(min)}}$ | MHz |

**Notes:**

1. These requirements are for successful FPGA configuration in SPI mode, where the FPGA generates the CCLK signal. The post-configuration timing can be different to support the specific needs of the application loaded into the FPGA.
2. Subtract additional printed circuit board routing delay as required by the application.

## Byte Peripheral Interface (BPI) Configuration Timing

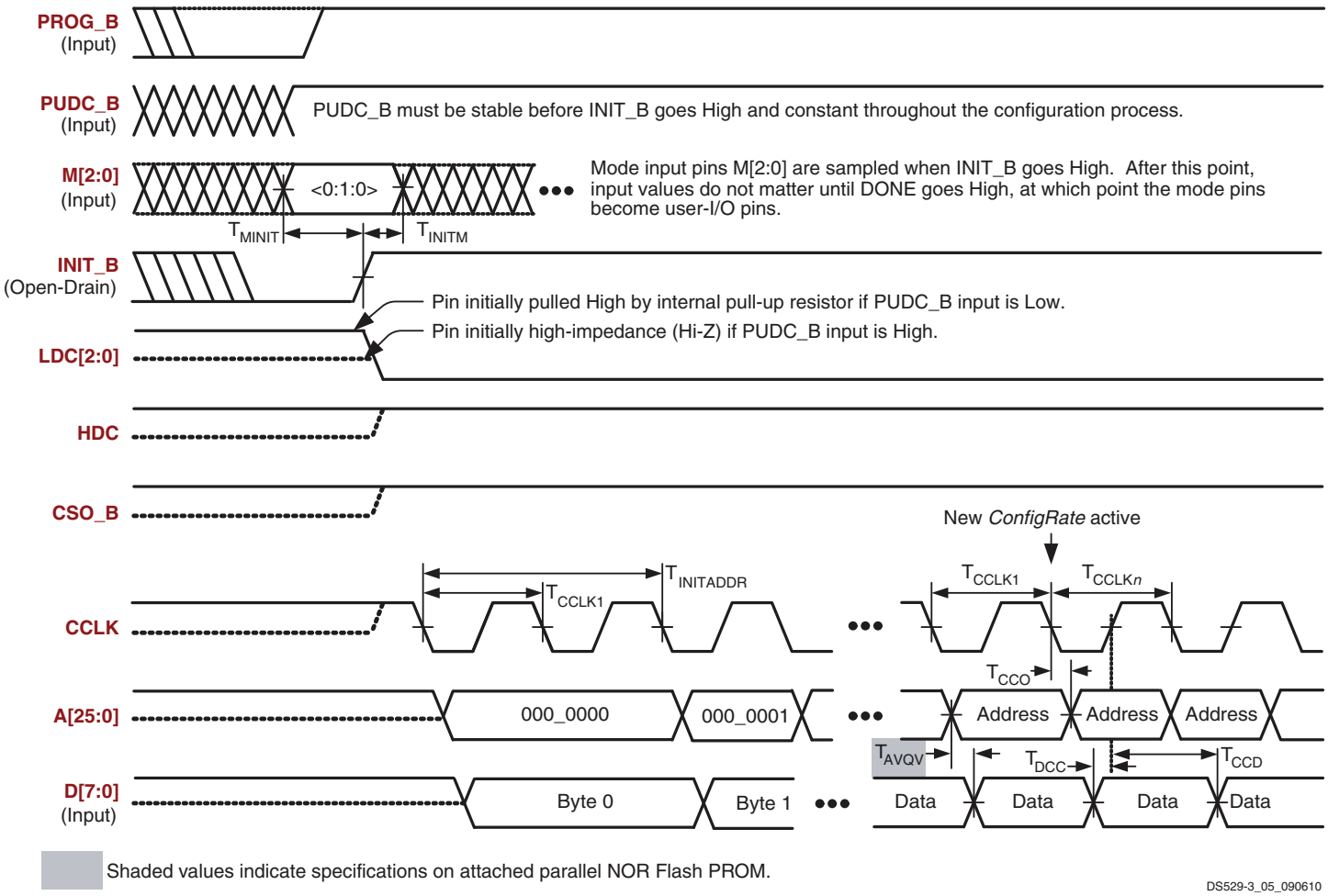



*Figure 14:* **Waveforms for Byte-wide Peripheral Interface (BPI) Configuration**

*Table 54:* **Timing for Byte-wide Peripheral Interface (BPI) Configuration Mode**

| Symbol | Description | Minimum | Maximum | Units |
|---|---|---|---|---|
| $T_{CCLK1}$ | Initial CCLK clock period | See Table 46 | | |
| $T_{CCLKn}$ | CCLK clock period after FPGA loads ConfigRate setting | See Table 46 | | |
| $T_{MINIT}$ | Setup time on M[2:0] mode pins before the rising edge of INIT_B | 50 | – | ns |
| $T_{INITM}$ | Hold time on M[2:0] mode pins after the rising edge of INIT_B | 0 | – | ns |
| $T_{INITADDR}$ | Minimum period of initial A[25:0] address cycle; LDC[2:0] and HDC are asserted and valid | 5 | 5 | $T_{CCLK1}$ cycles |
| $T_{CCO}$ | Address A[25:0] outputs valid after CCLK falling edge | See Table 50 | | |
| $T_{DCC}$ | Setup time on D[7:0] data inputs before CCLK rising edge | See $T_{SMDCC}$ in Table 51 | | |
| $T_{CCD}$ | Hold time on D[7:0] data inputs after CCLK rising edge | 0 | – | ns |

*Table 55:* **Configuration Timing Requirements for Attached Parallel NOR BPI Flash**

| Symbol | Description | Requirement | Units |
|---|---|---|---|
| $T_{CE}$ ($t_{ELQV}$) | Parallel NOR Flash PROM chip-select time | $T_{CE} \leq T_{INITADDR}$ | ns |
| $T_{OE}$ ($t_{GLQV}$) | Parallel NOR Flash PROM output-enable time | $T_{OE} \leq T_{INITADDR}$ | ns |
| $T_{ACC}$ ($t_{AVQV}$) | Parallel NOR Flash PROM read access time | $T_{ACC} \leq 50\% T_{CCLKn(min)} - T_{CCO} - T_{DCC} - PCB$ | ns |
| $T_{BYTE}$ ($t_{FLQV}$, $t_{FHQV}$) | For x8/x16 PROMs only: BYTE# to output valid time(3) | $T_{BYTE} \leq T_{INITADDR}$ | ns |

**Notes:**

1. These requirements are for successful FPGA configuration in BPI mode, where the FPGA generates the CCLK signal. The post-configuration timing can be different to support the specific needs of the application loaded into the FPGA.
2. Subtract additional printed circuit board routing delay as required by the application.
3. The initial BYTE# timing can be extended using an external, appropriately sized pull-down resistor on the FPGA's LDC2 pin. The resistor value also depends on whether the FPGA's PUDC_B pin is High or Low.

## IEEE 1149.1/1532 JTAG Test Access Port Timing

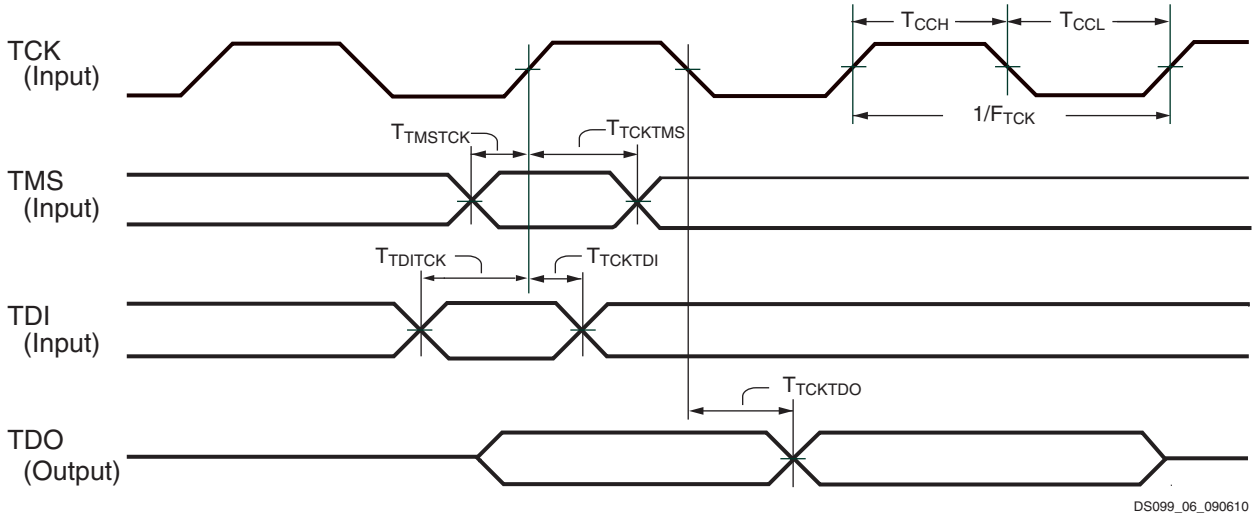



*Figure 15:* **JTAG Waveforms**

*Table 56:* **Timing for the JTAG[2] Test Access Port**

| Symbol | Description | | All Speed Grades | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| **Clock-to-Output Times** | | | | | |
| $T_{TCKTDO}$ | The time from the falling transition on the TCK pin to data appearing at the TDO pin | | 1.0 | 11.0 | ns |
| **Setup Times** | | | | | |
| $T_{TDITCK}$ | The time from the setup of data at the TDI pin to the rising transition at the TCK pin | All functions except those shown below | 7.0 | – | ns |
| | | Boundary scan commands (INTEST, EXTEST, SAMPLE) | 13.0 | | |
| $T_{TMSTCK}$ | The time from the setup of a logic level at the TMS pin to the rising transition at the TCK pin | | 7.0 | – | ns |
| **Hold Times** | | | | | |
| $T_{TCKTDI}$ | The time from the rising transition at the TCK pin to the point when data is last held at the TDI pin | All functions except those shown below | 0 | – | ns |
| | | Configuration commands (CFG_IN, ISC_PROGRAM) | 3.5 | | |
| $T_{TCKTMS}$ | The time from the rising transition at the TCK pin to the point when a logic level is last held at the TMS pin | | 0 | – | ns |
| **Clock Timing** | | | | | |
| $T_{CCH}$ | The High pulse width at the TCK pin | All functions except ISC_DNA command | 5 | – | ns |
| $T_{CCL}$ | The Low pulse width at the TCK pin | | 5 | – | ns |
| $T_{CCHDNA}$ | The High pulse width at the TCK pin | During ISC_DNA command | 10 | 10,000 | ns |
| $T_{CCLDNA}$ | The Low pulse width at the TCK pin | | 10 | 10,000 | ns |
| $F_{TCK}$ | Frequency of the TCK signal | BYPASS or HIGHZ instructions | 0 | 33 | MHz |
| | | All operations except for BYPASS or HIGHZ instructions | | 20 | |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 7.
2. For details on JTAG, see Chapter 9, “JTAG Configuraton Mode and Boundary-Scan” in UG332: *Spartan-3 Generation Configuration User Guide*.

# Revision History

The following table shows the revision history for this document.

| Date | Version | Revision |
|---|---|---|
| 04/02/07 | 1.0 | Initial Xilinx release. |
| 05/25/07 | 1.0.1 | Minor edits. |
| 06/18/07 | 1.2 | Updated for v1.29 production speed files. Noted banking rules in Table 11 and Table 12. Added DIFF_HSTL_I and DIFF_HSTL_III to Table 12, Table 13, and Table 26. Updated TMDS DC characteristics in Table 13. Updated I/O Test Method values in Table 26. Added Simultaneously Switching Output limits in Table 28. Updated DSP48A timing symbols, descriptions, and values in Table 34. Added power-on timing in Table 45. Added CCLK specifications for Commercial in Table 46 through Table 48. Updated Slave Parallel timing in Table 51. Updated JTAG specifications in Table 56. |
| 07/16/07 | 2.0 | Added Low-power options and updated typical values for quiescent current in Table 9. Updated DSP48A timing in Table 34 and Table 35. |
| 06/02/08 | 2.1 | Improved $V_{CCAUXT}$ and $V_{CCO2T}$ POR minimum in Table 4 and updated $V_{CCO}$ POR levels in Figure 10. Added $V_{IN}$ to Recommended Operating Conditions in Table 7 and added reference to XAPP459, "Eliminating I/O Coupling Effects when Interfacing Large-Swing Single-Ended Signals to User I/O Pins." Reduced typical $I_{CCINTQ}$ and $I_{CCAUXQ}$ quiescent current values by 20%-44% in Table 9. Increased $V_{IL}$ max to 0.4V for LVCMOS12/15/18 and improved $V_{IH}$ min to 0.7V for LVCMOS12 in Table 10. Changed $V_{OL}$ max to 0.4V and $V_{OH}$ min to $V_{CCO}$–0.4V for LVCMOS15/18 in Table 11. Added reference to $V_{CCAUX}$ in Simultaneously Switching Output Guidelines. Removed DNA_RETENTION limit of 10 years in Table 14 since number of Read cycles is the only unique limit. Updated speed files to v1.31 in Table 16 and elsewhere. Updated IOB Setup and Hold times with device-specific values in Table 19. Added reference to Sample Window in Table 20. Updated IOB Propagation times with device-specific values in Table 21. Improved SSTL_18_II SSO value in Table 28. Improved $F_{BUFG}$ for -4 to 334 MHz in Table 32. Added references to 375 MHz performance via SCD 4103 in Table 32,Table 37, Table 38, and Table 39. Added explanatory footnotes to DSP48A Timing tables. Simplified DSP48A $F_{MAX}$ to value with all registers used in Table 35. Improved FBUFG in Table 32 for -4 speed grade. Updated CCLK output maximum period in Table 46 to match minimum frequency in Table 47. Replaced BPI with SPI specification descriptions in Table 52. Corrected BPI Figure 14 and Table 54 from falling edge to rising edge. Added references to Spartan-3 Generation User Guides. Updated links. |
| 03/11/09 | 2.2 | Changed typical quiescent current temperature from ambient to quiescent. Updated selected I/O standard DC characteristics. Removed PCIX IOSTANDARD due to limited PCIX interface support. Added $T_{IOPI}$ and $T_{IOPID}$ to Table 21. Updated BPI configuration waveforms in Figure 14 and updated Table 55. Removed references to SCD 4103. |
| 10/04/10 | 3.0 | Added $I_{IK}$ to Table 3. Updated description for $V_{IN}$ in Table 7 including adding note 4. Also, added note 2 to $I_L$ in Table 8 to note potential leakage between pins of a differential pair. Added note 6 to Table 10. Updated notes 5 and 6 in Table 12. Corrected symbols for $T_{SUSPEND_GTS}$ and $T_{SUSPEND_GWE}$ in Table 44. |

## Introduction

This section describes how the various pins on a Spartan®-3A DSP FPGA connect within the supported component packages and provides device-specific thermal characteristics. For general information on the pin functions and the package characteristics, see the *Packaging* section in UG331: *Spartan-3 Generation FPGA User Guide.*

Spartan-3A DSP FPGAs are available in both standard and Pb-free, RoHS versions of each package, with the Pb-free version adding a “G” to the middle of the package code. Except for the thermal characteristics, all information for the standard package applies equally to the Pb-free package.

## Pin Types

Most pins on a Spartan-3A DSP FPGA are general-purpose, user-defined I/O pins. There are, however, up to 12 different functional types of pins on Spartan-3A DSP packages, as outlined in Table 57. In the package footprint drawings that follow, the individual pins are color-coded according to pin type as in the table.

*Table 57:* **Types of Pins on Spartan-3A DSP FPGAs**

| Type/Color Code | Description | Pin Name(s) in Type |
|---|---|---|
| I/O | Unrestricted, general-purpose user-I/O pin. Most pins can be paired together to form differential I/Os. | IO_#<br>IO_Lxxy_# |
| INPUT | Unrestricted, general-purpose input-only pin. This pin does not have an output structure, differential termination resistor, or PCI clamp diode. | IP_#<br>IP_Lxxy_# |
| DUAL | Dual-purpose pin used in some configuration modes during the configuration process and then usually available as a user I/O after configuration. If the pin is not used during configuration, this pin behaves as an I/O-type pin. See UG332: *Spartan-3 Generation Configuration User Guide* for additional information on these signals. | M[2:0]<br>PUDC_B<br>CCLK<br>MOSI/CSI_B<br>D[7:1]<br>D0/DIN<br>CSO_B<br>RDWR_B<br>INIT_B<br>A[25:0]<br>VS[2:0]<br>LDC[2:0]<br>HDC |
| VREF | Dual-purpose pin that is either a user-I/O pin or Input-only pin, or, along with all other VREF pins in the same bank, provides a reference voltage input for certain I/O standards. If used for a reference voltage within a bank, all VREF pins within the bank must be connected. | IP/VREF_#<br>IP_Lxxy_#/VREF_#<br>IO/VREF_#<br>IO_Lxxy_#/VREF_# |
| CLK | Either a user-I/O pin or an input to a specific clock buffer driver. Packages have 16 global clock inputs that optionally clock the entire device. The RHCLK inputs optionally clock the right half of the device. The LHCLK inputs optionally clock the left half of the device. See the Using Global Clock Resources chapter in UG331: *Spartan-3 Generation FPGA User Guide* for additional information on these signals. | IO_Lxxy_#/GCLK[15:0],<br>IO_Lxxy_#/LHCLK[7:0],<br>IO_Lxxy_#/RHCLK[7:0] |
| CONFIG | Dedicated configuration pin, two per device. Not available as a user-I/O pin. Every package has two dedicated configuration pins. These pins are powered by VCCAUX. See the UG332: *Spartan-3 Generation Configuration User Guide* for additional information on the DONE and PROG_B signals. | DONE, PROG_B |

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*Table 57:* **Types of Pins on Spartan-3A DSP FPGAs *(Cont'd)***

| Type/Color Code | Description | Pin Name(s) in Type |
|---|---|---|
| PWR MGMT | Control and status pins for the power-saving Suspend mode. SUSPEND is a dedicated pin and is powered by VCCAUX. AWAKE is a dual-purpose pin. Unless Suspend mode is enabled in the application, AWAKE is available as a user-I/O pin. | SUSPEND, AWAKE |
| JTAG | Dedicated JTAG pin - 4 per device. Not available as a user-I/O pin. Every package has four dedicated JTAG pins. These pins are powered by VCCAUX. | TDI, TMS, TCK, TDO |
| GND | Dedicated ground pin. The number of GND pins depends on the package used. All must be connected. | GND |
| VCCAUX | Dedicated auxiliary power supply pin. The number of VCCAUX pins depends on the package used. All must be connected. Set on board and using CONFIG VCCAUX constraint. | VCCAUX |
| VCCINT | Dedicated internal core logic power supply pin. The number of VCCINT pins depends on the package used. All must be connected to +1.2V. | VCCINT |
| VCCO | Along with all the other VCCO pins in the same bank, this pin supplies power to the output buffers within the I/O bank and sets the input threshold voltage for some I/O standards. All must be connected. | VCCO_# |
| N.C. | This package pin is not connected in this specific device/package combination but may be connected in larger devices in the same package. | N.C. |

**Notes:**

1. # = I/O bank number, an integer between 0 and 3.

## Package Pins by Type

Each package has three separate voltage supply inputs—VCCINT, VCCAUX, and VCCO—and a common ground return, GND. The numbers of pins dedicated to these functions vary by package, as shown in Table 58.

*Table 58:* **Power and Ground Supply Pins by Package**

| Package | Device | VCCINT | VCCAUX | VCCO | GND |
|---|---|---|---|---|---|
| CS484 | XC3SD1800A | 36 | 24 | 24 | 84 |
| | XC3SD3400A | 36 | 24 | 24 | 84 |
| FG676 | XC3SD1800A | 23 | 14 | 36 | 77 |
| | XC3SD3400A | 36 | 24 | 40 | 100 |

A majority of package pins are user-defined I/O or input pins. However, the numbers and characteristics of these I/O depend on the device type and the package in which it is available, as shown in Table 59. The table shows the maximum number of single-ended I/O pins available, assuming that all I/O-, INPUT-, DUAL-, VREF-, and CLK-type pins are used as general-purpose I/O. AWAKE is counted here as a dual-purpose I/O pin. Likewise, the table shows the maximum number of differential pin-pairs available on the package. Finally, the table shows how the total maximum user-I/Os are distributed by pin type, including the number of unconnected—N.C.—pins on the device.

Not all I/O standards are supported on all I/O banks. The left and right banks (I/O banks 1 and 3) support higher output drive current than the top and bottom banks (I/O banks 0 and 2). Similarly, true differential output standards, such as LVDS, RSDS, PPDS, miniLVDS, and TMDS, are only supported in the top or bottom banks (I/O banks 0 and 2). Inputs are unrestricted. For more details, see the *Using I/O Resources* chapter in UG331.

*Table 59:* **Maximum User I/O by Package**

| Package | Device | Maximum User I/Os and Input-Only | Maximum Input-Only | Maximum Differential Pairs | All Possible I/Os by Type | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | I/O | INPUT | DUAL | VREF[1] | CLK | N.C. |
| CS484 | XC3SD1800A | 309 | 60 | 140 | 156 | 41 | 52 | 28 | 32 | 0 |
| | XC3SD3400A | 309 | 60 | 140 | 156 | 41 | 52 | 28 | 32 | 0 |
| FG676 | XC3SD1800A | 519 | 110 | 227 | 314 | 82 | 52 | 39 | 32 | 0 |
| | XC3SD3400A | 469 | 60 | 213 | 314 | 34 | 52 | 37 | 32 | 0 |

**Notes:**

1. Some VREFs are on INPUT pins. See pinout tables for details.

Electronic versions of the package pinout tables and foot- prints are available for download from the Xilinx® website. Using a spreadsheet program, the data can be sorted and reformatted according to any specific needs. Similarly, the ASCII-text file is easily parsed by most scripting programs. www.xilinx.com/support/documentation/data_sheets/s3a_pin.zip

## Package Overview

Table 60 shows the two low-cost, space-saving production package styles for the Spartan-3A DSP family.

*Table 60:* **Spartan-3A DSP Family Package Options**

| Package | Leads | Type | Maximum I/O | Lead Pitch (mm) | Footprint Area (mm) | Height (mm) | Mass[1] (g) |
|---|---|---|---|---|---|---|---|
| CS484 / CSG484 | 484 | Chip-Scale Ball Grid Array (CS) | 309 | 0.8 | 19 x 19 | 1.80 | 1.4 |
| FG676 / FGG676 | 676 | Fine-pitch Ball Grid Array (FBGA) | 519 | 1.0 | 27 x 27 | 2.60 | 3.4 |

**Notes:**

1. Package mass is ±10%.

Each package style is available as a standard and an environmentally friendly lead-free (Pb-free) option. The Pb-free packages include an extra 'G' in the package style name. For example, the standard "CS484" package becomes "CSG484" when ordered as the Pb-free option. The mechanical dimensions of the standard and Pb-free packages are similar, as shown in the mechanical drawings provided in Table 61.

For additional package information, see UG112: *Device Package User Guide*.

### Mechanical Drawings

Detailed mechanical drawings for each package type are available from the Xilinx web site at the specified location in Table 61.

Material Declaration Data Sheets (MDDS) are also available on the Xilinx web site for each package.

*Table 61:* **Xilinx Package Documentation**

| Package | Drawing | MDDS |
|---|---|---|
| CS484 | Package Drawing | PK230_CS484 |
| CSG484 | | PK231_CSG484 |
| FG676 | Package Drawing | PK155_FG676 |
| FGG676 | | PK111_FGG676 |

## Package Thermal Characteristics

The power dissipated by an FPGA application has implications on package selection and system design. The power consumed by a Spartan-3A DSP FPGA is reported using either the XPower Power Estimator or the XPower Analyzer calculator integrated in the Xilinx ISE® development software. Table 62 provides the thermal characteristics for the various Spartan-3A DSP device package offerings. This information is also available using the Thermal Query tool.

The junction-to-case thermal resistance ($\theta_{JC}$) indicates the difference between the temperature measured on the package body (case) and the die junction temperature per watt of power consumption. The junction-to-board ($\theta_{JB}$) value similarly reports the difference between the board and junction temperature. The junction-to-ambient ($\theta_{JA}$) value reports the temperature difference between the ambient environment and the junction temperature. The $\theta_{JA}$ value is reported at different air velocities, measured in linear feet per minute (LFM). The "Still Air (0 LFM)" column shows the $\theta_{JA}$ value in a system without a fan. The thermal resistance drops with increasing air flow.

*Table 62:* **Spartan-3A DSP FPGA Package Thermal Characteristics**

| Package | Device | Junction-to-Case ($\theta_{JC}$) | Junction-to-Board ($\theta_{JB}$) | Junction-to-Ambient ($\theta_{JA}$) at Different Air Flows | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | Still Air (0 LFM) | 250 LFM | 500 LFM | 750 LFM | |
| CS484 CSG484 | XC3SD1800A | 4.1 | 6.8 | 18.0 | 13.3 | 12.3 | 11.5 | °C/W |
| | XC3SD3400A | 3.5 | 5.6 | 16.9 | 12.2 | 11.0 | 10.4 | °C/W |
| FG676 FGG676 | XC3SD1800A | 4.7 | 7.8 | 15.9 | 11.6 | 10.6 | 10.0 | °C/W |
| | XC3SD3400A | 3.8 | 6.4 | 14.7 | 10.5 | 9.4 | 8.9 | °C/W |

# CS484: 484-Ball Chip-Scale Ball Grid Array

The 484-ball chip-scale ball grid array, CS484, supports both the XC3SD1800A and XC3SD3400A FPGAs. There are no pinout differences between the two devices.

Table 63 lists all the CS484 package pins. They are sorted by bank number and then by pin name. Pairs of pins that form a differential I/O pair appear together in the table. The table also shows the pin number for each pin and the pin type, as defined earlier.

An electronic version of this package pinout table and footprint diagram is available for download from the Xilinx website at www.xilinx.com/support/documentation/data_sheets/s3a_pin.zip

## Pinout Table

*Table 63:* **Spartan-3A DSP CS484 Pinout**

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 0 | IO_L30N_0 | A3 | I/O |
| 0 | IO_L28N_0 | A4 | I/O |
| 0 | IO_L25N_0 | A5 | I/O |
| 0 | IO_L25P_0 | A6 | I/O |
| 0 | IO_L24N_0/VREF_0 | A7 | VREF |
| 0 | IO_L20P_0/GCLK10 | A8 | GCLK |
| 0 | IO_L18P_0/GCLK6 | A9 | GCLK |
| 0 | IP_0 | A10 | INPUT |
| 0 | IO_L15N_0 | A11 | I/O |
| 0 | IP_0 | A12 | INPUT |
| 0 | IO_L11P_0 | A13 | I/O |
| 0 | IO_L10P_0 | A14 | I/O |
| 0 | IP_0 | A15 | INPUT |
| 0 | IO_L06P_0/VREF_0 | A16 | VREF |
| 0 | IO_L06N_0 | A17 | I/O |
| 0 | IP_0 | A18 | INPUT |
| 0 | IO_L07N_0 | A19 | I/O |
| 0 | IO_0 | A20 | I/O |
| 0 | IO_L30P_0 | B3 | I/O |
| 0 | IO_L28P_0 | B4 | I/O |
| 0 | IO_L24P_0 | B6 | I/O |
| 0 | IO_L20N_0/GCLK11 | B8 | GCLK |
| 0 | IO_L18N_0/GCLK7 | B9 | GCLK |
| 0 | IO_L15P_0 | B11 | I/O |
| 0 | IO_L11N_0 | B13 | I/O |
| 0 | IO_L10N_0 | B15 | I/O |
| 0 | IO_L03P_0 | B17 | I/O |
| 0 | IO_L02N_0 | B19 | I/O |
| 0 | IO_L07P_0 | B20 | I/O |
| 0 | IO_L29N_0 | C4 | I/O |
| 0 | IP_0 | C5 | INPUT |
| 0 | IO_L21P_0 | C6 | I/O |
| 0 | IO_L26P_0 | C7 | I/O |
| 0 | IO_L22P_0 | C8 | I/O |
| 0 | IO_L16P_0 | C9 | I/O |
| 0 | IP_0 | C10 | INPUT |
| 0 | IP_0/VREF_0 | C11 | VREF |
| 0 | IO_L14N_0 | C12 | I/O |
| 0 | IO_L14P_0 | C13 | I/O |
| 0 | IP_0 | C14 | INPUT |
| 0 | IO_L12N_0/VREF_0 | C15 | VREF |
| 0 | IO_L08N_0 | C16 | I/O |
| 0 | IO_L03N_0 | C17 | I/O |
| 0 | IO_L02P_0/VREF_0 | C18 | VREF |
| 0 | IO_L01N_0 | C19 | I/O |
| 0 | IO_L29P_0 | D5 | I/O |
| 0 | IO_L21N_0 | D6 | I/O |
| 0 | IO_L26N_0 | D7 | I/O |
| 0 | IO_L22N_0 | D9 | I/O |
| 0 | IO_L16N_0 | D10 | I/O |
| 0 | IO_L09N_0 | D13 | I/O |
| 0 | IO_L12P_0 | D14 | I/O |
| 0 | IO_L08P_0 | D15 | I/O |
| 0 | IP_0 | D17 | INPUT |
| 0 | IP_0 | D18 | INPUT |
| 0 | IO_L01P_0 | D19 | I/O |
| 0 | IP_0 | E6 | INPUT |
| 0 | IO_L31P_0/VREF_0 | E7 | VREF |
| 0 | IO_L27N_0 | E8 | I/O |
| 0 | IP_0 | E10 | INPUT |
| 0 | IO_L19N_0/GCLK9 | E11 | GCLK |
| 0 | IO_L17P_0/GCLK4 | E12 | GCLK |
| 0 | IO_L09P_0 | E13 | I/O |
| 0 | IO_L05P_0 | E15 | I/O |
| 0 | IO_L04P_0 | E16 | I/O |
| 0 | IP_0 | E17 | INPUT |
| 0 | IO_L31N_0/PUDC_B | F7 | DUAL |
| 0 | IO_L27P_0 | F8 | I/O |
| 0 | IO_L23N_0 | F9 | I/O |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 0 | IO_L19P_0/GCLK8 | F10 | GCLK |
| 0 | IO_L17N_0/GCLK5 | F11 | GCLK |
| 0 | IP_0 | F12 | INPUT |
| 0 | IO_L13N_0 | F13 | I/O |
| 0 | IO_L13P_0 | F14 | I/O |
| 0 | IO_L05N_0 | F15 | I/O |
| 0 | IO_L04N_0 | F16 | I/O |
| 0 | IO_L23P_0 | G8 | I/O |
| 0 | VCCO_0 | B5 | VCCO |
| 0 | VCCO_0 | B10 | VCCO |
| 0 | VCCO_0 | B14 | VCCO |
| 0 | VCCO_0 | B18 | VCCO |
| 0 | VCCO_0 | E9 | VCCO |
| 0 | VCCO_0 | E14 | VCCO |
| 1 | IO_L02N_1/LDC0 | AA22 | DUAL |
| 1 | IP_L39N_1 | C21 | INPUT |
| 1 | IP_L39P_1/VREF_1 | C22 | VREF |
| 1 | IO_L36P_1/A20 | D20 | DUAL |
| 1 | IO_L37P_1/A22 | D21 | DUAL |
| 1 | IO_L37N_1/A23 | D22 | DUAL |
| 1 | IO_L36N_1/A21 | E19 | DUAL |
| 1 | IO_L35N_1 | E20 | I/O |
| 1 | IO_L33N_1 | E22 | I/O |
| 1 | IO_L38N_1/A25 | F18 | DUAL |
| 1 | IO_L38P_1/A24 | F19 | DUAL |
| 1 | IO_L30N_1/A19 | F20 | DUAL |
| 1 | IO_L35P_1 | F21 | I/O |
| 1 | IO_L33P_1 | F22 | I/O |
| 1 | IO_L34P_1 | G17 | I/O |
| 1 | IO_L34N_1 | G18 | I/O |
| 1 | IO_L30P_1/A18 | G19 | DUAL |
| 1 | IP_L31N_1 | G20 | INPUT |
| 1 | IO_L28N_1 | G22 | I/O |
| 1 | IO_L26P_1/A14 | H17 | DUAL |
| 1 | IO_L26N_1/A15 | H18 | DUAL |
| 1 | IO_L32N_1 | H20 | I/O |
| 1 | IP_L31P_1/VREF_1 | H21 | VREF |
| 1 | IO_L28P_1 | H22 | I/O |
| 1 | IO_L29N_1/A17 | J17 | DUAL |
| 1 | IO_L32P_1 | J19 | I/O |
| 1 | IO_L25N_1/A13 | J20 | DUAL |
| 1 | IP_L27P_1 | J21 | INPUT |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 1 | IP_L27N_1 | J22 | INPUT |
| 1 | IO_L29P_1/A16 | K16 | DUAL |
| 1 | IP_L23N_1 | K17 | INPUT |
| 1 | IO_L24N_1 | K18 | I/O |
| 1 | IO_L24P_1 | K19 | I/O |
| 1 | IO_L25P_1/A12 | K20 | DUAL |
| 1 | IO_L22N_1/A11 | K22 | DUAL |
| 1 | IO_L21N_1/RHCLK7 | L17 | RHCLK |
| 1 | IP_L23P_1/VREF_1 | L18 | VREF |
| 1 | IO_L20N_1/RHCLK5 | L20 | RHCLK |
| 1 | IO_L20P_1/RHCLK4 | L21 | RHCLK |
| 1 | IO_L22P_1/A10 | L22 | DUAL |
| 1 | IO_L18N_1/RHCLK1 | M17 | RHCLK |
| 1 | IO_L21P_1/IRDY1/RHCLK6 | M18 | RHCLK |
| 1 | IO_L19N_1/TRDY1/RHCLK3 | M20 | RHCLK |
| 1 | IO_L17N_1/A9 | M22 | DUAL |
| 1 | IO_L13P_1/A2 | N17 | DUAL |
| 1 | IO_L18P_1/RHCLK0 | N18 | RHCLK |
| 1 | IO_L15N_1/A7 | N19 | DUAL |
| 1 | IO_L15P_1/A6 | N20 | DUAL |
| 1 | IO_L19P_1/RHCLK2 | N21 | RHCLK |
| 1 | IO_L17P_1/A8 | N22 | DUAL |
| 1 | IO_L13N_1/A3 | P16 | DUAL |
| 1 | IP_L12N_1/VREF_1 | P17 | VREF |
| 1 | IO_L10P_1 | P19 | I/O |
| 1 | IP_L16N_1 | P20 | INPUT |
| 1 | IO_L14N_1/A5 | P22 | DUAL |
| 1 | IP_L12P_1 | R17 | INPUT |
| 1 | IO_L10N_1 | R18 | I/O |
| 1 | IO_L07P_1 | R19 | I/O |
| 1 | IO_L07N_1 | R20 | I/O |
| 1 | IP_L16P_1/VREF_1 | R21 | VREF |
| 1 | IO_L14P_1/A4 | R22 | DUAL |
| 1 | IO_L05N_1 | T17 | I/O |
| 1 | IO_L05P_1 | T18 | I/O |
| 1 | IO_L09N_1 | T20 | I/O |
| 1 | IO_L11N_1/VREF_1 | T22 | VREF |
| 1 | IO_L01P_1/HDC | U18 | DUAL |
| 1 | IO_L01N_1/LDC2 | U19 | DUAL |
| 1 | IO_L09P_1 | U20 | I/O |
| 1 | IP_L08N_1/VREF_1 | U21 | VREF |
| 1 | IO_L11P_1 | U22 | I/O |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 1 | IO_L03N_1/A1 | V20 | DUAL |
| 1 | IP_L08P_1 | V22 | INPUT |
| 1 | IO_L03P_1/A0 | W19 | DUAL |
| 1 | IP_L04N_1/VREF_1 | W20 | VREF |
| 1 | IP_L04P_1 | W21 | INPUT |
| 1 | IO_L06P_1 | W22 | I/O |
| 1 | IO_L02P_1/LDC1 | Y21 | DUAL |
| 1 | IO_L06N_1 | Y22 | I/O |
| 1 | VCCO_1 | E21 | VCCO |
| 1 | VCCO_1 | J18 | VCCO |
| 1 | VCCO_1 | K21 | VCCO |
| 1 | VCCO_1 | P18 | VCCO |
| 1 | VCCO_1 | P21 | VCCO |
| 1 | VCCO_1 | V21 | VCCO |
| 2 | IO_L01P_2/M1 | AA3 | DUAL |
| 2 | IO_L04N_2 | AA4 | I/O |
| 2 | IP_2 | AA6 | INPUT |
| 2 | IO_L08N_2 | AA8 | I/O |
| 2 | IO_L12N_2/D6 | AA10 | DUAL |
| 2 | IO_L16P_2/GCLK14 | AA12 | GCLK |
| 2 | IO_L18N_2/GCLK3 | AA14 | GCLK |
| 2 | IO_L19P_2 | AA15 | I/O |
| 2 | IO_L22P_2/AWAKE | AA17 | PWRMGMT |
| 2 | IO_L27N_2 | AA19 | I/O |
| 2 | IO_L30P_2 | AA20 | I/O |
| 2 | IP_2/VREF_2 | AB2 | VREF |
| 2 | IO_L01N_2/M0 | AB3 | DUAL |
| 2 | IO_L04P_2 | AB4 | I/O |
| 2 | IO_L05P_2 | AB5 | I/O |
| 2 | IO_L05N_2 | AB6 | I/O |
| 2 | IO_L08P_2 | AB7 | I/O |
| 2 | IO_L09P_2/VS1 | AB8 | DUAL |
| 2 | IO_L09N_2/VS0 | AB9 | DUAL |
| 2 | IO_L12P_2/D7 | AB10 | DUAL |
| 2 | IP_2/VREF_2 | AB11 | VREF |
| 2 | IO_L16N_2/GCLK15 | AB12 | GCLK |
| 2 | IO_L18P_2/GCLK2 | AB13 | GCLK |
| 2 | IO_L19N_2 | AB14 | I/O |
| 2 | IP_2 | AB15 | INPUT |
| 2 | IO_L22N_2/DOUT | AB16 | DUAL |
| 2 | IO_L23P_2 | AB17 | I/O |
| 2 | IO_L23N_2 | AB18 | I/O |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 2 | IO_L27P_2 | AB19 | I/O |
| 2 | IO_L30N_2 | AB20 | I/O |
| 2 | IO_L02N_2/CSO_B | U7 | DUAL |
| 2 | IO_L11N_2 | U8 | I/O |
| 2 | IO_L10N_2 | U9 | I/O |
| 2 | IO_L14N_2/D4 | U10 | DUAL |
| 2 | IO_L17P_2/GCLK0 | U12 | GCLK |
| 2 | IO_L20P_2 | U13 | I/O |
| 2 | IO_L25P_2 | U14 | I/O |
| 2 | IO_L25N_2 | U15 | I/O |
| 2 | IO_L28P_2 | U16 | I/O |
| 2 | IO_L02P_2/M2 | V6 | DUAL |
| 2 | IO_L11P_2 | V7 | I/O |
| 2 | IO_L06N_2 | V8 | I/O |
| 2 | IO_L10P_2 | V10 | I/O |
| 2 | IO_L14P_2/D5 | V11 | DUAL |
| 2 | IO_L17N_2/GCLK1 | V12 | GCLK |
| 2 | IO_L20N_2/MOSI/CSI_B | V13 | DUAL |
| 2 | IP_2/VREF_2 | V15 | VREF |
| 2 | IO_L28N_2 | V16 | I/O |
| 2 | IO_L31N_2/CCLK | V17 | DUAL |
| 2 | IP_2/VREF_2 | W4 | VREF |
| 2 | IO_L03P_2 | W5 | I/O |
| 2 | IO_L07N_2/VS2 | W6 | DUAL |
| 2 | IO_L06P_2 | W8 | I/O |
| 2 | IP_2/VREF_2 | W9 | VREF |
| 2 | IP_2 | W10 | INPUT |
| 2 | IP_2/VREF_2 | W13 | VREF |
| 2 | IO_L21N_2 | W14 | I/O |
| 2 | IO_L24P_2/INIT_B | W15 | DUAL |
| 2 | IO_L31P_2/D0/DIN/MISO | W17 | DUAL |
| 2 | IP_2/VREF_2 | W18 | VREF |
| 2 | IO_L03N_2 | Y4 | I/O |
| 2 | IO_L07P_2/RDWR_B | Y5 | DUAL |
| 2 | IP_2 | Y6 | INPUT |
| 2 | IP_2 | Y7 | INPUT |
| 2 | IO_L13P_2 | Y8 | I/O |
| 2 | IO_L13N_2 | Y9 | I/O |
| 2 | IO_L15N_2/GCLK13 | Y10 | GCLK |
| 2 | IO_L15P_2/GCLK12 | Y11 | GCLK |
| 2 | IP_2 | Y12 | INPUT |
| 2 | IO_L21P_2 | Y13 | I/O |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 2 | IP_2/VREF_2 | Y14 | VREF |
| 2 | IO_L24N_2/D3 | Y15 | DUAL |
| 2 | IO_L29N_2 | Y16 | I/O |
| 2 | IO_L29P_2 | Y17 | I/O |
| 2 | IO_L26P_2/D2 | Y18 | DUAL |
| 2 | IO_L26N_2/D1 | Y19 | DUAL |
| 2 | VCCO_2 | AA5 | VCCO |
| 2 | VCCO_2 | AA9 | VCCO |
| 2 | VCCO_2 | AA13 | VCCO |
| 2 | VCCO_2 | AA18 | VCCO |
| 2 | VCCO_2 | V9 | VCCO |
| 2 | VCCO_2 | V14 | VCCO |
| 3 | IP_L39N_3/VREF_3 | AA1 | VREF |
| 3 | IO_L02N_3 | C1 | I/O |
| 3 | IO_L02P_3 | C2 | I/O |
| 3 | IP_L04P_3 | D1 | INPUT |
| 3 | IP_L08P_3 | D3 | INPUT |
| 3 | IP_L08N_3 | D4 | INPUT |
| 3 | IP_L04N_3/VREF_3 | E1 | VREF |
| 3 | IO_L09P_3 | E3 | I/O |
| 3 | IO_L09N_3 | E4 | I/O |
| 3 | IO_L06N_3 | F1 | I/O |
| 3 | IO_L06P_3 | F2 | I/O |
| 3 | IO_L01P_3 | F3 | I/O |
| 3 | IO_L03P_3 | F4 | I/O |
| 3 | IO_L03N_3 | F5 | I/O |
| 3 | IO_L11P_3 | G1 | I/O |
| 3 | IO_L01N_3 | G3 | I/O |
| 3 | IO_L07P_3 | G5 | I/O |
| 3 | IO_L07N_3 | G6 | I/O |
| 3 | IO_L11N_3 | H1 | I/O |
| 3 | IO_L14P_3 | H2 | I/O |
| 3 | IO_L05P_3 | H3 | I/O |
| 3 | IO_L05N_3 | H4 | I/O |
| 3 | IO_L10P_3 | H5 | I/O |
| 3 | IO_L10N_3 | H6 | I/O |
| 3 | IO_L14N_3/VREF_3 | J1 | VREF |
| 3 | IP_L16P_3 | J3 | INPUT |
| 3 | IP_L16N_3 | J4 | INPUT |
| 3 | IP_L12P_3 | J6 | INPUT |
| 3 | IP_L12N_3/VREF_3 | J7 | VREF |
| 3 | IO_L19P_3/LHCLK2 | K1 | LHCLK |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 3 | IO_L17P_3 | K2 | I/O |
| 3 | IO_L17N_3 | K3 | I/O |
| 3 | IO_L13P_3 | K4 | I/O |
| 3 | IO_L13N_3 | K5 | I/O |
| 3 | IO_L15P_3 | K6 | I/O |
| 3 | IO_L19N_3/IRDY2/LHCLK3 | L1 | LHCLK |
| 3 | IO_L20P_3/LHCLK4 | L3 | LHCLK |
| 3 | IO_L15N_3 | L5 | I/O |
| 3 | IO_L18P_3/LHCLK0 | L6 | LHCLK |
| 3 | IO_L22P_3/VREF_3 | M1 | VREF |
| 3 | IO_L20N_3/LHCLK5 | M2 | LHCLK |
| 3 | IP_L23P_3 | M3 | INPUT |
| 3 | IO_L18N_3/LHCLK1 | M5 | LHCLK |
| 3 | IO_L21P_3/TRDY2/LHCLK6 | M6 | LHCLK |
| 3 | IO_L22N_3 | N1 | I/O |
| 3 | IP_L31P_3 | N3 | INPUT |
| 3 | IP_L23N_3 | N4 | INPUT |
| 3 | IO_L24N_3 | N5 | I/O |
| 3 | IO_L24P_3 | N6 | I/O |
| 3 | IO_L21N_3/LHCLK7 | N7 | LHCLK |
| 3 | IO_L25P_3 | P1 | I/O |
| 3 | IO_L25N_3 | P2 | I/O |
| 3 | IP_L31N_3 | P3 | INPUT |
| 3 | IO_L32P_3/VREF_3 | P4 | VREF |
| 3 | IO_L26P_3 | P6 | I/O |
| 3 | IO_L28N_3 | R1 | I/O |
| 3 | IO_L28P_3 | R2 | I/O |
| 3 | IO_L34P_3 | R3 | I/O |
| 3 | IO_L32N_3 | R5 | I/O |
| 3 | IO_L26N_3 | R6 | I/O |
| 3 | IO_L30P_3 | T1 | I/O |
| 3 | IP_L27P_3 | T3 | INPUT |
| 3 | IO_L34N_3 | T4 | I/O |
| 3 | IO_L29N_3 | T5 | I/O |
| 3 | IO_L29P_3 | T6 | I/O |
| 3 | IO_L30N_3 | U1 | I/O |
| 3 | IO_L33P_3 | U2 | I/O |
| 3 | IP_L27N_3 | U3 | INPUT |
| 3 | IO_L38P_3 | U4 | I/O |
| 3 | IO_L38N_3 | U5 | I/O |
| 3 | IO_L33N_3 | V1 | I/O |
| 3 | IO_L36N_3 | V3 | I/O |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| 3 | IO_L36P_3 | V4 | I/O |
| 3 | IO_L35N_3 | W1 | I/O |
| 3 | IO_L37N_3 | W2 | I/O |
| 3 | IO_L37P_3 | W3 | I/O |
| 3 | IO_L35P_3 | Y1 | I/O |
| 3 | IP_L39P_3 | Y2 | INPUT |
| 3 | VCCO_3 | E2 | VCCO |
| 3 | VCCO_3 | J2 | VCCO |
| 3 | VCCO_3 | J5 | VCCO |
| 3 | VCCO_3 | N2 | VCCO |
| 3 | VCCO_3 | P5 | VCCO |
| 3 | VCCO_3 | V2 | VCCO |
| GND | GND | A1 | GND |
| GND | GND | A22 | GND |
| GND | GND | AA7 | GND |
| GND | GND | AA11 | GND |
| GND | GND | AA16 | GND |
| GND | GND | AB1 | GND |
| GND | GND | AB22 | GND |
| GND | GND | B7 | GND |
| GND | GND | B12 | GND |
| GND | GND | B16 | GND |
| GND | GND | C3 | GND |
| GND | GND | C20 | GND |
| GND | GND | D8 | GND |
| GND | GND | D11 | GND |
| GND | GND | D16 | GND |
| GND | GND | F6 | GND |
| GND | GND | F17 | GND |
| GND | GND | G2 | GND |
| GND | GND | G4 | GND |
| GND | GND | G9 | GND |
| GND | GND | G11 | GND |
| GND | GND | G13 | GND |
| GND | GND | G15 | GND |
| GND | GND | G21 | GND |
| GND | GND | H7 | GND |
| GND | GND | H8 | GND |
| GND | GND | H10 | GND |
| GND | GND | H12 | GND |
| GND | GND | H14 | GND |
| GND | GND | H16 | GND |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| GND | GND | H19 | GND |
| GND | GND | J9 | GND |
| GND | GND | J11 | GND |
| GND | GND | J13 | GND |
| GND | GND | J15 | GND |
| GND | GND | K8 | GND |
| GND | GND | K10 | GND |
| GND | GND | K12 | GND |
| GND | GND | K14 | GND |
| GND | GND | L2 | GND |
| GND | GND | L7 | GND |
| GND | GND | L9 | GND |
| GND | GND | L11 | GND |
| GND | GND | L13 | GND |
| GND | GND | L15 | GND |
| GND | GND | L19 | GND |
| GND | GND | M4 | GND |
| GND | GND | M8 | GND |
| GND | GND | M10 | GND |
| GND | GND | M12 | GND |
| GND | GND | M14 | GND |
| GND | GND | M16 | GND |
| GND | GND | M21 | GND |
| GND | GND | N9 | GND |
| GND | GND | N11 | GND |
| GND | GND | N13 | GND |
| GND | GND | N15 | GND |
| GND | GND | P8 | GND |
| GND | GND | P10 | GND |
| GND | GND | P12 | GND |
| GND | GND | P14 | GND |
| GND | GND | R4 | GND |
| GND | GND | R7 | GND |
| GND | GND | R9 | GND |
| GND | GND | R11 | GND |
| GND | GND | R13 | GND |
| GND | GND | R15 | GND |
| GND | GND | R16 | GND |
| GND | GND | T2 | GND |
| GND | GND | T8 | GND |
| GND | GND | T10 | GND |
| GND | GND | T12 | GND |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| GND | GND | T14 | GND |
| GND | GND | T15 | GND |
| GND | GND | T19 | GND |
| GND | GND | T21 | GND |
| GND | GND | U6 | GND |
| GND | GND | U11 | GND |
| GND | GND | U17 | GND |
| GND | GND | W7 | GND |
| GND | GND | W12 | GND |
| GND | GND | W16 | GND |
| GND | GND | Y3 | GND |
| GND | GND | Y20 | GND |
| VCCAUX | SUSPEND | V19 | PWRMGMT |
| VCCAUX | PROG_B | A2 | CONFIG |
| VCCAUX | DONE | AB21 | CONFIG |
| VCCAUX | TCK | A21 | JTAG |
| VCCAUX | TMS | B1 | JTAG |
| VCCAUX | TDO | B22 | JTAG |
| VCCAUX | TDI | D2 | JTAG |
| VCCAUX | VCCAUX | AA2 | VCCAUX |
| VCCAUX | VCCAUX | AA21 | VCCAUX |
| VCCAUX | VCCAUX | B2 | VCCAUX |
| VCCAUX | VCCAUX | B21 | VCCAUX |
| VCCAUX | VCCAUX | D12 | VCCAUX |
| VCCAUX | VCCAUX | E5 | VCCAUX |
| VCCAUX | VCCAUX | E18 | VCCAUX |
| VCCAUX | VCCAUX | G10 | VCCAUX |
| VCCAUX | VCCAUX | G12 | VCCAUX |
| VCCAUX | VCCAUX | G14 | VCCAUX |
| VCCAUX | VCCAUX | J16 | VCCAUX |
| VCCAUX | VCCAUX | K7 | VCCAUX |
| VCCAUX | VCCAUX | L4 | VCCAUX |
| VCCAUX | VCCAUX | L16 | VCCAUX |
| VCCAUX | VCCAUX | M7 | VCCAUX |
| VCCAUX | VCCAUX | M19 | VCCAUX |
| VCCAUX | VCCAUX | N16 | VCCAUX |
| VCCAUX | VCCAUX | P7 | VCCAUX |
| VCCAUX | VCCAUX | T9 | VCCAUX |
| VCCAUX | VCCAUX | T11 | VCCAUX |
| VCCAUX | VCCAUX | T13 | VCCAUX |
| VCCAUX | VCCAUX | V5 | VCCAUX |
| VCCAUX | VCCAUX | V18 | VCCAUX |

*Table 63:* **Spartan-3A DSP CS484 Pinout *(Cont'd)***

| Bank | Pin Name | CS484 Ball | Type |
|---|---|---|---|
| VCCAUX | VCCAUX | W11 | VCCAUX |
| VCCINT | VCCINT | G7 | VCCINT |
| VCCINT | VCCINT | G16 | VCCINT |
| VCCINT | VCCINT | H9 | VCCINT |
| VCCINT | VCCINT | H11 | VCCINT |
| VCCINT | VCCINT | H13 | VCCINT |
| VCCINT | VCCINT | H15 | VCCINT |
| VCCINT | VCCINT | J8 | VCCINT |
| VCCINT | VCCINT | J10 | VCCINT |
| VCCINT | VCCINT | J12 | VCCINT |
| VCCINT | VCCINT | J14 | VCCINT |
| VCCINT | VCCINT | K9 | VCCINT |
| VCCINT | VCCINT | K11 | VCCINT |
| VCCINT | VCCINT | K13 | VCCINT |
| VCCINT | VCCINT | K15 | VCCINT |
| VCCINT | VCCINT | L8 | VCCINT |
| VCCINT | VCCINT | L10 | VCCINT |
| VCCINT | VCCINT | L12 | VCCINT |
| VCCINT | VCCINT | L14 | VCCINT |
| VCCINT | VCCINT | M9 | VCCINT |
| VCCINT | VCCINT | M11 | VCCINT |
| VCCINT | VCCINT | M13 | VCCINT |
| VCCINT | VCCINT | M15 | VCCINT |
| VCCINT | VCCINT | N8 | VCCINT |
| VCCINT | VCCINT | N10 | VCCINT |
| VCCINT | VCCINT | N12 | VCCINT |
| VCCINT | VCCINT | N14 | VCCINT |
| VCCINT | VCCINT | P9 | VCCINT |
| VCCINT | VCCINT | P11 | VCCINT |
| VCCINT | VCCINT | P13 | VCCINT |
| VCCINT | VCCINT | P15 | VCCINT |
| VCCINT | VCCINT | R8 | VCCINT |
| VCCINT | VCCINT | R10 | VCCINT |
| VCCINT | VCCINT | R12 | VCCINT |
| VCCINT | VCCINT | R14 | VCCINT |
| VCCINT | VCCINT | T7 | VCCINT |
| VCCINT | VCCINT | T16 | VCCINT |

## User I/Os by Bank

Table 64 and Table 65 indicates how the user-I/O pins are distributed between the four I/O banks on the CS484 package. The AWAKE pin is counted as a dual-purpose I/O.

*Table 64:* **User I/Os Per Bank for the XC3SD1800A in the CS484 Package**

| Package Edge | I/O Bank | Maximum I/Os and Input-Only | All Possible I/O Pins by Type | | | | |
|---|---|---|---|---|---|---|---|
| | | | I/O | INPUT | DUAL | VREF[1] | CLK |
| Top | 0 | 77 | 49 | 13 | 1 | 6 | 8 |
| Right | 1 | 78 | 23 | 9 | 30 | 8 | 8 |
| Bottom | 2 | 76 | 33 | 6 | 21 | 8 | 8 |
| Left | 3 | 78 | 51 | 13 | 0 | 6 | 8 |
| **TOTAL** | | **309** | **156** | **41** | **52** | **28** | **32** |

**Notes:**

1. 19 VREF are on INPUT pins.

*Table 65:* **User I/Os Per Bank for the XC3SD3400A in the CS484 Package**

| Package Edge | I/O Bank | Maximum I/O and Input-Only | All Possible I/O Pins by Type | | | | |
|---|---|---|---|---|---|---|---|
| | | | I/O | INPUT | DUAL | VREF[1] | CLK |
| Top | 0 | 77 | 49 | 13 | 1 | 6 | 8 |
| Right | 1 | 78 | 23 | 9 | 30 | 8 | 8 |
| Bottom | 2 | 76 | 33 | 6 | 21 | 8 | 8 |
| Left | 3 | 78 | 51 | 13 | 0 | 6 | 8 |
| **TOTAL** | | **309** | **156** | **41** | **52** | **28** | **32** |

**Notes:**

1. 19 VREF are on INPUT pins.

## Footprint Migration Differences

There are no migration footprint differences between the XC3SD1800A and the XC3SD3400A in the CS484 package.

## CS484 Footprint

***Left Half of Package (Top View)***

156 **I/O:** Unrestricted, general-purpose user I/O.

41 **INPUT:** Unrestricted, general-purpose input pin.

51 **DUAL:** Configuration pins, then possible user I/O.

28 **VREF:** User I/O or input voltage reference for bank.

32 **CLK:** User I/O, input, or clock buffer input.

2 **CONFIG:** Dedicated configuration pins.

2 **SUSPEND:** Dedicated SUSPEND and dual-purpose AWAKE Power Management pins.

4 **JTAG:** Dedicated JTAG port pins.

84 **GND:** Ground.

24 **VCCO:** Output voltage supply for bank.

36 **VCCINT:** Internal core supply voltage (+1.2V).

24 **VCCAUX:** Auxiliary supply voltage

| | Bank 0 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| A | GND | PROG_B | I/O L30N_0 | I/O L28N_0 | I/O L25N_0 | I/O L25P_0 | I/O L24N_0 VREF_0 | I/O L20P_0 GCLK10 | I/O L18P_0 GCLK6 | INPUT | I/O L15N_0 |
| B | TMS | VCCAUX | I/O L30P_0 | I/O L28P_0 | VCCO_0 | I/O L24P_0 | GND | I/O L20N_0 GCLK11 | I/O L18N_0 GCLK7 | VCCO_0 | I/O L15P_0 |
| C | I/O L02N_3 | I/O L02P_3 | GND | I/O L29N_0 | INPUT | I/O L21P_0 | I/O L26P_0 | I/O L22P_0 | I/O L16P_0 | INPUT | INPUT 0 VREF_0 |
| D | INPUT L04P_3 | TDI | INPUT L08P_3 | INPUT L08N_3 | I/O L29P_0 | I/O L21N_0 | I/O L26N_0 | GND | I/O L22N_0 | I/O L16N_0 | GND |
| E | INPUT L04N_3 VREF_3 | VCCO_3 | I/O L09P_3 | I/O L09N_3 | VCCAUX | INPUT | I/O L31P_0 VREF_0 | I/O L27N_0 | VCCO_0 | INPUT | I/O L19N_0 GCLK9 |
| F | I/O L06N_3 | I/O L06P_3 | I/O L01P_3 | I/O L03P_3 | I/O L03N_3 | GND | I/O L31N_0 PUDC_B | I/O L27P_0 | I/O L23N_0 | I/O L19P_0 GCLK8 | I/O L17N_0 GCLK5 |
| G | I/O L11P_3 | GND | I/O L01N_3 | GND | I/O L07P_3 | I/O L07N_3 | VCCINT | I/O L23P_0 | GND | VCCAUX | GND |
| H | I/O L11N_3 | I/O L14P_3 | I/O L05P_3 | I/O L05N_3 | I/O L10P_3 | I/O L10N_3 | GND | GND | VCCINT | GND | VCCINT |
| J | I/O L14N_3 VREF_3 | VCCO_3 | INPUT L16P_3 | INPUT L16N_3 | VCCO_3 | INPUT L12P_3 | INPUT L12N_3 VREF_3 | VCCINT | GND | VCCINT | GND |
| K | I/O L19P_3 LHCLK2 | I/O L17P_3 | I/O L17N_3 | I/O L13P_3 | I/O L13N_3 | I/O L15P_3 | VCCAUX | GND | VCCINT | GND | VCCINT |
| L | I/O L19N_3 IRDY2 LHCLK3 | GND | I/O L20P_3 LHCLK4 | VCCAUX | I/O L15N_3 | I/O L18P_3 LHCLK0 | GND | VCCINT | GND | VCCINT | GND |
| M | I/O L22P_3 VREF_3 | I/O L20N_3 LHCLK5 | INPUT L23P_3 | GND | I/O L18N_3 LHCLK1 | I/O L21P_3 TRDY2 LHCLK6 | VCCAUX | GND | VCCINT | GND | VCCINT |
| N | I/O L22N_3 | VCCO_3 | INPUT L31P_3 | INPUT L23N_3 | I/O L24N_3 | I/O L24P_3 | I/O L21N_3 LHCLK7 | VCCINT | GND | VCCINT | GND |
| P | I/O L25P_3 | I/O L25N_3 | INPUT L31N_3 | I/O L32P_3 VREF_3 | VCCO_3 | I/O L26P_3 | VCCAUX | GND | VCCINT | GND | VCCINT |
| R | I/O L28N_3 | I/O L28P_3 | I/O L34P_3 | GND | I/O L32N_3 | I/O L26N_3 | GND | VCCINT | GND | VCCINT | GND |
| T | I/O L30P_3 | GND | INPUT L27P_3 | I/O L34N_3 | I/O L29N_3 | I/O L29P_3 | VCCINT | GND | VCCAUX | GND | VCCAUX |
| U | I/O L30N_3 | I/O L33P_3 | INPUT L27N_3 | I/O L38P_3 | I/O L38N_3 | GND | I/O L02N_2 CSO_B | I/O L11N_2 | I/O L10N_2 | I/O L14N_2 D4 | GND |
| V | I/O L33N_3 | VCCO_3 | I/O L36N_3 | I/O L36P_3 | VCCAUX | I/O L02P_2 M2 | I/O L11P_2 | I/O L06N_2 | VCCO_2 | I/O L10P_2 | I/O L14P_2 D5 |
| W | I/O L35N_3 | I/O L37N_3 | I/O L37P_3 | INPUT 2 VREF_2 | I/O L03P_2 | I/O L07N_2 VS2 | GND | I/O L06P_2 | INPUT 2 VREF_2 | INPUT | VCCAUX |
| Y | I/O L35P_3 | INPUT L39P_3 | GND | I/O L03N_2 | I/O L07P_2 RDWR_B | INPUT | INPUT | I/O L13P_2 | I/O L13N_2 | I/O L15N_2 GCLK13 | I/O L15P_2 GCLK12 |
| AA | INPUT L39N_3 VREF_3 | VCCAUX | I/O L01P_2 M1 | I/O L04N_2 | VCCO_2 | INPUT | GND | I/O L08N_2 | VCCO_2 | I/O L12N_2 D6 | GND |
| AB | GND | INPUT 2 VREF_2 | I/O L01N_2 M0 | I/O L04P_2 | I/O L05P_2 | I/O L05N_2 | I/O L08P_2 | I/O L09P_2 VS1 | I/O L09N_2 VS0 | I/O L12P_2 D7 | INPUT 2 VREF_2 |

Bank 3

Bank 2

*Figure 15:* **CS484 Package Footprint (Top View–Left Half)**

***Right Half of CS484 Package (Top View)***

**Figure 16: CS484 Package Footprint (Top View–Right Half)**

# FG676: 676-Ball Fine-Pitch Ball Grid Array

The 676-ball fine-pitch ball grid array, FG676, supports both the XC3SD1800A and the XC3SD3400A FPGAs. There are multiple pinout differences between the two devices. For a list of differences and migration advice, see the Footprint Migration Differences section.

## XC3SD1800A FPGA

Table 66 lists all the FG676 package pins for the XC3SD1800A FPGA. They are sorted by bank number and then by pin name. Pairs of pins that form a differential I/O pair appear together in the table. The table also shows the pin number for each pin and the pin type, as defined earlier.

### Pinout Table

***Note:*** The grayed boxes denote a difference between the XC3SD1800A and the XC3SD3400A devices.

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA**

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L43N_0 | K11 | I/O |
| 0 | IO_L39N_0 | K12 | I/O |
| 0 | IO_L25P_0/GCLK4 | K14 | GCLK |
| 0 | IO_L12N_0 | K16 | I/O |
| 0 | IP_0 | J10 | INPUT |
| 0 | IO_L43P_0 | J11 | I/O |
| 0 | IO_L39P_0 | J12 | I/O |
| 0 | IP_0 | J13 | INPUT |
| 0 | IO_L25N_0/GCLK5 | J14 | GCLK |
| 0 | IP_0 | J15 | INPUT |
| 0 | IO_L12P_0 | J16 | I/O |
| 0 | IP_0/VREF_0 | J17 | VREF |
| 0 | IO_L47N_0 | H9 | I/O |
| 0 | IO_L46N_0 | H10 | I/O |
| 0 | IO_L35N_0 | H12 | I/O |
| 0 | IP_0 | H13 | INPUT |
| 0 | IO_L16N_0 | H15 | I/O |
| 0 | IO_L08P_0 | H17 | I/O |
| 0 | IP_0 | H18 | INPUT |
| 0 | IO_L52N_0/PUDC_B | G8 | DUAL |
| 0 | IO_L47P_0 | G9 | I/O |
| 0 | IO_L46P_0 | G10 | I/O |
| 0 | IP_0/VREF_0 | G11 | VREF |
| 0 | IO_L35P_0 | G12 | I/O |
| 0 | IO_L27N_0/GCLK9 | G13 | GCLK |
| 0 | IP_0 | G14 | INPUT |
| 0 | IO_L16P_0 | G15 | I/O |
| 0 | IO_L08N_0 | G17 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L02P_0/VREF_0 | G19 | VREF |
| 0 | IO_L01P_0 | G20 | I/O |
| 0 | IO_L48P_0 | F7 | I/O |
| 0 | IO_L52P_0/VREF_0 | F8 | VREF |
| 0 | IO_L31N_0 | F12 | I/O |
| 0 | IO_L27P_0/GCLK8 | F13 | GCLK |
| 0 | IO_L24N_0 | F14 | I/O |
| 0 | IO_L20P_0 | F15 | I/O |
| 0 | IO_L13P_0 | F17 | I/O |
| 0 | IO_L02N_0 | F19 | I/O |
| 0 | IO_L01N_0 | F20 | I/O |
| 0 | IO_L48N_0 | E7 | I/O |
| 0 | IO_L37P_0 | E10 | I/O |
| 0 | IP_0 | E11 | INPUT |
| 0 | IO_L31P_0 | E12 | I/O |
| 0 | IO_L24P_0 | E14 | I/O |
| 0 | IO_L20N_0/VREF_0 | E15 | VREF |
| 0 | IO_L13N_0 | E17 | I/O |
| 0 | IP_0 | E18 | INPUT |
| 0 | IO_L10P_0 | E21 | I/O |
| 0 | IO_L44N_0 | D6 | I/O |
| 0 | IP_0/VREF_0 | D7 | VREF |
| 0 | IO_L40N_0 | D8 | I/O |
| 0 | IO_L37N_0 | D9 | I/O |
| 0 | IO_L34N_0 | D10 | I/O |
| 0 | IO_L32N_0/VREF_0 | D11 | VREF |
| 0 | IP_0 | D12 | INPUT |
| 0 | IO_L30P_0 | D13 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IP_0/VREF_0 | D14 | VREF |
| 0 | IO_L22P_0 | D16 | I/O |
| 0 | IO_L21P_0 | D17 | I/O |
| 0 | IO_L17P_0 | D18 | I/O |
| 0 | IO_L11P_0 | D20 | I/O |
| 0 | IO_L10N_0 | D21 | I/O |
| 0 | IO_L05P_0 | D22 | I/O |
| 0 | IO_L06P_0 | D23 | I/O |
| 0 | IO_L44P_0 | C5 | I/O |
| 0 | IO_L41N_0 | C6 | I/O |
| 0 | IO_L42N_0 | C7 | I/O |
| 0 | IO_L40P_0 | C8 | I/O |
| 0 | IO_L34P_0 | C10 | I/O |
| 0 | IO_L32P_0 | C11 | I/O |
| 0 | IO_L30N_0 | C12 | I/O |
| 0 | IO_L28N_0/GCLK11 | C13 | GCLK |
| 0 | IO_L22N_0 | C15 | I/O |
| 0 | IO_L21N_0 | C16 | I/O |
| 0 | IO_L19P_0 | C17 | I/O |
| 0 | IO_L17N_0 | C18 | I/O |
| 0 | IO_L11N_0 | C20 | I/O |
| 0 | IO_L09P_0 | C21 | I/O |
| 0 | IO_L05N_0 | C22 | I/O |
| 0 | IO_L06N_0 | C23 | I/O |
| 0 | IO_L51N_0 | B3 | I/O |
| 0 | IO_L45N_0 | B4 | I/O |
| 0 | IO_L41P_0 | B6 | I/O |
| 0 | IO_L42P_0 | B7 | I/O |
| 0 | IO_L38N_0 | B8 | I/O |
| 0 | IO_L36N_0 | B9 | I/O |
| 0 | IO_L33N_0 | B10 | I/O |
| 0 | IO_L29N_0 | B12 | I/O |
| 0 | IO_L28P_0/GCLK10 | B13 | GCLK |
| 0 | IO_L26P_0/GCLK6 | B14 | GCLK |
| 0 | IO_L23P_0 | B15 | I/O |
| 0 | IO_L19N_0 | B17 | I/O |
| 0 | IO_L18P_0 | B18 | I/O |
| 0 | IO_L15P_0 | B19 | I/O |
| 0 | IO_L14P_0/VREF_0 | B20 | VREF |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L09N_0 | B21 | I/O |
| 0 | IO_L07P_0 | B23 | I/O |
| 0 | IO_L51P_0 | A3 | I/O |
| 0 | IO_L45P_0 | A4 | I/O |
| 0 | IP_0 | A7 | INPUT |
| 0 | IO_L38P_0 | A8 | I/O |
| 0 | IO_L36P_0 | A9 | I/O |
| 0 | IO_L33P_0 | A10 | I/O |
| 0 | IO_L29P_0 | A12 | I/O |
| 0 | IP_0 | A13 | INPUT |
| 0 | IO_L26N_0/GCLK7 | A14 | GCLK |
| 0 | IO_L23N_0 | A15 | I/O |
| 0 | IP_0 | A17 | INPUT |
| 0 | IO_L18N_0 | A18 | I/O |
| 0 | IO_L15N_0 | A19 | I/O |
| 0 | IO_L14N_0 | A20 | I/O |
| 0 | IO_L07N_0 | A22 | I/O |
| 0 | IP_0 | G16 | INPUT |
| 0 | IP_0 | E9 | INPUT |
| 0 | IP_0 | D15 | INPUT |
| 0 | IP_0 | D19 | INPUT |
| 0 | IP_0 | B24 | INPUT |
| 0 | IP_0 | A5 | INPUT |
| 0 | IP_0 | A23 | INPUT |
| 0 | IP_0 | F9 | INPUT |
| 0 | IP_0 | E20 | INPUT |
| 0 | IP_0 | A24 | INPUT |
| 0 | IP_0 | G18 | INPUT |
| 0 | IP_0 | F10 | INPUT |
| 0 | IP_0 | F18 | INPUT |
| 0 | IP_0 | E6 | INPUT |
| 0 | IP_0 | D5 | INPUT |
| 0 | IP_0 | C4 | INPUT |
| 0 | VCCO_0 | H11 | VCCO |
| 0 | VCCO_0 | H16 | VCCO |
| 0 | VCCO_0 | E8 | VCCO |
| 0 | VCCO_0 | E13 | VCCO |
| 0 | VCCO_0 | E19 | VCCO |
| 0 | VCCO_0 | B5 | VCCO |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | VCCO_0 | B11 | VCCO |
| 0 | VCCO_0 | B16 | VCCO |
| 0 | VCCO_0 | B22 | VCCO |
| 1 | IO_L01P_1/HDC | Y20 | DUAL |
| 1 | IO_L01N_1/LDC2 | Y21 | DUAL |
| 1 | IO_L13P_1 | Y22 | I/O |
| 1 | IO_L13N_1 | Y23 | I/O |
| 1 | IO_L15P_1 | Y24 | I/O |
| 1 | IO_L15N_1 | Y25 | I/O |
| 1 | IP_L16N_1 | Y26 | INPUT |
| 1 | IO_L04P_1 | W20 | I/O |
| 1 | IO_L04N_1 | W21 | I/O |
| 1 | IO_L18P_1 | W23 | I/O |
| 1 | IO_L08P_1 | V18 | I/O |
| 1 | IO_L08N_1 | V19 | I/O |
| 1 | IO_L10P_1 | V21 | I/O |
| 1 | IO_L18N_1 | V22 | I/O |
| 1 | IO_L21P_1 | V23 | I/O |
| 1 | IO_L19P_1 | V24 | I/O |
| 1 | IO_L19N_1 | V25 | I/O |
| 1 | IP_L20N_1/VREF_1 | V26 | VREF |
| 1 | IO_L12N_1 | U18 | I/O |
| 1 | IO_L12P_1 | U19 | I/O |
| 1 | IO_L10N_1 | U20 | I/O |
| 1 | IO_L14P_1 | U21 | I/O |
| 1 | IO_L21N_1 | U22 | I/O |
| 1 | IO_L23P_1 | U23 | I/O |
| 1 | IO_L23N_1/VREF_1 | U24 | VREF |
| 1 | IP_L24N_1/VREF_1 | U26 | VREF |
| 1 | IO_L17N_1 | T17 | I/O |
| 1 | IO_L17P_1 | T18 | I/O |
| 1 | IO_L14N_1 | T20 | I/O |
| 1 | IO_L26P_1/A4 | T23 | DUAL |
| 1 | IO_L26N_1/A5 | T24 | DUAL |
| 1 | IO_L27N_1/A7 | R17 | DUAL |
| 1 | IO_L27P_1/A6 | R18 | DUAL |
| 1 | IO_L22P_1 | R19 | I/O |
| 1 | IO_L22N_1 | R20 | I/O |
| 1 | IO_L25P_1/A2 | R21 | DUAL |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 1 | IO_L25N_1/A3 | R22 | DUAL |
| 1 | IP_L28P_1/VREF_1 | R23 | VREF |
| 1 | IP_L28N_1 | R24 | INPUT |
| 1 | IO_L29P_1/A8 | R25 | DUAL |
| 1 | IO_L29N_1/A9 | R26 | DUAL |
| 1 | IO_L34P_1/IRDY1/RHCLK6 | P18 | RHCLK |
| 1 | IO_L30N_1/RHCLK1 | P20 | RHCLK |
| 1 | IO_L30P_1/RHCLK0 | P21 | RHCLK |
| 1 | IO_L37P_1 | P22 | I/O |
| 1 | IO_L33P_1/RHCLK4 | P23 | RHCLK |
| 1 | IO_L31N_1/TRDY1/RHCLK3 | P25 | RHCLK |
| 1 | IO_L31P_1/RHCLK2 | P26 | RHCLK |
| 1 | IO_L39N_1/A15 | N17 | DUAL |
| 1 | IO_L39P_1/A14 | N18 | DUAL |
| 1 | IO_L34N_1/RHCLK7 | N19 | RHCLK |
| 1 | IO_L42P_1/A16 | N20 | DUAL |
| 1 | IO_L37N_1 | N21 | I/O |
| 1 | IP_L36N_1 | N23 | INPUT |
| 1 | IO_L33N_1/RHCLK5 | N24 | RHCLK |
| 1 | IP_L32N_1 | N25 | INPUT |
| 1 | IP_L32P_1 | N26 | INPUT |
| 1 | IO_L47N_1 | M18 | I/O |
| 1 | IO_L47P_1 | M19 | I/O |
| 1 | IO_L42N_1/A17 | M20 | DUAL |
| 1 | IO_L45P_1 | M21 | I/O |
| 1 | IO_L45N_1 | M22 | I/O |
| 1 | IO_L38N_1/A13 | M23 | DUAL |
| 1 | IP_L36P_1/VREF_1 | M24 | VREF |
| 1 | IO_L35N_1/A11 | M25 | DUAL |
| 1 | IO_L35P_1/A10 | M26 | DUAL |
| 1 | IO_L55N_1 | L17 | I/O |
| 1 | IO_L55P_1 | L18 | I/O |
| 1 | IO_L53P_1 | L20 | I/O |
| 1 | IO_L50P_1 | L22 | I/O |
| 1 | IP_L40N_1 | L23 | INPUT |
| 1 | IO_L38P_1/A12 | L24 | DUAL |
| 1 | IO_L57N_1 | K18 | I/O |
| 1 | IO_L57P_1 | K19 | I/O |
| 1 | IO_L53N_1 | K20 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 1 | IO_L50N_1 | K21 | I/O |
| 1 | IO_L46N_1 | K22 | I/O |
| 1 | IO_L46P_1 | K23 | I/O |
| 1 | IP_L40P_1 | K24 | INPUT |
| 1 | IO_L41P_1 | K25 | I/O |
| 1 | IO_L41N_1 | K26 | I/O |
| 1 | IO_L59P_1 | J19 | I/O |
| 1 | IO_L59N_1 | J20 | I/O |
| 1 | IO_L62P_1/A20 | J21 | DUAL |
| 1 | IO_L49N_1 | J22 | I/O |
| 1 | IO_L49P_1 | J23 | I/O |
| 1 | IO_L43N_1/A19 | J25 | DUAL |
| 1 | IO_L43P_1/A18 | J26 | DUAL |
| 1 | IO_L64P_1/A24 | H20 | DUAL |
| 1 | IO_L62N_1/A21 | H21 | DUAL |
| 1 | IP_L48N_1 | H24 | INPUT |
| 1 | IP_L44N_1 | H25 | INPUT |
| 1 | IP_L44P_1/VREF_1 | H26 | VREF |
| 1 | IO_L64N_1/A25 | G21 | DUAL |
| 1 | IO_L58N_1 | G22 | I/O |
| 1 | IO_L51P_1 | G23 | I/O |
| 1 | IO_L51N_1 | G24 | I/O |
| 1 | IP_L52N_1/VREF_1 | G25 | VREF |
| 1 | IO_L58P_1/VREF_1 | F22 | VREF |
| 1 | IO_L56N_1 | F23 | I/O |
| 1 | IO_L54N_1 | F24 | I/O |
| 1 | IO_L54P_1 | F25 | I/O |
| 1 | IO_L56P_1 | E24 | I/O |
| 1 | IO_L60P_1 | E26 | I/O |
| 1 | IO_L61N_1 | D24 | I/O |
| 1 | IO_L61P_1 | D25 | I/O |
| 1 | IO_L60N_1 | D26 | I/O |
| 1 | IO_L63N_1/A23 | C25 | DUAL |
| 1 | IO_L63P_1/A22 | C26 | DUAL |
| 1 | IP_L65P_1/VREF_1 | B26 | VREF |
| 1 | IO_L02P_1/LDC1 | AE26 | DUAL |
| 1 | IO_L02N_1/LDC0 | AD25 | DUAL |
| 1 | IO_L05P_1 | AD26 | I/O |
| 1 | IO_L03P_1/A0 | AC23 | DUAL |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 1 | IO_L03N_1/A1 | AC24 | DUAL |
| 1 | IO_L05N_1 | AC25 | I/O |
| 1 | IO_L06P_1 | AC26 | I/O |
| 1 | IO_L07P_1 | AB23 | I/O |
| 1 | IO_L07N_1/VREF_1 | AB24 | VREF |
| 1 | IO_L06N_1 | AB26 | I/O |
| 1 | IO_L09P_1 | AA22 | I/O |
| 1 | IO_L09N_1 | AA23 | I/O |
| 1 | IO_L11P_1 | AA24 | I/O |
| 1 | IO_L11N_1 | AA25 | I/O |
| 1 | IP_L16P_1 | W25 | INPUT |
| 1 | IP_L24P_1 | U25 | INPUT |
| 1 | IP_L65N_1 | B25 | INPUT |
| 1 | IP_L20P_1 | W26 | INPUT |
| 1 | IP_L48P_1 | H23 | INPUT |
| 1 | IP_L52P_1 | G26 | INPUT |
| 1 | VCCO_1 | W22 | VCCO |
| 1 | VCCO_1 | T19 | VCCO |
| 1 | VCCO_1 | T25 | VCCO |
| 1 | VCCO_1 | N22 | VCCO |
| 1 | VCCO_1 | L19 | VCCO |
| 1 | VCCO_1 | L25 | VCCO |
| 1 | VCCO_1 | H22 | VCCO |
| 1 | VCCO_1 | E25 | VCCO |
| 1 | VCCO_1 | AB25 | VCCO |
| 2 | IO_L02P_2/M2 | Y7 | DUAL |
| 2 | IO_L05N_2 | Y9 | I/O |
| 2 | IO_L12P_2 | Y10 | I/O |
| 2 | IO_L17P_2/RDWR_B | Y12 | DUAL |
| 2 | IO_L25N_2/GCLK13 | Y13 | GCLK |
| 2 | IO_L27P_2/GCLK0 | Y14 | GCLK |
| 2 | IO_L34N_2/D3 | Y15 | DUAL |
| 2 | IP_2/VREF_2 | Y16 | VREF |
| 2 | IO_L43N_2 | Y17 | I/O |
| 2 | IO_L05P_2 | W9 | I/O |
| 2 | IO_L09N_2 | W10 | I/O |
| 2 | IO_L16N_2 | W12 | I/O |
| 2 | IO_L20N_2 | W13 | I/O |
| 2 | IO_L31N_2 | W15 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | IO_L46P_2 | W17 | I/O |
| 2 | IO_L09P_2 | V10 | I/O |
| 2 | IO_L13P_2 | V11 | I/O |
| 2 | IO_L16P_2 | V12 | I/O |
| 2 | IO_L20P_2 | V13 | I/O |
| 2 | IO_L31P_2 | V14 | I/O |
| 2 | IO_L35P_2 | V15 | I/O |
| 2 | IO_L42P_2 | V16 | I/O |
| 2 | IO_L46N_2 | V17 | I/O |
| 2 | IO_L13N_2 | U11 | I/O |
| 2 | IO_L35N_2 | U15 | I/O |
| 2 | IO_L42N_2 | U16 | I/O |
| 2 | IO_L06N_2 | AF3 | I/O |
| 2 | IO_L07N_2 | AF4 | I/O |
| 2 | IO_L10P_2 | AF5 | I/O |
| 2 | IP_2 | AF7 | INPUT |
| 2 | IO_L18N_2 | AF8 | I/O |
| 2 | IO_L19N_2/VS0 | AF9 | DUAL |
| 2 | IO_L22N_2/D6 | AF10 | DUAL |
| 2 | IO_L24P_2/D5 | AF12 | DUAL |
| 2 | IO_L26P_2/GCLK14 | AF13 | GCLK |
| 2 | IO_L28P_2/GCLK2 | AF14 | GCLK |
| 2 | IP_2/VREF_2 | AF15 | VREF |
| 2 | IP_2/VREF_2 | AF17 | VREF |
| 2 | IO_L36P_2/D2 | AF18 | DUAL |
| 2 | IO_L37P_2 | AF19 | I/O |
| 2 | IO_L39P_2 | AF20 | I/O |
| 2 | IP_2/VREF_2 | AF22 | VREF |
| 2 | IO_L48P_2 | AF23 | I/O |
| 2 | IO_L52P_2/D0/DIN/MISO | AF24 | DUAL |
| 2 | IO_L51P_2 | AF25 | I/O |
| 2 | IO_L06P_2 | AE3 | I/O |
| 2 | IO_L07P_2 | AE4 | I/O |
| 2 | IO_L10N_2 | AE6 | I/O |
| 2 | IO_L11N_2 | AE7 | I/O |
| 2 | IO_L18P_2 | AE8 | I/O |
| 2 | IO_L19P_2/VS1 | AE9 | DUAL |
| 2 | IO_L22P_2/D7 | AE10 | DUAL |
| 2 | IO_L24N_2/D4 | AE12 | DUAL |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | IO_L26N_2/GCLK15 | AE13 | GCLK |
| 2 | IO_L28N_2/GCLK3 | AE14 | GCLK |
| 2 | IO_L32N_2/DOUT | AE15 | DUAL |
| 2 | IO_L33P_2 | AE17 | I/O |
| 2 | IO_L36N_2/D1 | AE18 | DUAL |
| 2 | IO_L37N_2 | AE19 | I/O |
| 2 | IO_L39N_2 | AE20 | I/O |
| 2 | IO_L44P_2 | AE21 | I/O |
| 2 | IO_L48N_2 | AE23 | I/O |
| 2 | IO_L52N_2/CCLK | AE24 | DUAL |
| 2 | IO_L51N_2 | AE25 | I/O |
| 2 | IO_L01N_2/M0 | AD4 | DUAL |
| 2 | IO_L08N_2 | AD6 | I/O |
| 2 | IO_L11P_2 | AD7 | I/O |
| 2 | IP_2 | AD9 | INPUT |
| 2 | IP_2 | AD10 | INPUT |
| 2 | IO_L23P_2 | AD11 | I/O |
| 2 | IP_2/VREF_2 | AD12 | VREF |
| 2 | IO_L29P_2 | AD14 | I/O |
| 2 | IO_L32P_2/AWAKE | AD15 | PWRMGMT |
| 2 | IP_2 | AD16 | INPUT |
| 2 | IO_L33N_2 | AD17 | I/O |
| 2 | IO_L40P_2 | AD19 | I/O |
| 2 | IO_L41P_2 | AD20 | I/O |
| 2 | IO_L44N_2 | AD21 | I/O |
| 2 | IO_L45P_2 | AD22 | I/O |
| 2 | IO_L01P_2/M1 | AC4 | DUAL |
| 2 | IO_L08P_2 | AC6 | I/O |
| 2 | IO_L14P_2 | AC8 | I/O |
| 2 | IO_L15N_2 | AC9 | I/O |
| 2 | IP_2/VREF_2 | AC10 | VREF |
| 2 | IO_L23N_2 | AC11 | I/O |
| 2 | IO_L21N_2 | AC12 | I/O |
| 2 | IP_2 | AC13 | INPUT |
| 2 | IO_L29N_2 | AC14 | I/O |
| 2 | IO_L30P_2 | AC15 | I/O |
| 2 | IO_L38P_2 | AC16 | I/O |
| 2 | IP_2 | AC17 | INPUT |
| 2 | IO_L40N_2 | AC19 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | IO_L41N_2 | AC20 | I/O |
| 2 | IO_L45N_2 | AC21 | I/O |
| 2 | IO_2 | AC22 | I/O |
| 2 | IP_2/VREF_2 | AB6 | VREF |
| 2 | IO_L14N_2 | AB7 | I/O |
| 2 | IO_L15P_2 | AB9 | I/O |
| 2 | IO_L21P_2 | AB12 | I/O |
| 2 | IP_2 | AB13 | INPUT |
| 2 | IO_L30N_2/MOSI/CSI_B | AB15 | DUAL |
| 2 | IO_L38N_2 | AB16 | I/O |
| 2 | IO_L47P_2 | AB18 | I/O |
| 2 | IO_L02N_2/CSO_B | AA7 | DUAL |
| 2 | IP_2/VREF_2 | AA9 | VREF |
| 2 | IO_L12N_2 | AA10 | I/O |
| 2 | IO_L17N_2/VS2 | AA12 | DUAL |
| 2 | IO_L25P_2/GCLK12 | AA13 | GCLK |
| 2 | IO_L27N_2/GCLK1 | AA14 | GCLK |
| 2 | IO_L34P_2/INIT_B | AA15 | DUAL |
| 2 | IO_L43P_2 | AA17 | I/O |
| 2 | IO_L47N_2 | AA18 | I/O |
| 2 | IP_2/VREF_2 | AA20 | VREF |
| 2 | IP_2 | AD5 | INPUT |
| 2 | IP_2 | AD23 | INPUT |
| 2 | IP_2 | AC5 | INPUT |
| 2 | IP_2 | AC7 | INPUT |
| 2 | IP_2 | AC18 | INPUT |
| 2 | IP_2/VREF_2 | AB10 | VREF |
| 2 | IP_2 | AB20 | INPUT |
| 2 | IP_2 | AA19 | INPUT |
| 2 | IP_2 | AF2 | INPUT |
| 2 | IP_2 | AB17 | INPUT |
| 2 | IP_2 | Y8 | INPUT |
| 2 | IP_2 | Y11 | INPUT |
| 2 | IP_2 | Y18 | INPUT |
| 2 | IP_2/VREF_2 | Y19 | VREF |
| 2 | IP_2 | W18 | INPUT |
| 2 | IP_2 | AA8 | INPUT |
| 2 | VCCO_2 | W11 | VCCO |
| 2 | VCCO_2 | W16 | VCCO |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | VCCO_2 | AE5 | VCCO |
| 2 | VCCO_2 | AE11 | VCCO |
| 2 | VCCO_2 | AE16 | VCCO |
| 2 | VCCO_2 | AE22 | VCCO |
| 2 | VCCO_2 | AB8 | VCCO |
| 2 | VCCO_2 | AB14 | VCCO |
| 2 | VCCO_2 | AB19 | VCCO |
| 3 | IO_L53P_3 | Y1 | I/O |
| 3 | IO_L53N_3 | Y2 | I/O |
| 3 | IP_L54P_3 | Y3 | INPUT |
| 3 | IO_L57P_3 | Y5 | I/O |
| 3 | IO_L57N_3 | Y6 | I/O |
| 3 | IP_L50P_3 | W1 | INPUT |
| 3 | IP_L50N_3/VREF_3 | W2 | VREF |
| 3 | IO_L52P_3 | W3 | I/O |
| 3 | IO_L52N_3 | W4 | I/O |
| 3 | IO_L63N_3 | W6 | I/O |
| 3 | IO_L63P_3 | W7 | I/O |
| 3 | IO_L47P_3 | V1 | I/O |
| 3 | IO_L47N_3 | V2 | I/O |
| 3 | IP_L46N_3 | V4 | INPUT |
| 3 | IO_L49N_3 | V5 | I/O |
| 3 | IO_L59N_3 | V6 | I/O |
| 3 | IO_L59P_3 | V7 | I/O |
| 3 | IO_L61N_3 | V8 | I/O |
| 3 | IO_L44P_3 | U1 | I/O |
| 3 | IO_L44N_3 | U2 | I/O |
| 3 | IP_L46P_3 | U3 | INPUT |
| 3 | IO_L42N_3 | U4 | I/O |
| 3 | IO_L49P_3 | U5 | I/O |
| 3 | IO_L51N_3 | U6 | I/O |
| 3 | IO_L56P_3 | U7 | I/O |
| 3 | IO_L56N_3 | U8 | I/O |
| 3 | IO_L61P_3 | U9 | I/O |
| 3 | IO_L38P_3 | T3 | I/O |
| 3 | IO_L38N_3 | T4 | I/O |
| 3 | IO_L42P_3 | T5 | I/O |
| 3 | IO_L51P_3 | T7 | I/O |
| 3 | IO_L48N_3 | T9 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 3 | IO_L48P_3 | T10 | I/O |
| 3 | IO_L36P_3/VREF_3 | R1 | VREF |
| 3 | IO_L36N_3 | R2 | I/O |
| 3 | IO_L37P_3 | R3 | I/O |
| 3 | IO_L37N_3 | R4 | I/O |
| 3 | IO_L40P_3 | R5 | I/O |
| 3 | IO_L40N_3 | R6 | I/O |
| 3 | IO_L45N_3 | R7 | I/O |
| 3 | IO_L45P_3 | R8 | I/O |
| 3 | IO_L43N_3 | R9 | I/O |
| 3 | IO_L43P_3/VREF_3 | R10 | VREF |
| 3 | IO_L33P_3/LHCLK2 | P1 | LHCLK |
| 3 | IO_L33N_3/IRDY2/LHCLK3 | P2 | LHCLK |
| 3 | IO_L34N_3/LHCLK5 | P3 | LHCLK |
| 3 | IO_L34P_3/LHCLK4 | P4 | LHCLK |
| 3 | IO_L39N_3 | P6 | I/O |
| 3 | IO_L39P_3 | P7 | I/O |
| 3 | IO_L41P_3 | P8 | I/O |
| 3 | IO_L41N_3 | P9 | I/O |
| 3 | IO_L35N_3/LHCLK7 | P10 | LHCLK |
| 3 | IO_L31P_3 | N1 | I/O |
| 3 | IO_L31N_3 | N2 | I/O |
| 3 | IO_L30N_3 | N4 | I/O |
| 3 | IO_L30P_3 | N5 | I/O |
| 3 | IO_L32P_3/LHCLK0 | N6 | LHCLK |
| 3 | IO_L32N_3/LHCLK1 | N7 | LHCLK |
| 3 | IO_L35P_3/TRDY2/LHCLK6 | N9 | LHCLK |
| 3 | IO_L29N_3/VREF_3 | M1 | VREF |
| 3 | IO_L29P_3 | M2 | I/O |
| 3 | IO_L27N_3 | M3 | I/O |
| 3 | IO_L27P_3 | M4 | I/O |
| 3 | IO_L28P_3 | M5 | I/O |
| 3 | IO_L28N_3 | M6 | I/O |
| 3 | IO_L26N_3 | M7 | I/O |
| 3 | IO_L26P_3 | M8 | I/O |
| 3 | IO_L21N_3 | M9 | I/O |
| 3 | IO_L21P_3 | M10 | I/O |
| 3 | IO_L25N_3 | L3 | I/O |
| 3 | IO_L25P_3 | L4 | I/O |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 3 | IO_L18N_3 | L7 | I/O |
| 3 | IO_L15N_3 | L9 | I/O |
| 3 | IO_L15P_3 | L10 | I/O |
| 3 | IP_L24N_3 | K1 | INPUT |
| 3 | IO_L23N_3 | K2 | I/O |
| 3 | IO_L23P_3 | K3 | I/O |
| 3 | IO_L22N_3 | K4 | I/O |
| 3 | IO_L22P_3 | K5 | I/O |
| 3 | IO_L18P_3 | K6 | I/O |
| 3 | IO_L13P_3 | K7 | I/O |
| 3 | IO_L05N_3 | K8 | I/O |
| 3 | IO_L05P_3 | K9 | I/O |
| 3 | IP_L24P_3 | J1 | INPUT |
| 3 | IP_L20N_3/VREF_3 | J2 | VREF |
| 3 | IP_L20P_3 | J3 | INPUT |
| 3 | IO_L19N_3 | J4 | I/O |
| 3 | IO_L19P_3 | J5 | I/O |
| 3 | IO_L13N_3 | J6 | I/O |
| 3 | IO_L10P_3 | J7 | I/O |
| 3 | IO_L01P_3 | J8 | I/O |
| 3 | IO_L01N_3 | J9 | I/O |
| 3 | IO_L17N_3 | H1 | I/O |
| 3 | IO_L17P_3 | H2 | I/O |
| 3 | IP_L12N_3/VREF_3 | H4 | VREF |
| 3 | IO_L10N_3 | H6 | I/O |
| 3 | IO_L03N_3 | H7 | I/O |
| 3 | IP_L16N_3 | G1 | INPUT |
| 3 | IO_L14P_3 | G3 | I/O |
| 3 | IO_L09N_3 | G4 | I/O |
| 3 | IO_L03P_3 | G6 | I/O |
| 3 | IO_L11N_3 | F2 | I/O |
| 3 | IO_L14N_3 | F3 | I/O |
| 3 | IO_L07N_3 | F4 | I/O |
| 3 | IO_L09P_3 | F5 | I/O |
| 3 | IO_L11P_3 | E1 | I/O |
| 3 | IO_L07P_3 | E3 | I/O |
| 3 | IO_L06N_3 | E4 | I/O |
| 3 | IO_L06P_3 | D3 | I/O |
| 3 | IP_L04N_3/VREF_3 | C1 | VREF |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 3 | IP_L04P_3 | C2 | INPUT |
| 3 | IO_L02N_3 | B1 | I/O |
| 3 | IO_L02P_3 | B2 | I/O |
| 3 | IP_L66P_3 | AE1 | INPUT |
| 3 | IP_L66N_3/VREF_3 | AE2 | VREF |
| 3 | IO_L65P_3 | AD1 | I/O |
| 3 | IO_L65N_3 | AD2 | I/O |
| 3 | IO_L60N_3 | AC1 | I/O |
| 3 | IO_L64P_3 | AC2 | I/O |
| 3 | IO_L64N_3 | AC3 | I/O |
| 3 | IO_L60P_3 | AB1 | I/O |
| 3 | IO_L55P_3 | AA2 | I/O |
| 3 | IO_L55N_3 | AA3 | I/O |
| 3 | IP_L58N_3/VREF_3 | AA5 | VREF |
| 3 | IP_L16P_3 | G2 | INPUT |
| 3 | IP_L12P_3 | G5 | INPUT |
| 3 | IP_L08P_3 | D2 | INPUT |
| 3 | IP_L62P_3 | AB3 | INPUT |
| 3 | IP_L58P_3 | AA4 | INPUT |
| 3 | IP_L08N_3 | D1 | INPUT |
| 3 | IP_L62N_3 | AB4 | INPUT |
| 3 | IP_L54N_3 | Y4 | INPUT |
| 3 | VCCO_3 | W5 | VCCO |
| 3 | VCCO_3 | T2 | VCCO |
| 3 | VCCO_3 | T8 | VCCO |
| 3 | VCCO_3 | P5 | VCCO |
| 3 | VCCO_3 | L2 | VCCO |
| 3 | VCCO_3 | L8 | VCCO |
| 3 | VCCO_3 | H5 | VCCO |
| 3 | VCCO_3 | E2 | VCCO |
| 3 | VCCO_3 | AB2 | VCCO |
| GND | GND | W8 | GND |
| GND | GND | W14 | GND |
| GND | GND | W19 | GND |
| GND | GND | W24 | GND |
| GND | GND | V3 | GND |
| GND | GND | U10 | GND |
| GND | GND | U13 | GND |
| GND | GND | U17 | GND |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| GND | GND | T1 | GND |
| GND | GND | T6 | GND |
| GND | GND | T12 | GND |
| GND | GND | T14 | GND |
| GND | GND | T16 | GND |
| GND | GND | T21 | GND |
| GND | GND | T26 | GND |
| GND | GND | R11 | GND |
| GND | GND | R13 | GND |
| GND | GND | R15 | GND |
| GND | GND | P12 | GND |
| GND | GND | P16 | GND |
| GND | GND | P19 | GND |
| GND | GND | P24 | GND |
| GND | GND | N3 | GND |
| GND | GND | N8 | GND |
| GND | GND | N11 | GND |
| GND | GND | N15 | GND |
| GND | GND | M12 | GND |
| GND | GND | M14 | GND |
| GND | GND | M16 | GND |
| GND | GND | L1 | GND |
| GND | GND | L6 | GND |
| GND | GND | L11 | GND |
| GND | GND | L13 | GND |
| GND | GND | L15 | GND |
| GND | GND | L21 | GND |
| GND | GND | L26 | GND |
| GND | GND | K10 | GND |
| GND | GND | K17 | GND |
| GND | GND | J24 | GND |
| GND | GND | H3 | GND |
| GND | GND | H8 | GND |
| GND | GND | H14 | GND |
| GND | GND | H19 | GND |
| GND | GND | F1 | GND |
| GND | GND | F6 | GND |
| GND | GND | F11 | GND |
| GND | GND | F16 | GND |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| GND | GND | F21 | GND |
| GND | GND | F26 | GND |
| GND | GND | C3 | GND |
| GND | GND | C9 | GND |
| GND | GND | C14 | GND |
| GND | GND | C19 | GND |
| GND | GND | C24 | GND |
| GND | GND | AF1 | GND |
| GND | GND | AF6 | GND |
| GND | GND | AF11 | GND |
| GND | GND | AF16 | GND |
| GND | GND | AF21 | GND |
| GND | GND | AF26 | GND |
| GND | GND | AD3 | GND |
| GND | GND | AD8 | GND |
| GND | GND | AD13 | GND |
| GND | GND | AD18 | GND |
| GND | GND | AD24 | GND |
| GND | GND | AA1 | GND |
| GND | GND | AA6 | GND |
| GND | GND | AA11 | GND |
| GND | GND | AA16 | GND |
| GND | GND | AA21 | GND |
| GND | GND | AA26 | GND |
| GND | GND | A1 | GND |
| GND | GND | A6 | GND |
| GND | GND | A11 | GND |
| GND | GND | A16 | GND |
| GND | GND | A21 | GND |
| GND | GND | A26 | GND |
| VCCAUX | SUSPEND | V20 | PWRMGMT |
| VCCAUX | DONE | AB21 | CONFIG |
| VCCAUX | PROG_B | A2 | CONFIG |
| VCCAUX | TDI | G7 | JTAG |
| VCCAUX | TDO | E23 | JTAG |
| VCCAUX | TMS | D4 | JTAG |
| VCCAUX | TCK | A25 | JTAG |
| VCCAUX | VCCAUX | V9 | VCCAUX |
| VCCAUX | VCCAUX | U14 | VCCAUX |

*Table 66:* **Spartan-3A DSP FG676 Pinout for XC3SD1800A FPGA *(Cont'd)***

| Bank | XC3SD1800A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| VCCAUX | VCCAUX | T22 | VCCAUX |
| VCCAUX | VCCAUX | P17 | VCCAUX |
| VCCAUX | VCCAUX | N10 | VCCAUX |
| VCCAUX | VCCAUX | L5 | VCCAUX |
| VCCAUX | VCCAUX | K13 | VCCAUX |
| VCCAUX | VCCAUX | J18 | VCCAUX |
| VCCAUX | VCCAUX | E5 | VCCAUX |
| VCCAUX | VCCAUX | E16 | VCCAUX |
| VCCAUX | VCCAUX | E22 | VCCAUX |
| VCCAUX | VCCAUX | AB5 | VCCAUX |
| VCCAUX | VCCAUX | AB11 | VCCAUX |
| VCCAUX | VCCAUX | AB22 | VCCAUX |
| VCCINT | VCCINT | U12 | VCCINT |
| VCCINT | VCCINT | T11 | VCCINT |
| VCCINT | VCCINT | T13 | VCCINT |
| VCCINT | VCCINT | T15 | VCCINT |
| VCCINT | VCCINT | R12 | VCCINT |
| VCCINT | VCCINT | R14 | VCCINT |
| VCCINT | VCCINT | R16 | VCCINT |
| VCCINT | VCCINT | P11 | VCCINT |
| VCCINT | VCCINT | P13 | VCCINT |
| VCCINT | VCCINT | P14 | VCCINT |
| VCCINT | VCCINT | P15 | VCCINT |
| VCCINT | VCCINT | N12 | VCCINT |
| VCCINT | VCCINT | N13 | VCCINT |
| VCCINT | VCCINT | N14 | VCCINT |
| VCCINT | VCCINT | N16 | VCCINT |
| VCCINT | VCCINT | M11 | VCCINT |
| VCCINT | VCCINT | M13 | VCCINT |
| VCCINT | VCCINT | M15 | VCCINT |
| VCCINT | VCCINT | M17 | VCCINT |
| VCCINT | VCCINT | L12 | VCCINT |
| VCCINT | VCCINT | L14 | VCCINT |
| VCCINT | VCCINT | L16 | VCCINT |
| VCCINT | VCCINT | K15 | VCCINT |

## User I/Os by Bank

Table 67 indicates how the available user-I/O pins are distributed between the four I/O banks on the FG676 package. The AWAKE pin is counted as a dual-purpose I/O.

*Table 67:* **User I/Os Per Bank for the XC3SD1800A in the FG676 Package**

| Package Edge | I/O Bank | Maximum I/Os and Input-Only | All Possible I/O Pins by Type | | | | |
|---|---|---|---|---|---|---|---|
| | | | I/O | INPUT | DUAL | VREF[1] | CLK |
| Top | 0 | 128 | 82 | 28 | 1 | 9 | 8 |
| Right | 1 | 130 | 67 | 15 | 30 | 10 | 8 |
| Bottom | 2 | 129 | 68 | 21 | 21 | 11 | 8 |
| Left | 3 | 132 | 97 | 18 | 0 | 9 | 8 |
| **TOTAL** | | **519** | **314** | **82** | **52** | **39** | **32** |

**Notes:**

1. 28 VREF are on INPUT pins.

## FG676 Footprint – XC3SD1800A FPGA

### *Left Half of Package (Top View)*

314 **I/O:** Unrestricted, general-purpose user I/O.

82 **INPUT:** Unrestricted, general-purpose input pin.

51 **DUAL:** Configuration pins, then possible user I/O.

39 **VREF:** User I/O or input voltage reference for bank.

32 **CLK:** User I/O, input, or clock buffer input.

2 **CONFIG:** Dedicated configuration pins.

4 **JTAG:** Dedicated JTAG port pins.

2 **SUSPEND:** Dedicated SUSPEND and dual-purpose AWAKE Power Management pins

77 **GND:** Ground

36 **VCCO:** Output voltage supply for bank.

23 **VCCINT:** Internal core supply voltage (+1.2V).

14 **VCCAUX:** Auxiliary supply voltage.

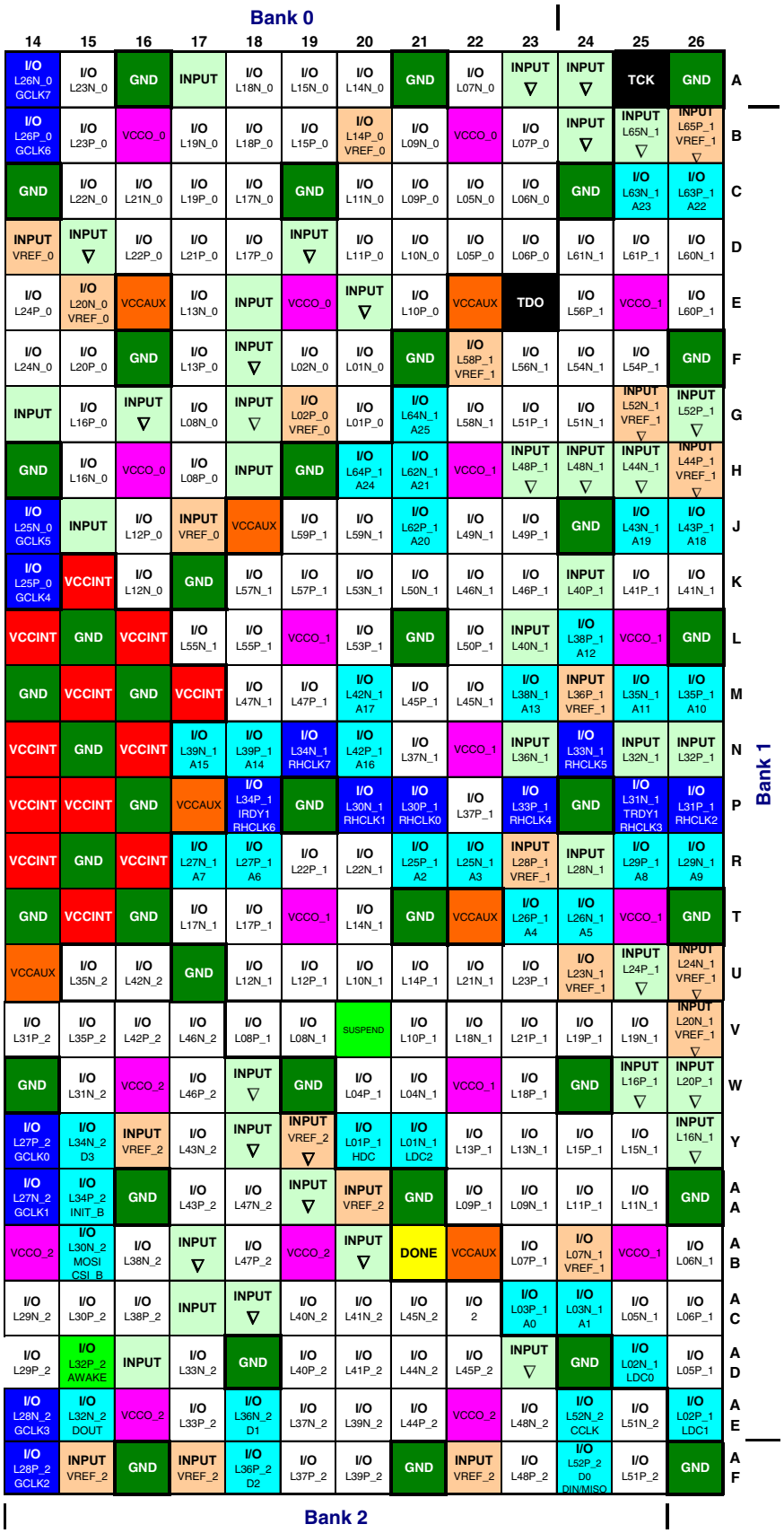
***Note:*** The boxes with triangles inside indicate pin differences from the XC3SD3400A device. Please see the Footprint Migration Differences section for more information.

| | Bank 0 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| A | GND | PROG_B | I/O L51P_0 | I/O L45P_0 | INPUT ▽ | GND | INPUT ▽ | I/O L38P_0 | I/O L36P_0 | I/O L33P_0 | GND | I/O L29P_0 | INPUT |
| B | I/O L02N_3 | I/O L02P_3 | I/O L51N_0 | I/O L45N_0 | VCCO_0 | I/O L41P_0 | I/O L42P_0 | I/O L38N_0 | I/O L36N_0 | I/O L33N_0 | VCCO_0 | I/O L29N_0 | I/O L28P_0 GCLK10 |
| C | INPUT L04N_3 VREF_3 ▽ | INPUT L04P_3 ▽ | GND | INPUT ▽ | I/O L44P_0 | I/O L41N_0 | I/O L42N_0 | I/O L40P_0 | GND | I/O L34P_0 | I/O L32P_0 | I/O L30N_0 | I/O L28N_0 GCLK11 |
| D | INPUT L08N_3 ▽ | INPUT L08P_3 ▽ | I/O L06P_3 | TMS | INPUT ▽ | I/O L44N_0 | INPUT VREF_0 | I/O L40N_0 | I/O L37N_0 | I/O L34N_0 | I/O L32N_0 VREF_0 | INPUT | I/O L30P_0 |
| E | I/O L11P_3 | VCCO_3 | I/O L07P_3 | I/O L06N_3 | VCCAUX | INPUT ▽ | I/O L48N_0 | VCCO_0 | INPUT ▽ | I/O L37P_0 | INPUT | I/O L31P_0 | VCCO_0 |
| F | GND | I/O L11N_3 | I/O L14N_3 | I/O L07N_3 | I/O L09P_3 | GND | I/O L48P_0 | I/O L52P_0 VREF_0 | INPUT ▽ | INPUT ▽ | GND | I/O L31N_0 | I/O L27P_0 GCLK8 |
| G | INPUT L16N_3 ▽ | INPUT L16P_3 ▽ | I/O L14P_3 | I/O L09N_3 | INPUT L12P_3 ▽ | I/O L03P_3 | TDI | I/O L52N_0 PUDC_B | I/O L47P_0 | I/O L46P_0 | INPUT VREF_0 | I/O L35P_0 | I/O L27N_0 GCLK9 |
| H | I/O L17N_3 | I/O L17P_3 | GND | INPUT L12N_3 VREF_3 ▽ | VCCO_3 | I/O L10N_3 | I/O L03N_3 | GND | I/O L47N_0 | I/O L46N_0 | VCCO_0 | I/O L35N_0 | INPUT |
| J | INPUT L24P_3 | INPUT L20N_3 VREF_3 | INPUT L20P_3 | I/O L19N_3 | I/O L19P_3 | I/O L13N_3 | I/O L10P_3 | I/O L01P_3 | I/O L01N_3 | INPUT | I/O L43P_0 | I/O L39P_0 | INPUT |
| K | INPUT L24N_3 | I/O L23N_3 | I/O L23P_3 | I/O L22N_3 | I/O L22P_3 | I/O L18P_3 | I/O L13P_3 | I/O L05N_3 | I/O L05P_3 | GND | I/O L43N_0 | I/O L39N_0 | VCCAUX |
| L | GND | VCCO_3 | I/O L25N_3 | I/O L25P_3 | VCCAUX | GND | I/O L18N_3 | VCCO_3 | I/O L15N_3 | I/O L15P_3 | GND | VCCINT | GND |
| M | I/O L29N_3 VREF_3 | I/O L29P_3 | I/O L27N_3 | I/O L27P_3 | I/O L28P_3 | I/O L28N_3 | I/O L26N_3 | I/O L26P_3 | I/O L21N_3 | I/O L21P_3 | VCCINT | GND | VCCINT |
| N | I/O L31P_3 | I/O L31N_3 | GND | I/O L30N_3 | I/O L30P_3 | I/O L32P_3 LHCLK0 | I/O L32N_3 LHCLK1 | GND | I/O L35P_3 TRDY2 LHCLK6 | VCCAUX | GND | VCCINT | VCCINT |
| P | I/O L33P_3 LHCLK2 | I/O L33N_3 IRDY2 LHCLK3 | I/O L34N_3 LHCLK5 | I/O L34P_3 LHCLK4 | VCCO_3 | I/O L39N_3 | I/O L39P_3 | I/O L41P_3 | I/O L41N_3 | I/O L35N_3 LHCLK7 | VCCINT | GND | VCCINT |
| R | I/O L36P_3 VREF_3 | I/O L36N_3 | I/O L37P_3 | I/O L37N_3 | I/O L40P_3 | I/O L40N_3 | I/O L45N_3 | I/O L45P_3 | I/O L43N_3 | I/O L43P_3 VREF_3 | GND | VCCINT | GND |
| T | GND | VCCO_3 | I/O L38P_3 | I/O L38N_3 | I/O L42P_3 | GND | I/O L51P_3 | VCCO_3 | I/O L48N_3 | I/O L48P_3 | VCCINT | GND | VCCINT |
| U | I/O L44P_3 | I/O L44N_3 | INPUT L46P_3 | I/O L42N_3 | I/O L49P_3 | I/O L51N_3 | I/O L56P_3 | I/O L56N_3 | I/O L61P_3 | GND | I/O L13N_2 | VCCINT | GND |
| V | I/O L47P_3 | I/O L47N_3 | GND | INPUT L46N_3 | I/O L49N_3 | I/O L59N_3 | I/O L59P_3 | I/O L61N_3 | VCCAUX | I/O L09P_2 | I/O L13P_2 | I/O L16P_2 | I/O L20P_2 |
| W | INPUT L50P_3 | INPUT L50N_3 VREF_3 | I/O L52P_3 | I/O L52N_3 | VCCO_3 | I/O L63N_3 | I/O L63P_3 | GND | I/O L05P_2 | I/O L09N_2 | VCCO_2 | I/O L16N_2 | I/O L20N_2 |
| Y | I/O L53P_3 | I/O L53N_3 | INPUT L54P_3 ▽ | INPUT L54N_3 ▽ | I/O L57P_3 | I/O L57N_3 | I/O L02P_2 M2 | INPUT ▽ | I/O L05N_2 | I/O L12P_2 | INPUT ▽ | I/O L17P_2 RDWR_B | I/O L25N_2 GCLK13 |
| AA | GND | I/O L55P_3 | I/O L55N_3 | INPUT L58P_3 ▽ | INPUT L58N_3 VREF_3 ▽ | GND | I/O L02N_2 CSO_B | INPUT ▽ | INPUT VREF_2 | I/O L12N_2 | GND | I/O L17N_2 VS2 | I/O L25P_2 GCLK12 |
| AB | I/O L60P_3 | VCCO_3 | INPUT L62P_3 ▽ | INPUT L62N_3 ▽ | VCCAUX | INPUT VREF_2 | I/O L14N_2 | VCCO_2 | I/O L15P_2 | INPUT VREF_2 ▽ | VCCAUX | I/O L21P_2 | INPUT |
| AC | I/O L60N_3 | I/O L64P_3 | I/O L64N_3 | I/O L01P_2 M1 | INPUT ▽ | I/O L08P_2 | INPUT ▽ | I/O L14P_2 | I/O L15N_2 | INPUT VREF_2 | I/O L23N_2 | I/O L21N_2 | INPUT |
| AD | I/O L65P_3 | I/O L65N_3 | GND | I/O L01N_2 M0 | INPUT ▽ | I/O L08N_2 | I/O L11P_2 | GND | INPUT | INPUT | I/O L23P_2 | INPUT VREF_2 | GND |
| AE | INPUT L66P_3 | INPUT L66N_3 VREF_3 | I/O L06P_2 | I/O L07P_2 | VCCO_2 | I/O L10N_2 | I/O L11N_2 | I/O L18P_2 | I/O L19P_2 VS1 | I/O L22P_2 D7 | VCCO_2 | I/O L24N_2 D4 | I/O L26N_2 GCLK15 |
| AF | GND | INPUT ▽ | I/O L06N_2 | I/O L07N_2 | I/O L10P_2 | GND | INPUT ▽ | I/O L18N_2 | I/O L19N_2 VS0 | I/O L22N_2 D6 | GND | I/O L24P_2 D5 | I/O L26P_2 GCLK14 |

Bank 3

Bank 2

*Figure 16:* **FG676 Package Footprint for XC3SD1800A FPGA (Top View–Left Half)**




***Right Half of FG676 Package (Top View)***

**Figure 17: FG676 Package Footprint for XC3SD1800A FPGA (Top View–Right Half)**

## XC3SD3400A FPGA

Table 68 lists all the FG676 package pins for the XC3SD3400A FPGA. They are sorted by bank number and then by pin name. Pairs of pins that form a differential I/O pair appear together in the table. Table 68 also shows the pin number for each pin and the pin type, as defined earlier.

An electronic version of this package pinout table and footprint diagram is available for download from the Xilinx website at: www.xilinx.com/support/documentation/data_sheets/s3a_pin.zip.

### Pinout Table

***Note:*** The grayed boxes denote a difference between the XC3SD1800A and the XC3SD3400A devices.

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA**

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L43N_0 | K11 | I/O |
| 0 | IO_L39N_0 | K12 | I/O |
| 0 | IO_L25P_0/GCLK4 | K14 | GCLK |
| 0 | IO_L12N_0 | K16 | I/O |
| 0 | IP_0 | J10 | INPUT |
| 0 | IO_L43P_0 | J11 | I/O |
| 0 | IO_L39P_0 | J12 | I/O |
| 0 | IP_0 | J13 | INPUT |
| 0 | IO_L25N_0/GCLK5 | J14 | GCLK |
| 0 | IP_0 | J15 | INPUT |
| 0 | IO_L12P_0 | J16 | I/O |
| 0 | IP_0/VREF_0 | J17 | VREF |
| 0 | IO_L47N_0 | H9 | I/O |
| 0 | IO_L46N_0 | H10 | I/O |
| 0 | IO_L35N_0 | H12 | I/O |
| 0 | IP_0 | H13 | INPUT |
| 0 | IO_L16N_0 | H15 | I/O |
| 0 | IO_L08P_0 | H17 | I/O |
| 0 | IP_0 | H18 | INPUT |
| 0 | IO_L52N_0/PUDC_B | G8 | DUAL |
| 0 | IO_L47P_0 | G9 | I/O |
| 0 | IO_L46P_0 | G10 | I/O |
| 0 | IP_0/VREF_0 | G11 | VREF |
| 0 | IO_L35P_0 | G12 | I/O |
| 0 | IO_L27N_0/GCLK9 | G13 | GCLK |
| 0 | IP_0 | G14 | INPUT |
| 0 | IO_L16P_0 | G15 | I/O |
| 0 | IO_L08N_0 | G17 | I/O |
| 0 | IO_L02P_0/VREF_0 | G19 | VREF |
| 0 | IO_L01P_0 | G20 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L48P_0 | F7 | I/O |
| 0 | IO_L52P_0/VREF_0 | F8 | VREF |
| 0 | IO_L31N_0 | F12 | I/O |
| 0 | IO_L27P_0/GCLK8 | F13 | GCLK |
| 0 | IO_L24N_0 | F14 | I/O |
| 0 | IO_L20P_0 | F15 | I/O |
| 0 | IO_L13P_0 | F17 | I/O |
| 0 | IO_L02N_0 | F19 | I/O |
| 0 | IO_L01N_0 | F20 | I/O |
| 0 | IO_L48N_0 | E7 | I/O |
| 0 | IO_L37P_0 | E10 | I/O |
| 0 | IP_0 | E11 | INPUT |
| 0 | IO_L31P_0 | E12 | I/O |
| 0 | IO_L24P_0 | E14 | I/O |
| 0 | IO_L20N_0/VREF_0 | E15 | VREF |
| 0 | IO_L13N_0 | E17 | I/O |
| 0 | IP_0 | E18 | INPUT |
| 0 | IO_L10P_0 | E21 | I/O |
| 0 | IO_L44N_0 | D6 | I/O |
| 0 | IP_0/VREF_0 | D7 | VREF |
| 0 | IO_L40N_0 | D8 | I/O |
| 0 | IO_L37N_0 | D9 | I/O |
| 0 | IO_L34N_0 | D10 | I/O |
| 0 | IO_L32N_0/VREF_0 | D11 | VREF |
| 0 | IP_0 | D12 | INPUT |
| 0 | IO_L30P_0 | D13 | I/O |
| 0 | IP_0/VREF_0 | D14 | VREF |
| 0 | IO_L22P_0 | D16 | I/O |
| 0 | IO_L21P_0 | D17 | I/O |
| 0 | IO_L17P_0 | D18 | I/O |
| 0 | IO_L11P_0 | D20 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L10N_0 | D21 | I/O |
| 0 | IO_L05P_0 | D22 | I/O |
| 0 | IO_L06P_0 | D23 | I/O |
| 0 | IO_L44P_0 | C5 | I/O |
| 0 | IO_L41N_0 | C6 | I/O |
| 0 | IO_L42N_0 | C7 | I/O |
| 0 | IO_L40P_0 | C8 | I/O |
| 0 | IO_L34P_0 | C10 | I/O |
| 0 | IO_L32P_0 | C11 | I/O |
| 0 | IO_L30N_0 | C12 | I/O |
| 0 | IO_L28N_0/GCLK11 | C13 | GCLK |
| 0 | IO_L22N_0 | C15 | I/O |
| 0 | IO_L21N_0 | C16 | I/O |
| 0 | IO_L19P_0 | C17 | I/O |
| 0 | IO_L17N_0 | C18 | I/O |
| 0 | IO_L11N_0 | C20 | I/O |
| 0 | IO_L09P_0 | C21 | I/O |
| 0 | IO_L05N_0 | C22 | I/O |
| 0 | IO_L06N_0 | C23 | I/O |
| 0 | IO_L51N_0 | B3 | I/O |
| 0 | IO_L45N_0 | B4 | I/O |
| 0 | IO_L41P_0 | B6 | I/O |
| 0 | IO_L42P_0 | B7 | I/O |
| 0 | IO_L38N_0 | B8 | I/O |
| 0 | IO_L36N_0 | B9 | I/O |
| 0 | IO_L33N_0 | B10 | I/O |
| 0 | IO_L29N_0 | B12 | I/O |
| 0 | IO_L28P_0/GCLK10 | B13 | GCLK |
| 0 | IO_L26P_0/GCLK6 | B14 | GCLK |
| 0 | IO_L23P_0 | B15 | I/O |
| 0 | IO_L19N_0 | B17 | I/O |
| 0 | IO_L18P_0 | B18 | I/O |
| 0 | IO_L15P_0 | B19 | I/O |
| 0 | IO_L14P_0/VREF_0 | B20 | VREF |
| 0 | IO_L09N_0 | B21 | I/O |
| 0 | IO_L07P_0 | B23 | I/O |
| 0 | IO_L51P_0 | A3 | I/O |
| 0 | IO_L45P_0 | A4 | I/O |
| 0 | IO_L38P_0 | A8 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 0 | IO_L36P_0 | A9 | I/O |
| 0 | IO_L33P_0 | A10 | I/O |
| 0 | IO_L29P_0 | A12 | I/O |
| 0 | IP_0 | A13 | INPUT |
| 0 | IO_L26N_0/GCLK7 | A14 | GCLK |
| 0 | IO_L23N_0 | A15 | I/O |
| 0 | IP_0 | A17 | INPUT |
| 0 | IO_L18N_0 | A18 | I/O |
| 0 | IO_L15N_0 | A19 | I/O |
| 0 | IO_L14N_0 | A20 | I/O |
| 0 | IO_L07N_0 | A22 | I/O |
| 0 | VCCO_0 | H11 | VCCO |
| 0 | VCCO_0 | H16 | VCCO |
| 0 | VCCO_0 | E8 | VCCO |
| 0 | VCCO_0 | E13 | VCCO |
| 0 | VCCO_0 | E19 | VCCO |
| 0 | VCCO_0 | B5 | VCCO |
| 0 | VCCO_0 | B11 | VCCO |
| 0 | VCCO_0 | B16 | VCCO |
| 0 | VCCO_0 | B22 | VCCO |
| 0 | VCCO_0 | A7 | VCCO |
| 1 | IO_L01P_1/HDC | Y20 | DUAL |
| 1 | IO_L01N_1/LDC2 | Y21 | DUAL |
| 1 | IO_L13P_1 | Y22 | I/O |
| 1 | IO_L13N_1 | Y23 | I/O |
| 1 | IO_L15P_1 | Y24 | I/O |
| 1 | IO_L15N_1 | Y25 | I/O |
| 1 | IP_1 | Y26 | INPUT |
| 1 | IO_L04P_1 | W20 | I/O |
| 1 | IO_L04N_1 | W21 | I/O |
| 1 | IO_L18P_1 | W23 | I/O |
| 1 | IO_L08P_1 | V18 | I/O |
| 1 | IO_L08N_1 | V19 | I/O |
| 1 | IO_L10P_1 | V21 | I/O |
| 1 | IO_L18N_1 | V22 | I/O |
| 1 | IO_L21P_1 | V23 | I/O |
| 1 | IO_L19P_1 | V24 | I/O |
| 1 | IO_L19N_1 | V25 | I/O |
| 1 | IP_1/VREF_1 | V26 | VREF |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 1 | IO_L12N_1 | U18 | I/O |
| 1 | IO_L12P_1 | U19 | I/O |
| 1 | IO_L10N_1 | U20 | I/O |
| 1 | IO_L14P_1 | U21 | I/O |
| 1 | IO_L21N_1 | U22 | I/O |
| 1 | IO_L23P_1 | U23 | I/O |
| 1 | IO_L23N_1/VREF_1 | U24 | VREF |
| 1 | IP_1/VREF_1 | U26 | VREF |
| 1 | IO_L17N_1 | T17 | I/O |
| 1 | IO_L17P_1 | T18 | I/O |
| 1 | IO_L14N_1 | T20 | I/O |
| 1 | IO_L26P_1/A4 | T23 | DUAL |
| 1 | IO_L26N_1/A5 | T24 | DUAL |
| 1 | IO_L27N_1/A7 | R17 | DUAL |
| 1 | IO_L27P_1/A6 | R18 | DUAL |
| 1 | IO_L22P_1 | R19 | I/O |
| 1 | IO_L22N_1 | R20 | I/O |
| 1 | IO_L25P_1/A2 | R21 | DUAL |
| 1 | IO_L25N_1/A3 | R22 | DUAL |
| 1 | IP_L28P_1/VREF_1 | R23 | VREF |
| 1 | IP_L28N_1 | R24 | INPUT |
| 1 | IO_L29P_1/A8 | R25 | DUAL |
| 1 | IO_L29N_1/A9 | R26 | DUAL |
| 1 | IO_L34P_1/IRDY1/RHCLK6 | P18 | RHCLK |
| 1 | IO_L30N_1/RHCLK1 | P20 | RHCLK |
| 1 | IO_L30P_1/RHCLK0 | P21 | RHCLK |
| 1 | IO_L37P_1 | P22 | I/O |
| 1 | IO_L33P_1/RHCLK4 | P23 | RHCLK |
| 1 | IO_L31N_1/TRDY1/RHCLK3 | P25 | RHCLK |
| 1 | IO_L31P_1/RHCLK2 | P26 | RHCLK |
| 1 | IO_L39N_1/A15 | N17 | DUAL |
| 1 | IO_L39P_1/A14 | N18 | DUAL |
| 1 | IO_L34N_1/RHCLK7 | N19 | RHCLK |
| 1 | IO_L42P_1/A16 | N20 | DUAL |
| 1 | IO_L37N_1 | N21 | I/O |
| 1 | IP_L36N_1 | N23 | INPUT |
| 1 | IO_L33N_1/RHCLK5 | N24 | RHCLK |
| 1 | IP_L32N_1 | N25 | INPUT |
| 1 | IP_L32P_1 | N26 | INPUT |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 1 | IO_L47N_1 | M18 | I/O |
| 1 | IO_L47P_1 | M19 | I/O |
| 1 | IO_L42N_1/A17 | M20 | DUAL |
| 1 | IO_L45P_1 | M21 | I/O |
| 1 | IO_L45N_1 | M22 | I/O |
| 1 | IO_L38N_1/A13 | M23 | DUAL |
| 1 | IP_L36P_1/VREF_1 | M24 | VREF |
| 1 | IO_L35N_1/A11 | M25 | DUAL |
| 1 | IO_L35P_1/A10 | M26 | DUAL |
| 1 | IO_L55N_1 | L17 | I/O |
| 1 | IO_L55P_1 | L18 | I/O |
| 1 | IO_L53P_1 | L20 | I/O |
| 1 | IO_L50P_1 | L22 | I/O |
| 1 | IP_L40N_1 | L23 | INPUT |
| 1 | IO_L38P_1/A12 | L24 | DUAL |
| 1 | IO_L57N_1 | K18 | I/O |
| 1 | IO_L57P_1 | K19 | I/O |
| 1 | IO_L53N_1 | K20 | I/O |
| 1 | IO_L50N_1 | K21 | I/O |
| 1 | IO_L46N_1 | K22 | I/O |
| 1 | IO_L46P_1 | K23 | I/O |
| 1 | IP_L40P_1 | K24 | INPUT |
| 1 | IO_L41P_1 | K25 | I/O |
| 1 | IO_L41N_1 | K26 | I/O |
| 1 | IO_L59P_1 | J19 | I/O |
| 1 | IO_L59N_1 | J20 | I/O |
| 1 | IO_L62P_1/A20 | J21 | DUAL |
| 1 | IO_L49N_1 | J22 | I/O |
| 1 | IO_L49P_1 | J23 | I/O |
| 1 | IO_L43N_1/A19 | J25 | DUAL |
| 1 | IO_L43P_1/A18 | J26 | DUAL |
| 1 | IO_L64P_1/A24 | H20 | DUAL |
| 1 | IO_L62N_1/A21 | H21 | DUAL |
| 1 | IP_1 | H24 | INPUT |
| 1 | IP_1/VREF_1 | H26 | VREF |
| 1 | IO_L64N_1/A25 | G21 | DUAL |
| 1 | IO_L58N_1 | G22 | I/O |
| 1 | IO_L51P_1 | G23 | I/O |
| 1 | IO_L51N_1 | G24 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 1 | IP_1/VREF_1 | G25 | VREF |
| 1 | IO_L58P_1/VREF_1 | F22 | VREF |
| 1 | IO_L56N_1 | F23 | I/O |
| 1 | IO_L54N_1 | F24 | I/O |
| 1 | IO_L54P_1 | F25 | I/O |
| 1 | IO_L56P_1 | E24 | I/O |
| 1 | IO_L60P_1 | E26 | I/O |
| 1 | IO_L61N_1 | D24 | I/O |
| 1 | IO_L61P_1 | D25 | I/O |
| 1 | IO_L60N_1 | D26 | I/O |
| 1 | IO_L63N_1/A23 | C25 | DUAL |
| 1 | IO_L63P_1/A22 | C26 | DUAL |
| 1 | IP_1/VREF_1 | B26 | VREF |
| 1 | IO_L02P_1/LDC1 | AE26 | DUAL |
| 1 | IO_L02N_1/LDC0 | AD25 | DUAL |
| 1 | IO_L05P_1 | AD26 | I/O |
| 1 | IO_L03P_1/A0 | AC23 | DUAL |
| 1 | IO_L03N_1/A1 | AC24 | DUAL |
| 1 | IO_L05N_1 | AC25 | I/O |
| 1 | IO_L06P_1 | AC26 | I/O |
| 1 | IO_L07P_1 | AB23 | I/O |
| 1 | IO_L07N_1/VREF_1 | AB24 | VREF |
| 1 | IO_L06N_1 | AB26 | I/O |
| 1 | IO_L09P_1 | AA22 | I/O |
| 1 | IO_L09N_1 | AA23 | I/O |
| 1 | IO_L11P_1 | AA24 | I/O |
| 1 | IO_L11N_1 | AA25 | I/O |
| 1 | VCCO_1 | W22 | VCCO |
| 1 | VCCO_1 | T19 | VCCO |
| 1 | VCCO_1 | T25 | VCCO |
| 1 | VCCO_1 | N22 | VCCO |
| 1 | VCCO_1 | L19 | VCCO |
| 1 | VCCO_1 | L25 | VCCO |
| 1 | VCCO_1 | H22 | VCCO |
| 1 | VCCO_1 | H25 | VCCO |
| 1 | VCCO_1 | E25 | VCCO |
| 1 | VCCO_1 | AB25 | VCCO |
| 2 | IO_L02P_2/M2 | Y7 | DUAL |
| 2 | IO_L05N_2 | Y9 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | IO_L12P_2 | Y10 | I/O |
| 2 | IO_L17P_2/RDWR_B | Y12 | DUAL |
| 2 | IO_L25N_2/GCLK13 | Y13 | GCLK |
| 2 | IO_L27P_2/GCLK0 | Y14 | GCLK |
| 2 | IO_L34N_2/D3 | Y15 | DUAL |
| 2 | IP_2/VREF_2 | Y16 | VREF |
| 2 | IO_L43N_2 | Y17 | I/O |
| 2 | IO_L05P_2 | W9 | I/O |
| 2 | IO_L09N_2 | W10 | I/O |
| 2 | IO_L16N_2 | W12 | I/O |
| 2 | IO_L20N_2 | W13 | I/O |
| 2 | IO_L31N_2 | W15 | I/O |
| 2 | IO_L46P_2 | W17 | I/O |
| 2 | IO_L09P_2 | V10 | I/O |
| 2 | IO_L13P_2 | V11 | I/O |
| 2 | IO_L16P_2 | V12 | I/O |
| 2 | IO_L20P_2 | V13 | I/O |
| 2 | IO_L31P_2 | V14 | I/O |
| 2 | IO_L35P_2 | V15 | I/O |
| 2 | IO_L42P_2 | V16 | I/O |
| 2 | IO_L46N_2 | V17 | I/O |
| 2 | IO_L13N_2 | U11 | I/O |
| 2 | IO_L35N_2 | U15 | I/O |
| 2 | IO_L42N_2 | U16 | I/O |
| 2 | IO_L06N_2 | AF3 | I/O |
| 2 | IO_L07N_2 | AF4 | I/O |
| 2 | IO_L10P_2 | AF5 | I/O |
| 2 | IO_L18N_2 | AF8 | I/O |
| 2 | IO_L19N_2/VS0 | AF9 | DUAL |
| 2 | IO_L22N_2/D6 | AF10 | DUAL |
| 2 | IO_L24P_2/D5 | AF12 | DUAL |
| 2 | IO_L26P_2/GCLK14 | AF13 | GCLK |
| 2 | IO_L28P_2/GCLK2 | AF14 | GCLK |
| 2 | IP_2/VREF_2 | AF15 | VREF |
| 2 | IP_2/VREF_2 | AF17 | VREF |
| 2 | IO_L36P_2/D2 | AF18 | DUAL |
| 2 | IO_L37P_2 | AF19 | I/O |
| 2 | IO_L39P_2 | AF20 | I/O |
| 2 | IP_2/VREF_2 | AF22 | VREF |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | IO_L48P_2 | AF23 | I/O |
| 2 | IO_L52P_2/D0/DIN/MISO | AF24 | DUAL |
| 2 | IO_L51P_2 | AF25 | I/O |
| 2 | IO_L06P_2 | AE3 | I/O |
| 2 | IO_L07P_2 | AE4 | I/O |
| 2 | IO_L10N_2 | AE6 | I/O |
| 2 | IO_L11N_2 | AE7 | I/O |
| 2 | IO_L18P_2 | AE8 | I/O |
| 2 | IO_L19P_2/VS1 | AE9 | DUAL |
| 2 | IO_L22P_2/D7 | AE10 | DUAL |
| 2 | IO_L24N_2/D4 | AE12 | DUAL |
| 2 | IO_L26N_2/GCLK15 | AE13 | GCLK |
| 2 | IO_L28N_2/GCLK3 | AE14 | GCLK |
| 2 | IO_L32N_2/DOUT | AE15 | DUAL |
| 2 | IO_L33P_2 | AE17 | I/O |
| 2 | IO_L36N_2/D1 | AE18 | DUAL |
| 2 | IO_L37N_2 | AE19 | I/O |
| 2 | IO_L39N_2 | AE20 | I/O |
| 2 | IO_L44P_2 | AE21 | I/O |
| 2 | IO_L48N_2 | AE23 | I/O |
| 2 | IO_L52N_2/CCLK | AE24 | DUAL |
| 2 | IO_L51N_2 | AE25 | I/O |
| 2 | IO_L01N_2/M0 | AD4 | DUAL |
| 2 | IO_L08N_2 | AD6 | I/O |
| 2 | IO_L11P_2 | AD7 | I/O |
| 2 | IP_2 | AD9 | INPUT |
| 2 | IP_2 | AD10 | INPUT |
| 2 | IO_L23P_2 | AD11 | I/O |
| 2 | IP_2/VREF_2 | AD12 | VREF |
| 2 | IO_L29P_2 | AD14 | I/O |
| 2 | IO_L32P_2/AWAKE | AD15 | PWRMGMT |
| 2 | IP_2 | AD16 | INPUT |
| 2 | IO_L33N_2 | AD17 | I/O |
| 2 | IO_L40P_2 | AD19 | I/O |
| 2 | IO_L41P_2 | AD20 | I/O |
| 2 | IO_L44N_2 | AD21 | I/O |
| 2 | IO_L45P_2 | AD22 | I/O |
| 2 | IO_L01P_2/M1 | AC4 | DUAL |
| 2 | IO_L08P_2 | AC6 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | IO_L14P_2 | AC8 | I/O |
| 2 | IO_L15N_2 | AC9 | I/O |
| 2 | IP_2/VREF_2 | AC10 | VREF |
| 2 | IO_L23N_2 | AC11 | I/O |
| 2 | IO_L21N_2 | AC12 | I/O |
| 2 | IP_2 | AC13 | INPUT |
| 2 | IO_L29N_2 | AC14 | I/O |
| 2 | IO_L30P_2 | AC15 | I/O |
| 2 | IO_L38P_2 | AC16 | I/O |
| 2 | IP_2 | AC17 | INPUT |
| 2 | IO_L40N_2 | AC19 | I/O |
| 2 | IO_L41N_2 | AC20 | I/O |
| 2 | IO_L45N_2 | AC21 | I/O |
| 2 | IO_2 | AC22 | I/O |
| 2 | IP_2/VREF_2 | AB6 | VREF |
| 2 | IO_L14N_2 | AB7 | I/O |
| 2 | IO_L15P_2 | AB9 | I/O |
| 2 | IO_L21P_2 | AB12 | I/O |
| 2 | IP_2 | AB13 | INPUT |
| 2 | IO_L30N_2/MOSI/CSI_B | AB15 | DUAL |
| 2 | IO_L38N_2 | AB16 | I/O |
| 2 | IO_L47P_2 | AB18 | I/O |
| 2 | IO_L02N_2/CSO_B | AA7 | DUAL |
| 2 | IP_2/VREF_2 | AA9 | VREF |
| 2 | IO_L12N_2 | AA10 | I/O |
| 2 | IO_L17N_2/VS2 | AA12 | DUAL |
| 2 | IO_L25P_2/GCLK12 | AA13 | GCLK |
| 2 | IO_L27N_2/GCLK1 | AA14 | GCLK |
| 2 | IO_L34P_2/INIT_B | AA15 | DUAL |
| 2 | IO_L43P_2 | AA17 | I/O |
| 2 | IO_L47N_2 | AA18 | I/O |
| 2 | IP_2/VREF_2 | AA20 | VREF |
| 2 | VCCO_2 | W11 | VCCO |
| 2 | VCCO_2 | W16 | VCCO |
| 2 | VCCO_2 | AF7 | VCCO |
| 2 | VCCO_2 | AE5 | VCCO |
| 2 | VCCO_2 | AE11 | VCCO |
| 2 | VCCO_2 | AE16 | VCCO |
| 2 | VCCO_2 | AE22 | VCCO |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 2 | VCCO_2 | AB8 | VCCO |
| 2 | VCCO_2 | AB14 | VCCO |
| 2 | VCCO_2 | AB19 | VCCO |
| 3 | IO_L53P_3 | Y1 | I/O |
| 3 | IO_L53N_3 | Y2 | I/O |
| 3 | IP_3 | Y3 | INPUT |
| 3 | IO_L57P_3 | Y5 | I/O |
| 3 | IO_L57N_3 | Y6 | I/O |
| 3 | IP_L50P_3 | W1 | INPUT |
| 3 | IP_L50N_3/VREF_3 | W2 | VREF |
| 3 | IO_L52P_3 | W3 | I/O |
| 3 | IO_L52N_3 | W4 | I/O |
| 3 | IO_L63N_3 | W6 | I/O |
| 3 | IO_L63P_3 | W7 | I/O |
| 3 | IO_L47P_3 | V1 | I/O |
| 3 | IO_L47N_3 | V2 | I/O |
| 3 | IP_L46N_3 | V4 | INPUT |
| 3 | IO_L49N_3 | V5 | I/O |
| 3 | IO_L59N_3 | V6 | I/O |
| 3 | IO_L59P_3 | V7 | I/O |
| 3 | IO_L61N_3 | V8 | I/O |
| 3 | IO_L44P_3 | U1 | I/O |
| 3 | IO_L44N_3 | U2 | I/O |
| 3 | IP_L46P_3 | U3 | INPUT |
| 3 | IO_L42N_3 | U4 | I/O |
| 3 | IO_L49P_3 | U5 | I/O |
| 3 | IO_L51N_3 | U6 | I/O |
| 3 | IO_L56P_3 | U7 | I/O |
| 3 | IO_L56N_3 | U8 | I/O |
| 3 | IO_L61P_3 | U9 | I/O |
| 3 | IO_L38P_3 | T3 | I/O |
| 3 | IO_L38N_3 | T4 | I/O |
| 3 | IO_L42P_3 | T5 | I/O |
| 3 | IO_L51P_3 | T7 | I/O |
| 3 | IO_L48N_3 | T9 | I/O |
| 3 | IO_L48P_3 | T10 | I/O |
| 3 | IO_L36P_3/VREF_3 | R1 | VREF |
| 3 | IO_L36N_3 | R2 | I/O |
| 3 | IO_L37P_3 | R3 | I/O |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 3 | IO_L37N_3 | R4 | I/O |
| 3 | IO_L40P_3 | R5 | I/O |
| 3 | IO_L40N_3 | R6 | I/O |
| 3 | IO_L45N_3 | R7 | I/O |
| 3 | IO_L45P_3 | R8 | I/O |
| 3 | IO_L43N_3 | R9 | I/O |
| 3 | IO_L43P_3/VREF_3 | R10 | VREF |
| 3 | IO_L33P_3/LHCLK2 | P1 | LHCLK |
| 3 | IO_L33N_3/IRDY2/LHCLK3 | P2 | LHCLK |
| 3 | IO_L34N_3/LHCLK5 | P3 | LHCLK |
| 3 | IO_L34P_3/LHCLK4 | P4 | LHCLK |
| 3 | IO_L39N_3 | P6 | I/O |
| 3 | IO_L39P_3 | P7 | I/O |
| 3 | IO_L41P_3 | P8 | I/O |
| 3 | IO_L41N_3 | P9 | I/O |
| 3 | IO_L35N_3/LHCLK7 | P10 | LHCLK |
| 3 | IO_L31P_3 | N1 | I/O |
| 3 | IO_L31N_3 | N2 | I/O |
| 3 | IO_L30N_3 | N4 | I/O |
| 3 | IO_L30P_3 | N5 | I/O |
| 3 | IO_L32P_3/LHCLK0 | N6 | LHCLK |
| 3 | IO_L32N_3/LHCLK1 | N7 | LHCLK |
| 3 | IO_L35P_3/TRDY2/LHCLK6 | N9 | LHCLK |
| 3 | IO_L29N_3/VREF_3 | M1 | VREF |
| 3 | IO_L29P_3 | M2 | I/O |
| 3 | IO_L27N_3 | M3 | I/O |
| 3 | IO_L27P_3 | M4 | I/O |
| 3 | IO_L28P_3 | M5 | I/O |
| 3 | IO_L28N_3 | M6 | I/O |
| 3 | IO_L26N_3 | M7 | I/O |
| 3 | IO_L26P_3 | M8 | I/O |
| 3 | IO_L21N_3 | M9 | I/O |
| 3 | IO_L21P_3 | M10 | I/O |
| 3 | IO_L25N_3 | L3 | I/O |
| 3 | IO_L25P_3 | L4 | I/O |
| 3 | IO_L18N_3 | L7 | I/O |
| 3 | IO_L15N_3 | L9 | I/O |
| 3 | IO_L15P_3 | L10 | I/O |
| 3 | IP_L24N_3 | K1 | INPUT |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 3 | IO_L23N_3 | K2 | I/O |
| 3 | IO_L23P_3 | K3 | I/O |
| 3 | IO_L22N_3 | K4 | I/O |
| 3 | IO_L22P_3 | K5 | I/O |
| 3 | IO_L18P_3 | K6 | I/O |
| 3 | IO_L13P_3 | K7 | I/O |
| 3 | IO_L05N_3 | K8 | I/O |
| 3 | IO_L05P_3 | K9 | I/O |
| 3 | IP_L24P_3 | J1 | INPUT |
| 3 | IP_L20N_3/VREF_3 | J2 | VREF |
| 3 | IP_L20P_3 | J3 | INPUT |
| 3 | IO_L19N_3 | J4 | I/O |
| 3 | IO_L19P_3 | J5 | I/O |
| 3 | IO_L13N_3 | J6 | I/O |
| 3 | IO_L10P_3 | J7 | I/O |
| 3 | IO_L01P_3 | J8 | I/O |
| 3 | IO_L01N_3 | J9 | I/O |
| 3 | IO_L17N_3 | H1 | I/O |
| 3 | IO_L17P_3 | H2 | I/O |
| 3 | IP_3/VREF_3 | H4 | VREF |
| 3 | IO_L10N_3 | H6 | I/O |
| 3 | IO_L03N_3 | H7 | I/O |
| 3 | IP_3 | G1 | INPUT |
| 3 | IO_L14P_3 | G3 | I/O |
| 3 | IO_L09N_3 | G4 | I/O |
| 3 | IO_L03P_3 | G6 | I/O |
| 3 | IO_L11N_3 | F2 | I/O |
| 3 | IO_L14N_3 | F3 | I/O |
| 3 | IO_L07N_3 | F4 | I/O |
| 3 | IO_L09P_3 | F5 | I/O |
| 3 | IO_L11P_3 | E1 | I/O |
| 3 | IO_L07P_3 | E3 | I/O |
| 3 | IO_L06N_3 | E4 | I/O |
| 3 | IO_L06P_3 | D3 | I/O |
| 3 | IP_3/VREF_3 | C1 | VREF |
| 3 | IO_L02N_3 | B1 | I/O |
| 3 | IO_L02P_3 | B2 | I/O |
| 3 | IP_L66P_3 | AE1 | INPUT |
| 3 | IP_L66N_3/VREF_3 | AE2 | VREF |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| 3 | IO_L65P_3 | AD1 | I/O |
| 3 | IO_L65N_3 | AD2 | I/O |
| 3 | IO_L60N_3 | AC1 | I/O |
| 3 | IO_L64P_3 | AC2 | I/O |
| 3 | IO_L64N_3 | AC3 | I/O |
| 3 | IO_L60P_3 | AB1 | I/O |
| 3 | IO_L55P_3 | AA2 | I/O |
| 3 | IO_L55N_3 | AA3 | I/O |
| 3 | IP_3/VREF_3 | AA5 | VREF |
| 3 | VCCO_3 | W5 | VCCO |
| 3 | VCCO_3 | T2 | VCCO |
| 3 | VCCO_3 | T8 | VCCO |
| 3 | VCCO_3 | P5 | VCCO |
| 3 | VCCO_3 | L2 | VCCO |
| 3 | VCCO_3 | L8 | VCCO |
| 3 | VCCO_3 | H5 | VCCO |
| 3 | VCCO_3 | E2 | VCCO |
| 3 | VCCO_3 | C2 | VCCO |
| 3 | VCCO_3 | AB2 | VCCO |
| GND | GND | W8 | GND |
| GND | GND | W14 | GND |
| GND | GND | W19 | GND |
| GND | GND | W24 | GND |
| GND | GND | W25 | GND |
| GND | GND | V3 | GND |
| GND | GND | U10 | GND |
| GND | GND | U13 | GND |
| GND | GND | U17 | GND |
| GND | GND | U25 | GND |
| GND | GND | T1 | GND |
| GND | GND | T6 | GND |
| GND | GND | T12 | GND |
| GND | GND | T14 | GND |
| GND | GND | T16 | GND |
| GND | GND | T21 | GND |
| GND | GND | T26 | GND |
| GND | GND | R11 | GND |
| GND | GND | R13 | GND |
| GND | GND | R15 | GND |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| GND | GND | P12 | GND |
| GND | GND | P16 | GND |
| GND | GND | P19 | GND |
| GND | GND | P24 | GND |
| GND | GND | N3 | GND |
| GND | GND | N8 | GND |
| GND | GND | N11 | GND |
| GND | GND | N15 | GND |
| GND | GND | M12 | GND |
| GND | GND | M14 | GND |
| GND | GND | M16 | GND |
| GND | GND | L1 | GND |
| GND | GND | L6 | GND |
| GND | GND | L11 | GND |
| GND | GND | L13 | GND |
| GND | GND | L15 | GND |
| GND | GND | L21 | GND |
| GND | GND | L26 | GND |
| GND | GND | K10 | GND |
| GND | GND | K17 | GND |
| GND | GND | J24 | GND |
| GND | GND | H3 | GND |
| GND | GND | H8 | GND |
| GND | GND | H14 | GND |
| GND | GND | H19 | GND |
| GND | GND | G2 | GND |
| GND | GND | G5 | GND |
| GND | GND | G16 | GND |
| GND | GND | F1 | GND |
| GND | GND | F6 | GND |
| GND | GND | F11 | GND |
| GND | GND | F16 | GND |
| GND | GND | F21 | GND |
| GND | GND | F26 | GND |
| GND | GND | E9 | GND |
| GND | GND | D2 | GND |
| GND | GND | D15 | GND |
| GND | GND | D19 | GND |
| GND | GND | C3 | GND |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| GND | GND | C9 | GND |
| GND | GND | C14 | GND |
| GND | GND | C19 | GND |
| GND | GND | C24 | GND |
| GND | GND | B24 | GND |
| GND | GND | B25 | GND |
| GND | GND | AF1 | GND |
| GND | GND | AF6 | GND |
| GND | GND | AF11 | GND |
| GND | GND | AF16 | GND |
| GND | GND | AF21 | GND |
| GND | GND | AF26 | GND |
| GND | GND | AD3 | GND |
| GND | GND | AD5 | GND |
| GND | GND | AD8 | GND |
| GND | GND | AD13 | GND |
| GND | GND | AD18 | GND |
| GND | GND | AD23 | GND |
| GND | GND | AD24 | GND |
| GND | GND | AC5 | GND |
| GND | GND | AC7 | GND |
| GND | GND | AC18 | GND |
| GND | GND | AB3 | GND |
| GND | GND | AB10 | GND |
| GND | GND | AB20 | GND |
| GND | GND | AA1 | GND |
| GND | GND | AA4 | GND |
| GND | GND | AA6 | GND |
| GND | GND | AA11 | GND |
| GND | GND | AA16 | GND |
| GND | GND | AA19 | GND |
| GND | GND | AA21 | GND |
| GND | GND | AA26 | GND |
| GND | GND | A1 | GND |
| GND | GND | A5 | GND |
| GND | GND | A6 | GND |
| GND | GND | A11 | GND |
| GND | GND | A16 | GND |
| GND | GND | A21 | GND |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| GND | GND | A23 | GND |
| GND | GND | A26 | GND |
| VCCAUX | SUSPEND | V20 | PWRMGMT |
| VCCAUX | DONE | AB21 | CONFIG |
| VCCAUX | PROG_B | A2 | CONFIG |
| VCCAUX | TDI | G7 | JTAG |
| VCCAUX | TDO | E23 | JTAG |
| VCCAUX | TMS | D4 | JTAG |
| VCCAUX | TCK | A25 | JTAG |
| VCCAUX | VCCAUX | W26 | VCCAUX |
| VCCAUX | VCCAUX | V9 | VCCAUX |
| VCCAUX | VCCAUX | U14 | VCCAUX |
| VCCAUX | VCCAUX | T22 | VCCAUX |
| VCCAUX | VCCAUX | P17 | VCCAUX |
| VCCAUX | VCCAUX | N10 | VCCAUX |
| VCCAUX | VCCAUX | L5 | VCCAUX |
| VCCAUX | VCCAUX | K13 | VCCAUX |
| VCCAUX | VCCAUX | J18 | VCCAUX |
| VCCAUX | VCCAUX | H23 | VCCAUX |
| VCCAUX | VCCAUX | G26 | VCCAUX |
| VCCAUX | VCCAUX | F9 | VCCAUX |
| VCCAUX | VCCAUX | E5 | VCCAUX |
| VCCAUX | VCCAUX | E16 | VCCAUX |
| VCCAUX | VCCAUX | E20 | VCCAUX |
| VCCAUX | VCCAUX | E22 | VCCAUX |
| VCCAUX | VCCAUX | D1 | VCCAUX |
| VCCAUX | VCCAUX | AF2 | VCCAUX |
| VCCAUX | VCCAUX | AB4 | VCCAUX |
| VCCAUX | VCCAUX | AB5 | VCCAUX |
| VCCAUX | VCCAUX | AB11 | VCCAUX |
| VCCAUX | VCCAUX | AB17 | VCCAUX |
| VCCAUX | VCCAUX | AB22 | VCCAUX |
| VCCAUX | VCCAUX | A24 | VCCAUX |
| VCCINT | VCCINT | Y4 | VCCINT |
| VCCINT | VCCINT | Y8 | VCCINT |
| VCCINT | VCCINT | Y11 | VCCINT |
| VCCINT | VCCINT | Y18 | VCCINT |
| VCCINT | VCCINT | Y19 | VCCINT |
| VCCINT | VCCINT | W18 | VCCINT |

*Table 68:* **Spartan-3A DSP FG676 Pinout for XC3SD3400A FPGA *(Cont'd)***

| Bank | XC3SD3400A Pin Name | FG676 Ball | Type |
|---|---|---|---|
| VCCINT | VCCINT | U12 | VCCINT |
| VCCINT | VCCINT | T11 | VCCINT |
| VCCINT | VCCINT | T13 | VCCINT |
| VCCINT | VCCINT | T15 | VCCINT |
| VCCINT | VCCINT | R12 | VCCINT |
| VCCINT | VCCINT | R14 | VCCINT |
| VCCINT | VCCINT | R16 | VCCINT |
| VCCINT | VCCINT | P11 | VCCINT |
| VCCINT | VCCINT | P13 | VCCINT |
| VCCINT | VCCINT | P14 | VCCINT |
| VCCINT | VCCINT | P15 | VCCINT |
| VCCINT | VCCINT | N12 | VCCINT |
| VCCINT | VCCINT | N13 | VCCINT |
| VCCINT | VCCINT | N14 | VCCINT |
| VCCINT | VCCINT | N16 | VCCINT |
| VCCINT | VCCINT | M11 | VCCINT |
| VCCINT | VCCINT | M13 | VCCINT |
| VCCINT | VCCINT | M15 | VCCINT |
| VCCINT | VCCINT | M17 | VCCINT |
| VCCINT | VCCINT | L12 | VCCINT |
| VCCINT | VCCINT | L14 | VCCINT |
| VCCINT | VCCINT | L16 | VCCINT |
| VCCINT | VCCINT | K15 | VCCINT |
| VCCINT | VCCINT | G18 | VCCINT |
| VCCINT | VCCINT | F10 | VCCINT |
| VCCINT | VCCINT | F18 | VCCINT |
| VCCINT | VCCINT | E6 | VCCINT |
| VCCINT | VCCINT | D5 | VCCINT |
| VCCINT | VCCINT | C4 | VCCINT |
| VCCINT | VCCINT | AA8 | VCCINT |

## User I/Os by Bank

Table 69 indicates how the available user-I/O pins are distributed between the four I/O banks on the FG676 package. The AWAKE pin is counted as a dual-purpose I/O.

*Table 69:* **User I/Os Per Bank for the XC3SD3400A in the FG676 Package**

| Package Edge | I/O Bank | Maximum I/Os and Input-Only | All Possible I/O Pins by Type | | | | |
|---|---|---|---|---|---|---|---|
| | | | I/O | INPUT | DUAL | VREF[1] | CLK |
| Top | 0 | 111 | 82 | 11 | 1 | 9 | 8 |
| Right | 1 | 123 | 67 | 8 | 30 | 10 | 8 |
| Bottom | 2 | 112 | 68 | 6 | 21 | 9 | 8 |
| Left | 3 | 123 | 97 | 9 | 0 | 9 | 8 |
| **TOTAL** | | **469** | **314** | **34** | **52** | **37** | **32** |

**Notes:**

1. 26 VREF are on INPUT pins.

## FG676 Footprint – XC3SD3400A FPGA

### *Left Half of Package (Top View)*

314 **I/O:** Unrestricted, general-purpose user I/O.

34 **INPUT:** Unrestricted, general-purpose input pin.

51 **DUAL:** Configuration pins, then possible user I/O.

37 **VREF:** User I/O or input voltage reference for bank.

32 **CLK:** User I/O, input, or clock buffer input.

2 **CONFIG:** Dedicated configuration pins.

2 **SUSPEND:** Dedicated SUSPEND and dual-purpose AWAKE Power Management pins

4 **JTAG:** Dedicated JTAG port pins.

100 **GND:** Ground

40 **VCCO:** Output voltage supply for bank.

36 **VCCINT:** Internal core supply voltage (+1.2V).

24 **VCCAUX:** Auxiliary supply voltage.

***Note:*** The boxes with question marks inside indicate pin differences from the XC3SD1800A device. Please see the Footprint Migration Differences section for more information.

| | Bank 0 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| A | GND | PROG_B | I/O L51P_0 | I/O L45P_0 | GND ▽ | GND | VCCO_0 ▽ | I/O L38P_0 | I/O L36P_0 | I/O L33P_0 | GND | I/O L29P_0 | INPUT |
| B | I/O L02N_3 | I/O L02P_3 | I/O L51N_0 | I/O L45N_0 | VCCO_0 | I/O L41P_0 | I/O L42P_0 | I/O L38N_0 | I/O L36N_0 | I/O L33N_0 | VCCO_0 | I/O L29N_0 | I/O L28P_0 GCLK10 |
| C | INPUT VREF_3 ▽ | VCCO_3 ▽ | GND | VCCINT ▽ | I/O L44P_0 | I/O L41N_0 | I/O L42N_0 | I/O L40P_0 | GND | I/O L34P_0 | I/O L32P_0 | I/O L30N_0 | I/O L28N_0 GCLK11 |
| D | VCCAUX ▽ | GND ▽ | I/O L06P_3 | TMS | VCCINT ▽ | I/O L44N_0 | INPUT VREF_0 | I/O L40N_0 | I/O L37N_0 | I/O L34N_0 | I/O L32N_0 VREF_0 | INPUT | I/O L30P_0 |
| E | I/O L11P_3 | VCCO_3 | I/O L07P_3 | I/O L06N_3 | VCCAUX | VCCINT ▽ | I/O L48N_0 | VCCO_0 | GND ▽ | I/O L37P_0 | INPUT | I/O L31P_0 | VCCO_0 |
| F | GND | I/O L11N_3 | I/O L14N_3 | I/O L07N_3 | I/O L09P_3 | GND | I/O L48P_0 | I/O L52P_0 VREF_0 | VCCAUX ▽ | VCCINT ▽ | GND | I/O L31N_0 | I/O L27P_0 GCLK8 |
| G | INPUT ▽ | GND ▽ | I/O L14P_3 | I/O L09N_3 | GND ▽ | I/O L03P_3 | TDI | I/O L52N_0 PUDC_B | I/O L47P_0 | I/O L46P_0 | INPUT VREF_0 | I/O L35P_0 | I/O L27N_0 GCLK9 |
| H | I/O L17N_3 | I/O L17P_3 | GND | INPUT VREF_3 ▽ | VCCO_3 | I/O L10N_3 | I/O L03N_3 | GND | I/O L47N_0 | I/O L46N_0 | VCCO_0 | I/O L35N_0 | INPUT |
| J | INPUT L24P_3 | INPUT L20N_3 VREF_3 | INPUT L20P_3 | I/O L19N_3 | I/O L19P_3 | I/O L13N_3 | I/O L10P_3 | I/O L01P_3 | I/O L01N_3 | INPUT | I/O L43P_0 | I/O L39P_0 | INPUT |
| K | INPUT L24N_3 | I/O L23N_3 | I/O L23P_3 | I/O L22N_3 | I/O L22P_3 | I/O L18P_3 | I/O L13P_3 | I/O L05N_3 | I/O L05P_3 | GND | I/O L43N_0 | I/O L39N_0 | VCCAUX |
| L | GND | VCCO_3 | I/O L25N_3 | I/O L25P_3 | VCCAUX | GND | I/O L18N_3 | VCCO_3 | I/O L15N_3 | I/O L15P_3 | GND | VCCINT | GND |
| M | I/O L29N_3 VREF_3 | I/O L29P_3 | I/O L27N_3 | I/O L27P_3 | I/O L28P_3 | I/O L28N_3 | I/O L26N_3 | I/O L26P_3 | I/O L21N_3 | I/O L21P_3 | VCCINT | GND | VCCINT |
| N | I/O L31P_3 | I/O L31N_3 | GND | I/O L30N_3 | I/O L30P_3 | I/O L32P_3 LHCLK0 | I/O L32N_3 LHCLK1 | GND | I/O L35P_3 TRDY2 LHCLK6 | VCCAUX | GND | VCCINT | VCCINT |
| P | I/O L33P_3 LHCLK2 | I/O L33N_3 IRDY2 LHCLK3 | I/O L34N_3 LHCLK5 | I/O L34P_3 LHCLK4 | VCCO_3 | I/O L39N_3 | I/O L39P_3 | I/O L41P_3 | I/O L41N_3 | I/O L35N_3 LHCLK7 | VCCINT | GND | VCCINT |
| R | I/O L36P_3 VREF_3 | I/O L36N_3 | I/O L37P_3 | I/O L37N_3 | I/O L40P_3 | I/O L40N_3 | I/O L45N_3 | I/O L45P_3 | I/O L43N_3 | I/O L43P_3 VREF_3 | GND | VCCINT | GND |
| T | GND | VCCO_3 | I/O L38P_3 | I/O L38N_3 | I/O L42P_3 | GND | I/O L51P_3 | VCCO_3 | I/O L48N_3 | I/O L48P_3 | VCCINT | GND | VCCINT |
| U | I/O L44P_3 | I/O L44N_3 | INPUT L46P_3 | I/O L42N_3 | I/O L49P_3 | I/O L51N_3 | I/O L56P_3 | I/O L56N_3 | I/O L61P_3 | GND | I/O L13N_2 | VCCINT | GND |
| V | I/O L47P_3 | I/O L47N_3 | GND | INPUT L46N_3 | I/O L49N_3 | I/O L59N_3 | I/O L59P_3 | I/O L61N_3 | VCCAUX | I/O L09P_2 | I/O L13P_2 | I/O L16P_2 | I/O L20P_2 |
| W | INPUT L50P_3 | INPUT L50N_3 VREF_3 | I/O L52P_3 | I/O L52N_3 | VCCO_3 | I/O L63N_3 | I/O L63P_3 | GND | I/O L05P_2 | I/O L09N_2 | VCCO_2 | I/O L16N_2 | I/O L20N_2 |
| Y | I/O L53P_3 | I/O L53N_3 | INPUT ▽ | VCCINT ▽ | I/O L57P_3 | I/O L57N_3 | I/O L02P_2 M2 | VCCINT ▽ | I/O L05N_2 | I/O L12P_2 | VCCINT ▽ | I/O L17P_2 RDWR_B | I/O L25N_2 GCLK13 |
| AA | GND | I/O L55P_3 | I/O L55N_3 | GND ▽ | INPUT VREF_3 ▽ | GND | I/O L02N_2 CSO_B | VCCINT ▽ | INPUT VREF_2 | I/O L12N_2 | GND | I/O L17N_2 VS2 | I/O L25P_2 GCLK12 |
| AB | I/O L60P_3 | VCCO_3 | GND ▽ | VCCAUX ▽ | VCCAUX | INPUT VREF_2 | I/O L14N_2 | VCCO_2 | I/O L15P_2 | GND ▽ | VCCAUX | I/O L21P_2 | INPUT |
| AC | I/O L60N_3 | I/O L64P_3 | I/O L64N_3 | I/O L01P_2 M1 | GND ▽ | I/O L08P_2 | GND ▽ | I/O L14P_2 | I/O L15N_2 | INPUT VREF_2 | I/O L23N_2 | I/O L21N_2 | INPUT |
| AD | I/O L65P_3 | I/O L65N_3 | GND | I/O L01N_2 M0 | GND ▽ | I/O L08N_2 | I/O L11P_2 | GND | INPUT | INPUT | I/O L23P_2 | INPUT VREF_2 | GND |
| AE | INPUT L66P_3 | INPUT L66N_3 VREF_3 | I/O L06P_2 | I/O L07P_2 | VCCO_2 | I/O L10N_2 | I/O L11N_2 | I/O L18P_2 | I/O L19P_2 VS1 | I/O L22P_2 D7 | VCCO_2 | I/O L24N_2 D4 | I/O L26N_2 GCLK15 |
| AF | GND | VCCAUX ▽ | I/O L06N_2 | I/O L07N_2 | I/O L10P_2 | GND | VCCO_2 ▽ | I/O L18N_2 | I/O L19N_2 VS0 | I/O L22N_2 D6 | GND | I/O L24P_2 D5 | I/O L26P_2 GCLK14 |

Bank 3 (rows A–AF)

Bank 2

*Figure 17:* **FG676 Package Footprint for XC3SD3400A FPGA (Top View–Left Half)**

***Right Half of FG676 Package (Top View)***

*Figure 17:* **FG676 Package Footprint for XC3SD3400A FPGA (Top View–Right Half)**

## Footprint Migration Differences

There are multiple migration footprint differences between the XC3SD1800A and the XC3SD3400A in the FG676 package. These migration footprint differences are shown in Table 70. Migration from the XC3S1400A Spartan-3A device in the FG676 package to a Spartan-3A DSP device in the FG676 package is also possible. The XC3S1800A pin migration differences have been added to Table 70 for designs migrating between these devices.

*Table 70:* **FG676 Footprint Migration Differences**

| FG676 Ball | Spartan-3A | | Spartan-3A DSP | | Spartan-3A DSP | | FG676 Ball |
|---|---|---|---|---|---|---|---|
| | XC3S1400A Type | XC3S1400A Bank | XC3SD1800A Type | XC3SD1800A Bank | XC3SD3400A Type | XC3SD3400A Bank | |
| G16 | IP_0 | 0 | IP_0 | 0 | GND | GND | G16 |
| G18 | N.C. | N.C. | IP_0 | 0 | VCCINT | VCCINT | G18 |
| F9 | N.C. | N.C. | IP_0 | 0 | VCCAUX | VCCAUX | F9 |
| F10 | IP_0 | 0 | IP_0 | 0 | VCCINT | VCCINT | F10 |
| F18 | N.C. | N.C. | IP_0 | 0 | VCCINT | VCCINT | F18 |
| E6 | N.C. | N.C. | IP_0 | 0 | VCCINT | VCCINT | E6 |
| E9 | N.C. | N.C. | IP_0 | 0 | GND | GND | E9 |
| E20 | IP_0 | 0 | IP_0 | 0 | VCCAUX | VCCAUX | E20 |
| D5 | N.C. | N.C. | IP_0 | 0 | VCCINT | VCCINT | D5 |
| D15 | IP_0 | 0 | IP_0 | 0 | GND | GND | D15 |
| D19 | IP_0 | 0 | IP_0 | 0 | GND | GND | D19 |
| C4 | IP_0 | 0 | IP_0 | 0 | VCCINT | VCCINT | C4 |
| B24 | N.C. | N.C. | IP_0 | 0 | GND | GND | B24 |
| A5 | IP_0 | 0 | IP_0 | 0 | GND | GND | A5 |
| A7 | IP_0 | 0 | IP_0 | 0 | VCCO_0 | 0 | A7 |
| A23 | IP_0 | 0 | IP_0 | 0 | GND | GND | A23 |
| A24 | N.C. | N.C. | IP_0 | 0 | VCCAUX | VCCAUX | A24 |
| Y26 | IP_L16N_1 | 1 | IP_L16N_1 | 1 | IP_1 | 1 | Y26 |
| W25 | IP_L16P_1 | 1 | IP_L16P_1 | 1 | GND | GND | W25 |
| W26 | IP_L20P_1 | 1 | IP_L20P_1 | 1 | VCCAUX | VCCAUX | W26 |
| V26 | IP_L20N_1/ VREF_1 | 1 | IP_L20N_1/ VREF_1 | 1 | IP_1/VREF_1 | 1 | V26 |
| U25 | IP_L24P_1 | 1 | IP_L24P_1 | 1 | GND | GND | U25 |
| U26 | IP_L24N_1/ VREF_1 | 1 | IP_L24N_1/ VREF_1 | 1 | IP_1/VREF_1 | 1 | U26 |
| H23 | IP_L48P_1 | 1 | IP_L48P_1 | 1 | VCCAUX | VCCAUX | H23 |
| H24 | IP_L48N_1 | 1 | IP_L48N_1 | 1 | IP_1 | 1 | H24 |
| H25 | IP_L44N_1 | 1 | IP_L44N_1 | 1 | VCCO_1 | 1 | H25 |
| H26 | IP_L44P_1/ VREF_1 | 1 | IP_L44P_1/ VREF_1 | 1 | IP_1/VREF_1 | 1 | H26 |
| G25 | IP_L52N_1/ VREF_1 | 1 | IP_L52N_1/ VREF_1 | 1 | IP_1/VREF_1 | 1 | G25 |
| G26 | IP_L52P_1 | 1 | IP_L52P_1 | 1 | VCCAUX | VCCAUX | G26 |
| B25 | IP_L65N_1 | 1 | IP_L65N_1 | 1 | GND | GND | B25 |
| B26 | IP_L65P_1/ VREF_1 | 1 | IP_L65P_1/ VREF_1 | 1 | IP_1/VREF_1 | 1 | B26 |

*Table 70:* **FG676 Footprint Migration Differences *(Cont'd)***

| FG676 Ball | Spartan-3A | | Spartan-3A DSP | | Spartan-3A DSP | | FG676 Ball |
|---|---|---|---|---|---|---|---|
| | XC3S1400A Type | XC3S1400A Bank | XC3SD1800A Type | XC3SD1800A Bank | XC3SD3400A Type | XC3SD3400A Bank | |
| Y8 | N.C. | N.C. | IP_2 | 2 | VCCINT | VCCINT | Y8 |
| Y11 | IP_2 | 2 | IP_2 | 2 | VCCINT | VCCINT | Y11 |
| Y18 | N.C. | N.C. | IP_2 | 2 | VCCINT | VCCINT | Y18 |
| Y19 | N.C. | N.C. | IP_2/VREF_2 | 2 | VCCINT | VCCINT | Y19 |
| W18 | N.C. | N.C. | IP_2 | 2 | VCCINT | VCCINT | W18 |
| AF2 | IP_2 | 2 | IP_2 | 2 | VCCAUX | VCCAUX | AF2 |
| AF7 | IP_2 | 2 | IP_2 | 2 | VCCO_2 | 2 | AF7 |
| AD5 | N.C. | N.C. | IP_2 | 2 | GND | GND | AD5 |
| AD23 | N.C. | N.C. | IP_2 | 2 | GND | GND | AD23 |
| AC5 | N.C. | N.C. | IP_2 | 2 | GND | GND | AC5 |
| AC7 | IP_2 | 2 | IP_2 | 2 | GND | GND | AC7 |
| AC18 | IP_2 | 2 | IP_2 | 2 | GND | GND | AC18 |
| AB10 | IP_2/VREF_2 | 2 | IP_2/VREF_2 | 2 | GND | GND | AB10 |
| AB17 | IP_2 | 2 | IP_2 | 2 | VCCAUX | VCCAUX | AB17 |
| AB20 | IP_2 | 2 | IP_2 | 2 | GND | GND | AB20 |
| AA8 | N.C. | N.C. | IP_2 | 2 | VCCINT | VCCINT | AA8 |
| AA19 | IP_2 | 2 | IP_2 | 2 | GND | GND | AA19 |
| AC22 | N.C. | N.C. | IO_2 | 2 | IO_2 | 2 | AC22 |
| Y3 | IP_L54P_3 | 3 | IP_L54P_3 | 3 | IP_3 | 3 | Y3 |
| Y4 | IP_L54N_3 | 3 | IP_L54N_3 | 3 | VCCINT | VCCINT | Y4 |
| H4 | IP_L12N_3/ VREF_3 | 3 | IP_L12N_3/ VREF_3 | 3 | IP_3/VREF_3 | 3 | H4 |
| G1 | IP_L16N_3 | 3 | IP_L16N_3 | 3 | IP_3 | 3 | G1 |
| G2 | IP_L16P_3 | 3 | IP_L16P_3 | 3 | GND | GND | G2 |
| G5 | IP_L12P_3 | 3 | IP_L12P_3 | 3 | GND | GND | G5 |
| D1 | IP_L08N_3 | 3 | IP_L08N_3 | 3 | VCCAUX | VCCAUX | D1 |
| D2 | IP_L08P_3 | 3 | IP_L08P_3 | 3 | GND | GND | D2 |
| C1 | IP_L04N_3/ VREF_3 | 3 | IP_L04N_3/ VREF_3 | 3 | IP_3/VREF_3 | 3 | C1 |
| C2 | IP_L04P_3 | 3 | IP_L04P_3 | 3 | VCCO_3 | 3 | C2 |
| AB3 | IP_L62P_3 | 3 | IP_L62P_3 | 3 | GND | GND | AB3 |
| AB4 | IP_L62N_3 | 3 | IP_L62N_3 | 3 | VCCAUX | VCCAUX | AB4 |
| AA4 | IP_L58P_3 | 3 | IP_L58P_3 | 3 | GND | GND | AA4 |
| AA5 | IP_L58N_3/ VREF_3 | 3 | IP_L58N_3/ VREF_3 | 3 | IP_3/VREF_3 | 3 | AA5 |

## Migration Recommendations

There are multiple pinout differences between the XC3SD1800A and the XC3SD3400A FPGAs in the FG676 package. Please note the differences between the two devices from Table 70 and take the necessary precautions.

## Revision History

The following table shows the revision history for this document.

| Date | Version | Revision |
|---|---|---|
| 04/02/07 | 1.0 | Initial Xilinx release. |
| 05/25/07 | 1.1 | Updates to Table 59, Table 63, Table 64, Table 65, Table 66, Table 67, Table 68, Table 69. Corrected VREF pins in XC3S1800A FG676 (Table 70). Updated FG676 package footprints for XC3SD1800A FPGA (Figure 16) and XC3SD3400A FPGA (Figure 17). Minor edits. |
| 06/18/07 | 1.2 | Updated for Production release. |
| 07/16/07 | 2.0 | Added Low-power options. Added advance thermal data to Table 62. |
| 06/02/08 | 2.1 | Added Package Overview section. Updated Thermal Characteristics in Table 62. Corrected name for AB14 in CS484 in Table 63. Updated links. |
| 03/11/09 | 2.2 | Corrected bank designation for SUSPEND to VCCAUX. |
| 10/04/10 | 3.0 | Revision update to match other data sheet modules. |

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