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## Introduction

The Spartan®-3 family of Field-Programmable Gate Arrays is specifically designed to meet the needs of high volume, cost-sensitive consumer electronic applications. The eight-member family offers densities ranging from 50,000 to 5,000,000 system gates, as shown in [Table 1](#).

The Spartan-3 family builds on the success of the earlier Spartan-IIIE family by increasing the amount of logic resources, the capacity of internal RAM, the total number of I/Os, and the overall level of performance as well as by improving clock management functions. Numerous enhancements derive from the Virtex®-II platform technology. These Spartan-3 FPGA enhancements, combined with advanced process technology, deliver more functionality and bandwidth per dollar than was previously possible, setting new standards in the programmable logic industry.

Because of their exceptionally low cost, Spartan-3 FPGAs are ideally suited to a wide range of consumer electronics applications, including broadband access, home networking, display/projection and digital television equipment.

The Spartan-3 family is a superior alternative to mask programmed ASICs. FPGAs avoid the high initial cost, the 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.

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

| Device                  | System Gates | Equivalent Logic Cells <sup>(1)</sup> | CLB Array<br>(One CLB = Four Slices) |         |            | Distributed RAM Bits<br>(K=1024) | Block RAM Bits<br>(K=1024) | Dedicated Multipliers | DCMs | Max. User I/O | Maximum Differential I/O Pairs |
|-------------------------|--------------|---------------------------------------|--------------------------------------|---------|------------|----------------------------------|----------------------------|-----------------------|------|---------------|--------------------------------|
|                         |              |                                       | Rows                                 | Columns | Total CLBs |                                  |                            |                       |      |               |                                |
| XC3S50 <sup>(2)</sup>   | 50K          | 1,728                                 | 16                                   | 12      | 192        | 12K                              | 72K                        | 4                     | 2    | 124           | 56                             |
| XC3S200 <sup>(2)</sup>  | 200K         | 4,320                                 | 24                                   | 20      | 480        | 30K                              | 216K                       | 12                    | 4    | 173           | 76                             |
| XC3S400 <sup>(2)</sup>  | 400K         | 8,064                                 | 32                                   | 28      | 896        | 56K                              | 288K                       | 16                    | 4    | 264           | 116                            |
| XC3S1000 <sup>(2)</sup> | 1M           | 17,280                                | 48                                   | 40      | 1,920      | 120K                             | 432K                       | 24                    | 4    | 391           | 175                            |
| XC3S1500                | 1.5M         | 29,952                                | 64                                   | 52      | 3,328      | 208K                             | 576K                       | 32                    | 4    | 487           | 221                            |
| XC3S2000                | 2M           | 46,080                                | 80                                   | 64      | 5,120      | 320K                             | 720K                       | 40                    | 4    | 565           | 270                            |
| XC3S4000                | 4M           | 62,208                                | 96                                   | 72      | 6,912      | 432K                             | 1,728K                     | 96                    | 4    | 633           | 300                            |
| XC3S5000                | 5M           | 74,880                                | 104                                  | 80      | 8,320      | 520K                             | 1,872K                     | 104                   | 4    | 633           | 300                            |

### Notes:

- Logic Cell = 4-input Look-Up Table (LUT) plus a 'D' flip-flop. "Equivalent Logic Cells" equals "Total CLBs" x 8 Logic Cells/CLB x 1.125 effectiveness.
- These devices are available in Xilinx Automotive versions as described in [DS314: Spartan-3 Automotive XA FPGA Family](#).

## Features

- Low-cost, high-performance logic solution for high-volume, consumer-oriented applications
  - Densities up to 74,880 logic cells
- SelectIO™ interface signaling
  - Up to 633 I/O pins
  - 622+ Mb/s data transfer rate per I/O
  - 18 single-ended signal standards
  - 8 differential I/O standards including LVDS, RSDS
  - Termination by Digitally Controlled Impedance
  - Signal swing ranging from 1.14V to 3.465V
  - Double Data Rate (DDR) support
  - [DDR, DDR2 SDRAM support](#) up to 333 Mb/s
- Logic resources
  - Abundant logic cells with shift register capability
  - Wide, fast multiplexers
  - Fast look-ahead carry logic
  - Dedicated 18 x 18 multipliers
  - JTAG logic compatible with IEEE 1149.1/1532
- SelectRAM™ hierarchical memory
  - Up to 1,872 Kbits of total block RAM
  - Up to 520 Kbits of total distributed RAM
- Digital Clock Manager (up to four DCMs)
  - Clock skew elimination
  - Frequency synthesis
  - High resolution phase shifting
- Eight global clock lines and abundant routing
- Fully supported by [Xilinx ISE®](#) and [WebPACK™](#) software development systems
- [MicroBlaze™](#) and [PicoBlaze™](#) processor, [PCI®](#), [PCI Express® PIPE Endpoint](#), and other [IP cores](#)
- Pb-free packaging options
- Automotive [Spartan-3 XA Family](#) variant

## Architectural Overview

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

- Configurable Logic Blocks (CLBs) contain RAM-based Look-Up Tables (LUTs) to implement logic and storage elements that can be used as flip-flops or latches. CLBs can be programmed to perform a wide variety of logical functions as well as to store data.
- Input/Output Blocks (IOBs) control the flow of data between the I/O pins and the internal logic of the device. Each IOB supports bidirectional data flow plus 3-state operation. Twenty-six different signal standards, including eight high-performance differential standards, are available as shown in Table 2. Double Data-Rate (DDR) registers are included. The Digitally Controlled Impedance (DCI) feature provides automatic on-chip terminations, simplifying board designs.
- Block RAM provides data storage in the form of 18-Kbit dual-port blocks.
- Multiplier blocks accept two 18-bit binary numbers as inputs and calculate the product.
- 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 ring of IOBs surrounds a regular array of CLBs. The XC3S50 has a single column of block RAM embedded in the array. Those devices ranging from the XC3S200 to the XC3S2000 have two columns of block RAM. The XC3S4000 and XC3S5000 devices have four RAM columns. Each column is made up of several 18-Kbit RAM blocks; each block is associated with a dedicated multiplier. The DCMs are positioned at the ends of the outer block RAM columns.

The Spartan-3 family features a rich network of traces and switches 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 two additional block RAM columns of the XC3S4000 and XC3S5000 devices are shown with dashed lines. The XC3S50 has only the block RAM column on the far left.

Figure 1: Spartan-3 Family Architecture

## Configuration

Spartan-3 FPGAs are programmed by loading configuration data into robust reprogrammable static CMOS configuration latches (CCLs) that collectively control all functional elements and routing resources. Before powering on the FPGA, configuration data is stored externally in a PROM or some other nonvolatile medium either on or off the board. After applying

power, the configuration data is written to the FPGA using any of five different modes: Master Parallel, Slave Parallel, Master Serial, Slave Serial, and Boundary Scan (JTAG). The Master and Slave Parallel modes use an 8-bit-wide SelectMAP port.

The recommended memory for storing the configuration data is the low-cost Xilinx Platform Flash PROM family, which includes the XCF00S PROMs for serial configuration and the higher density XCF00P PROMs for parallel or serial configuration.

## I/O Capabilities

The SelectIO feature of Spartan-3 devices supports eighteen single-ended standards and eight differential standards as listed in [Table 2](#). Many standards support the DCI feature, which uses integrated terminations to eliminate unwanted signal reflections.

**Table 2: Signal Standards Supported by the Spartan-3 Family**

| Standard Category   | Description                                      | V <sub>CCO</sub> (V) | Class                 | Symbol (IOSTANDARD) | DCI Option |
|---------------------|--|----------------------|-----------------------|---------------------|------------|
| <b>Single-Ended</b> |  |                      |                       |                     |            |
| GTL                 | Gunning Transceiver Logic                        | N/A                  | Terminated            | GTL                 | Yes        |
|                     |  |                      | Plus                  | GTLP                | Yes        |
| HSTL                | High-Speed Transceiver Logic                     | 1.5                  | I                     | HSTL_I              | Yes        |
|                     |  |                      | III                   | HSTL_III            | Yes        |
|                     |  | 1.8                  | I                     | HSTL_I_18           | Yes        |
|                     |  |                      | II                    | HSTL_II_18          | Yes        |
| LVCMOS              | Low-Voltage CMOS                                 | 1.2                  | N/A                   | LVCMOS12            | No         |
|                     |  | 1.5                  | N/A                   | LVCMOS15            | Yes        |
|                     |  | 1.8                  | N/A                   | LVCMOS18            | Yes        |
|                     |  | 2.5                  | N/A                   | LVCMOS25            | Yes        |
|                     |  | 3.3                  | N/A                   | LVCMOS33            | Yes        |
| LVTTTL              | Low-Voltage Transistor-Transistor Logic          | 3.3                  | N/A                   | LVTTTL              | No         |
| PCI                 | Peripheral Component Interconnect                | 3.0                  | 33 MHz <sup>(1)</sup> | PCI33_3             | No         |
| SSTL                | Stub Series Terminated Logic                     | 1.8                  | N/A (±6.7 mA)         | SSTL18_I            | Yes        |
|                     |  |                      | N/A (±13.4 mA)        | SSTL18_II           | No         |
|                     |  | 2.5                  | I                     | SSTL2_I             | Yes        |
|                     |  |                      | II                    | SSTL2_II            | Yes        |
| <b>Differential</b> |  |                      |                       |                     |            |
| LDT (ULVDS)         | Lightning Data Transport (HyperTransport™) Logic | 2.5                  | N/A                   | LDT_25              | No         |
| LVDS                | Low-Voltage Differential Signaling               |                      | Standard              | LVDS_25             | Yes        |
|                     |  |                      | Bus                   | BLVDS_25            | No         |
|                     |  |                      | Extended Mode         | LVDSEXT_25          | Yes        |
| LVPECL              | Low-Voltage Positive Emitter-Coupled Logic       | 2.5                  | N/A                   | LVPECL_25           | No         |
| RSDS                | Reduced-Swing Differential Signaling             | 2.5                  | N/A                   | RSDS_25             | No         |
| HSTL                | Differential High-Speed Transceiver Logic        | 1.8                  | II                    | DIFF_HSTL_II_18     | Yes        |
| SSTL                | Differential Stub Series Terminated Logic        | 2.5                  | II                    | DIFF_SSTL2_II       | Yes        |

**Notes:**

- 66 MHz PCI is not supported by the Xilinx IP core although PCI66\_3 is an available I/O standard.

Table 3 shows the number of user I/Os as well as the number of differential I/O pairs available for each device/package combination.

Table 3: Spartan-3 Device I/O Chart

| Available User I/Os and Differential (Diff) I/O Pairs by Package Type |                 |      |                                |                   |                 |      |                 |      |                 |      |                 |      |                 |      |                 |      |                 |      |                                  |                    |
|---|-----------------|------|--------------------------------|-------------------|-----------------|------|-----------------|------|-----------------|------|-----------------|------|-----------------|------|-----------------|------|-----------------|------|----------------------------------|--------------------|
| Package   | VQ100<br>VQG100 |      | CP132 <sup>(1)</sup><br>CPG132 |                   | TQ144<br>TQG144 |      | PQ208<br>PQG208 |      | FT256<br>FTG256 |      | FG320<br>FGG320 |      | FG456<br>FGG456 |      | FG676<br>FGG676 |      | FG900<br>FGG900 |      | FG1156 <sup>(1)</sup><br>FGG1156 |                    |
| Footprint (mm)  | 16 x 16         |      | 8 x 8                          |                   | 22 x 22         |      | 30.6 x 30.6     |      | 17 x 17         |      | 19 x 19         |      | 23 x 23         |      | 27 x 27         |      | 31 x 31         |      | 35 x 35                          |                    |
| Device  | User            | Diff | User                           | Diff              | User            | Diff | User            | Diff | User            | Diff | User            | Diff | User            | Diff | User            | Diff | User            | Diff | User                             | Diff               |
| XC3S50  | 63              | 29   | 89 <sup>(1)</sup>              | 44 <sup>(1)</sup> | 97              | 46   | 124             | 56   | –               | –    | –               | –    | –               | –    | –               | –    | –               | –    | –                                | –                  |
| XC3S200   | 63              | 29   | –                              | –                 | 97              | 46   | 141             | 62   | 173             | 76   | –               | –    | –               | –    | –               | –    | –               | –    | –                                | –                  |
| XC3S400   | –               | –    | –                              | –                 | 97              | 46   | 141             | 62   | 173             | 76   | 221             | 100  | 264             | 116  | –               | –    | –               | –    | –                                | –                  |
| XC3S1000  | –               | –    | –                              | –                 | –               | –    | –               | –    | 173             | 76   | 221             | 100  | 333             | 149  | 391             | 175  | –               | –    | –                                | –                  |
| XC3S1500  | –               | –    | –                              | –                 | –               | –    | –               | –    | –               | –    | 221             | 100  | 333             | 149  | 487             | 221  | –               | –    | –                                | –                  |
| XC3S2000  | –               | –    | –                              | –                 | –               | –    | –               | –    | –               | –    | –               | –    | 333             | 149  | 489             | 221  | 565             | 270  | –                                | –                  |
| XC3S4000  | –               | –    | –                              | –                 | –               | –    | –               | –    | –               | –    | –               | –    | –               | –    | 489             | 221  | 633             | 300  | 712 <sup>(1)</sup>               | 312 <sup>(1)</sup> |
| XC3S5000  | –               | –    | –                              | –                 | –               | –    | –               | –    | –               | –    | –               | –    | –               | –    | 489             | 221  | 633             | 300  | 784 <sup>(1)</sup>               | 344 <sup>(1)</sup> |

Notes:

1. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).
2. All device options listed in a given package column are pin-compatible.
3. User = Single-ended user I/O pins. Diff = Differential I/O pairs.

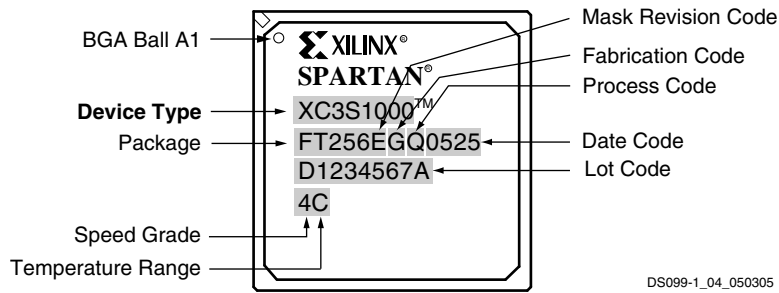
Package Marking

Figure 2 shows the top marking for Spartan-3 FPGAs in the quad-flat packages. Figure 3 shows the top marking for Spartan-3 FPGAs in BGA packages except the 132-ball chip-scale package (CP132 and CPG132). The markings for the BGA packages are nearly identical to those for the quad-flat packages, except that the marking is rotated with respect to the ball A1 indicator. Figure 4 shows the top marking for Spartan-3 FPGAs in the CP132 and CPG132 packages.

The “5C” and “4I” 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. Some specifications vary according to mask revision. Mask revision E devices are errata-free. All shipments since 2006 have been mask revision E.

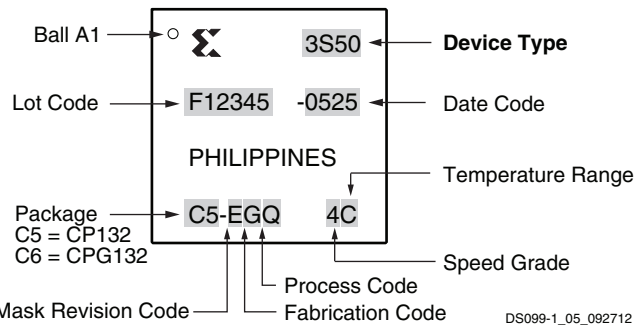


Figure 2: Spartan-3 FPGA QFP Package Marking Example for Part Number XC3S400-4PQ208C



DS099-1\_04\_050305

Figure 3: Spartan-3 FPGA BGA Package Marking Example for Part Number XC3S1000-4FT256C

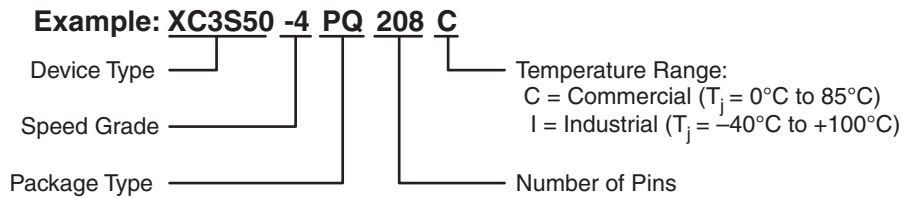


DS099-1\_05\_092712

Figure 4: Spartan-3 FPGA CP132 and CPG132 Package Marking Example for XC3S50-4CP132C

## Ordering Information

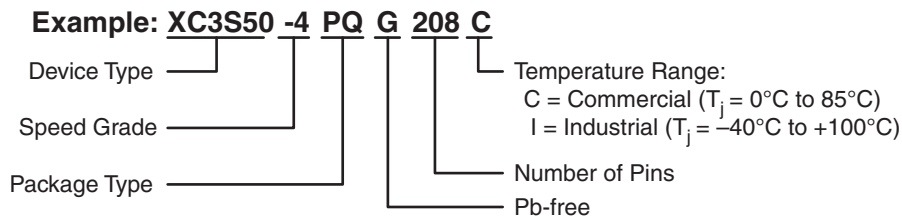
Spartan-3 FPGAs are available in both standard (Figure 5) and Pb-free (Figure 6) packaging options for all device/package combinations. The Pb-free packages include a special ‘G’ character in the ordering code.



DS099\_1\_05\_020711

Figure 5: Standard Packaging

For additional information on Pb-free packaging, see [XAPP427: Implementation and Solder Reflow Guidelines for Pb-Free Packages](#).



DS099\_1\_06\_020711

Figure 6: Pb-Free Packaging

**Table 4: Example Ordering Information**

| Device   | Speed Grade |                                 | Package Type/Number of Pins |  | Temperature Range (T <sub>j</sub> ) |                             |
|----------|-------------|---------------------------------|-----------------------------|--|-------------------------------------|-----------------------------|
|          |             |                                 |                             |  |                                     |                             |
| XC3S50   | -4          | Standard Performance            | VQ(G)100                    | 100-pin Very Thin Quad Flat Pack (VQFP)          | C                                   | Commercial (0°C to 85°C)    |
| XC3S200  | -5          | High Performance <sup>(1)</sup> | CP(G)132 <sup>(2)</sup>     | 132-pin Chip-Scale Package (CSP)                 | I                                   | Industrial (-40°C to 100°C) |
| XC3S400  |             |                                 | TQ(G)144                    | 144-pin Thin Quad Flat Pack (TQFP)               |                                     |                             |
| XC3S1000 |             |                                 | PQ(G)208                    | 208-pin Plastic Quad Flat Pack (PQFP)            |                                     |                             |
| XC3S1500 |             |                                 | FT(G)256                    | 256-ball Fine-Pitch Thin Ball Grid Array (FTBGA) |                                     |                             |
| XC3S2000 |             |                                 | FG(G)320                    | 320-ball Fine-Pitch Ball Grid Array (FBGA)       |                                     |                             |
| XC3S4000 |             |                                 | FG(G)456                    | 456-ball Fine-Pitch Ball Grid Array (FBGA)       |                                     |                             |
| XC3S5000 |             |                                 | FG(G)676                    | 676-ball Fine-Pitch Ball Grid Array (FBGA)       |                                     |                             |
|          |             |                                 | FG(G)900                    | 900-ball Fine-Pitch Ball Grid Array (FBGA)       |                                     |                             |
|          |             |                                 | FG(G)1156 <sup>(2)</sup>    | 1156-ball Fine-Pitch Ball Grid Array (FBGA)      |                                     |                             |

**Notes:**

1. The -5 speed grade is exclusively available in the Commercial temperature range.
2. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

## Revision History

| Date       | Version | Description  |
|------------|---------|--|
| 04/11/2003 | 1.0     | Initial Xilinx release.  |
| 04/24/2003 | 1.1     | Updated block RAM, DCM, and multiplier counts for the XC3S50.  |
| 12/24/2003 | 1.2     | Added the FG320 package.   |
| 07/13/2004 | 1.3     | Added information on Pb-free packaging options.  |
| 01/17/2005 | 1.4     | Referenced Spartan-3 XA Automotive FPGA families in <a href="#">Table 1</a> . Added XC3S50CP132, XC3S2000FG456, XC3S4000FG676 options to <a href="#">Table 3</a> . Updated <a href="#">Package Marking</a> to show mask revision code, fabrication facility code, and process technology code.   |
| 08/19/2005 | 1.5     | Added package markings for BGA packages ( <a href="#">Figure 3</a> ) and CP132/CPG132 packages ( <a href="#">Figure 4</a> ). Added differential (complementary single-ended) HSTL and SSTL I/O standards.  |
| 04/03/2006 | 2.0     | Increased number of supported single-ended and differential I/O standards.   |
| 04/26/2006 | 2.1     | Updated document links.  |
| 05/25/2007 | 2.2     | Updated <a href="#">Package Marking</a> to allow for dual-marking.   |
| 11/30/2007 | 2.3     | Added XC3S5000 FG(G)676 to <a href="#">Table 3</a> . Noted that FG(G)1156 package is being discontinued and updated max I/O count.   |
| 06/25/2008 | 2.4     | Updated max I/O counts based on FG1156 discontinuation. Clarified dual mark in <a href="#">Package Marking</a> . Updated formatting and links.   |
| 12/04/2009 | 2.5     | CP132 and CPG132 packages are being discontinued. Added link to Spartan-3 FPGA customer notices. Updated <a href="#">Table 3</a> with package footprint dimensions.  |
| 10/29/2012 | 3.0     | Added <a href="#">Notice of Disclaimer</a> section. Per <a href="#">XCN07022</a> , updated the discontinued FG1156 and FGG1156 package discussion throughout document. Per <a href="#">XCN08011</a> , updated the discontinued CP132 and CPG132 package discussion throughout document. Although the package is discontinued, updated the marking on <a href="#">Figure 4</a> . This product is not recommended for new designs. |
| 06/27/2013 | 3.1     | Removed banner. This product IS recommended for new designs.   |



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## Spartan-3 FPGA Design Documentation

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

- [UG331: Spartan-3 Generation FPGA User Guide](#)
  - Clocking Resources
  - Digital Clock Managers (DCMs)
  - Block RAM
  - Configurable Logic Blocks (CLBs)
    - Distributed RAM
    - SRL16 Shift Registers
    - Carry and Arithmetic Logic
  - I/O Resources
  - Embedded Multiplier Blocks
  - Programmable Interconnect
  - ISE® Software Design Tools
  - IP Cores
  - Embedded Processing and Control Solutions
  - Pin Types and Package Overview
  - Package Drawings
  - Powering FPGAs
- [UG332: Spartan-3 Generation Configuration User Guide](#)
  - Configuration Overview
    - Configuration Pins and Behavior
    - Bitstream Sizes
  - Detailed Descriptions by Mode
    - Master Serial Mode using Xilinx Platform Flash PROM
    - Slave Parallel (SelectMAP) using a Processor
    - Slave Serial using a Processor
    - JTAG Mode
  - ISE iMPACT Programming Examples

Create a Xilinx user account and sign up to receive automatic e-mail notification whenever this data sheet or the associated user guides are updated.

- **Sign Up for Alerts on Xilinx.com**  
<https://secure.xilinx.com/webreg/register.do?group=myprofile&languageID=1>

For specific hardware examples, see the Spartan-3 FPGA Starter Kit board web page, which has links to various design examples and the user guide.

- Spartan-3 FPGA Starter Kit Board page  
<http://www.xilinx.com/s3starter>
- [UG130: Spartan-3 FPGA Starter Kit User Guide](#)

## IOBs

For additional information, refer to the chapter entitled “Using I/O Resources” in [UG331: Spartan-3 Generation FPGA User Guide](#).

### IOB Overview

The Input/Output Block (IOB) provides a programmable, bidirectional interface between an I/O pin and the FPGA’s internal logic.

A simplified diagram of the IOB’s internal structure appears in [Figure 7](#). There are three main signal paths within the IOB: the output path, input path, and 3-state path. Each path has its own pair of storage elements that can act as either registers or latches. For more information, see the [Storage Element Functions](#) section. The three main signal paths are as follows:

- The input path carries data from the pad, which is bonded to a package pin, through an optional programmable delay element directly to the I line. There are alternate routes through a pair of storage elements to the IQ1 and IQ2 lines. The IOB outputs I, IQ1, and IQ2 all lead to the FPGA’s internal logic. The delay element can be set to ensure a hold time of zero.
- The output path, starting with the O1 and O2 lines, carries data from the FPGA’s internal logic through a multiplexer and then a three-state driver to the IOB pad. In addition to this direct path, the multiplexer provides the option to insert a pair of storage elements.
- The 3-state path determines when the output driver is high impedance. The T1 and T2 lines carry data from the FPGA’s internal logic through a multiplexer to the output driver. In addition to this direct path, the multiplexer provides the option to insert a pair of storage elements. When the T1 or T2 lines are asserted High, the output driver is high-impedance (floating, hi-Z). The output driver is active-Low enabled.
- All signal paths entering the IOB, including those associated with the storage elements, have an inverter option. Any inverter placed on these paths is automatically absorbed into the IOB.

### Storage Element Functions

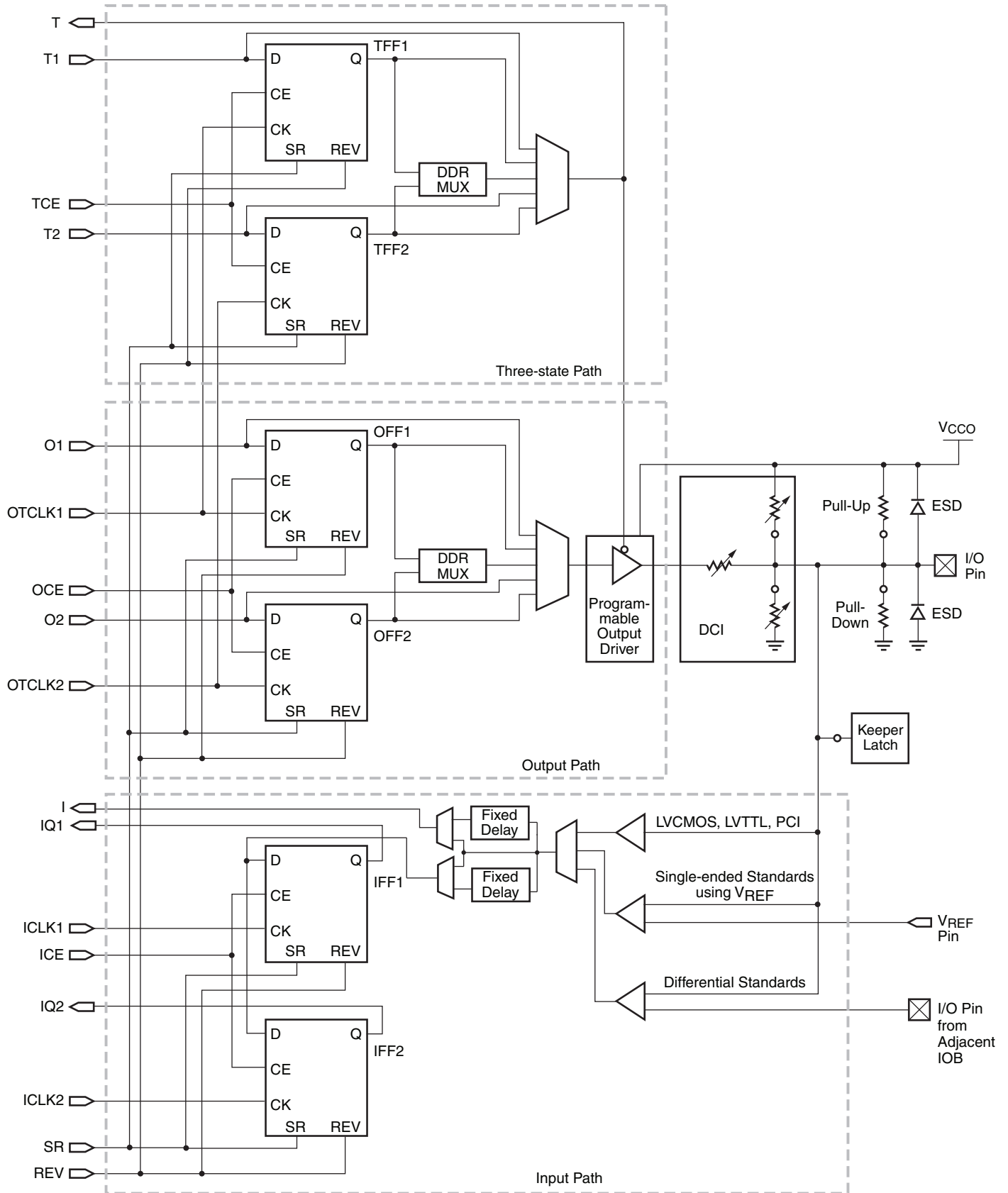
There are three pairs of storage elements in each IOB, one pair for each of the three paths. It is possible to configure each of these storage elements as an edge-triggered D-type flip-flop (FD) or a level-sensitive latch (LD).

The storage-element-pair on either the Output path or the Three-State path can be used together with a special multiplexer to produce Double-Data-Rate (DDR) transmission. This is accomplished by taking data synchronized to the clock signal’s rising edge and converting them to bits synchronized on both the rising and the falling edge. The combination of two registers and a multiplexer is referred to as a Double-Data-Rate D-type flip-flop (FDDR). See [Double-Data-Rate Transmission, page 12](#) for more information.

The signal paths associated with the storage element are described in [Table 5](#).

*Table 5: Storage Element Signal Description*

| Storage Element Signal | Description        | Function  |
|------------------------|--------------------|---|
| D                      | Data input         | Data at this input is stored on the active edge of CK enabled by CE. For latch operation when the input is enabled, data passes directly to the output Q.                       |
| Q                      | Data output        | The data on this output reflects the state of the storage element. For operation as a latch in transparent mode, Q will mirror the data at D.                                   |
| CK                     | Clock input        | A signal’s active edge on this input with CE asserted, loads data into the storage element.   |
| CE                     | Clock Enable input | When asserted, this input enables CK. If not connected, CE defaults to the asserted state.  |
| SR                     | Set/Reset          | Forces storage element into the state specified by the SRHIGH/SRLOW attributes. The SYNC/ASYN attribute setting determines if the SR input is synchronized to the clock or not. |
| REV                    | Reverse            | Used together with SR. Forces storage element into the state opposite from what SR does.  |



Note: All IOB signals originating from the FPGA's internal logic have an optional polarity inverter.

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Figure 7: Simplified IOB Diagram

According to [Figure 7](#), the clock line OTCLK1 connects the CK inputs of the upper registers on the output and three-state paths. Similarly, OTCLK2 connects the CK inputs for the lower registers on the output and three-state paths. The upper and lower registers on the input path have independent clock lines: ICLK1 and ICLK2. The enable line OCE connects the CE inputs of the upper and lower registers on the output path. Similarly, TCE connects the CE inputs for the register pair on the three-state path and ICE does the same for the register pair on the input path. The Set/Reset (SR) line entering the IOB is common to all six registers, as is the Reverse (REV) line.

Each storage element supports numerous options in addition to the control over signal polarity described in the IOB Overview section. These are described in [Table 6](#).

**Table 6: Storage Element Options**

| Option Switch | Function   | Specificity   |
|---------------|--|---|
| FF/Latch      | Chooses between an edge-sensitive flip-flop or a level-sensitive latch   | Independent for each storage element.   |
| SYNC/ASYNC    | Determines whether SR is synchronous or asynchronous   | Independent for each storage element.   |
| SRHIGH/SRLOW  | Determines whether SR acts as a Set, which forces the storage element to a logic "1" (SRHIGH) or a Reset, which forces a logic "0" (SRLOW).  | Independent for each storage element, except when using FDDR. In the latter case, the selection for the upper element (OFF1 or TFF2) applies to both elements.                            |
| INIT1/INIT0   | In the event of a Global Set/Reset, after configuration or upon activation of the GSR net, this switch decides whether to set or reset a storage element. By default, choosing SRLOW also selects INIT0; choosing SRHIGH also selects INIT1. | Independent for each storage element, except when using FDDR. In the latter case, selecting INIT0 for one element applies to both elements (even though INIT1 is selected for the other). |

## Double-Data-Rate Transmission

Double-Data-Rate (DDR) transmission describes the technique of synchronizing signals to both the rising and falling edges of the clock signal. Spartan-3 devices use register-pairs in all three IOB paths to perform DDR operations.

The pair of storage elements on the IOB's Output path (OFF1 and OFF2), used as registers, combine with a special multiplexer to form a DDR D-type flip-flop (FDDR). This primitive permits DDR transmission where output data bits are synchronized to both the rising and falling edges of a clock. It is possible to access this function by placing either an FDDRSE or an FDDRCPE component or symbol into the design. DDR operation requires two clock signals (50% duty cycle), one the inverted form of the other. These signals trigger the two registers in alternating fashion, as shown in [Figure 8](#). Commonly, the Digital Clock Manager (DCM) generates the two clock signals by mirroring an incoming signal, then shifting it 180 degrees. This approach ensures minimal skew between the two signals.

The storage-element-pair on the Three-State path (TFF1 and TFF2) can also be combined with a local multiplexer to form an FDDR primitive. This permits synchronizing the output enable to both the rising and falling edges of a clock. This DDR operation is realized in the same way as for the output path.

The storage-element-pair on the input path (IFF1 and IFF2) allows an I/O to receive a DDR signal. An incoming DDR clock signal triggers one register and the inverted clock signal triggers the other register. In this way, the registers take turns capturing bits of the incoming DDR data signal.



Figure 8: Clocking the DDR Register

Aside from high bandwidth data transfers, DDR can also be used to reproduce, or “mirror”, a clock signal on the output. This approach is used to transmit clock and data signals together. A similar approach is used to reproduce a clock signal at multiple outputs. The advantage for both approaches is that skew across the outputs will be minimal.

Some adjacent I/O blocks (IOBs) share common routing connecting the ICLK1, ICLK2, OTCLK1, and OTCLK2 clock inputs of both IOBs. These IOB pairs are identified by their differential pair names IO\_LxxN\_# and IO\_LxxP\_#, where “xx” is an I/O pair number and ‘#’ is an I/O bank number. Two adjacent IOBs containing DDR registers must share common clock inputs, otherwise one or more of the clock signals will be unroutable.

## Pull-Up and Pull-Down Resistors

The optional pull-up and pull-down resistors are intended to establish High and Low levels, respectively, at unused I/Os. The pull-up resistor optionally connects each IOB pad to  $V_{CCO}$ . A pull-down resistor optionally connects each pad to GND. These resistors are placed in a design using the PULLUP and PULLDOWN symbols in a schematic, respectively. They can also be instantiated as components, set as constraints or passed as attributes in HDL code. These resistors can also be selected for all unused I/O using the Bitstream Generator (BitGen) option UnusedPin. A Low logic level on HSWAP\_EN activates the pull-up resistors on all I/Os during configuration (see [The I/Os During Power-On, Configuration, and User Mode, page 21](#)).

The Spartan-3 FPGAs I/O pull-up and pull-down resistors are significantly stronger than the “weak” pull-up/pull-down resistors used in previous Xilinx FPGA families. See [Table 33, page 61](#) for equivalent resistor strengths.

## Keeper Circuit

Each I/O has an optional keeper circuit that retains the last logic level on a line after all drivers have been turned off. This is useful to keep bus lines from floating when all connected drivers are in a high-impedance state. This function is placed in a design using the KEEPER symbol. Pull-up and pull-down resistors override the keeper circuit.

## ESD Protection

Clamp diodes protect all device pads against damage from Electro-Static Discharge (ESD) as well as excessive voltage transients. Each I/O has two clamp diodes: One diode extends P-to-N from the pad to  $V_{CCO}$  and a second diode extends N-to-P from the pad to GND. During operation, these diodes are normally biased in the off state. These clamp diodes are always connected to the pad, regardless of the signal standard selected. The presence of diodes limits the ability of Spartan-3 FPGA I/Os to tolerate high signal voltages. The  $V_{IN}$  absolute maximum rating in [Table 28, page 58](#) specifies the voltage range that I/Os can tolerate.

## Slew Rate Control and Drive Strength

Two options, FAST and SLOW, control the output slew rate. The FAST option supports output switching at a high rate. The SLOW option reduces bus transients. These options are only available when using one of the LVCMOS or LVTTTL standards, which also provide up to seven different levels of current drive strength: 2, 4, 6, 8, 12, 16, and 24 mA. Choosing the appropriate drive strength level is yet another means to minimize bus transients.

[Table 7](#) shows the drive strengths that the LVCMOS and LVTTTL standards support.

Table 7: Programmable Output Drive Current

| Signal Standard<br>(IOSTANDARD) | Current Drive (mA) |   |   |   |    |    |    |
|---------------------------------|--------------------|---|---|---|----|----|----|
|                                 | 2                  | 4 | 6 | 8 | 12 | 16 | 24 |
| LVTTTL                          | ✓                  | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  |
| LVCMOS33                        | ✓                  | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  |
| LVCMOS25                        | ✓                  | ✓ | ✓ | ✓ | ✓  | ✓  | ✓  |
| LVCMOS18                        | ✓                  | ✓ | ✓ | ✓ | ✓  | ✓  | –  |
| LVCMOS15                        | ✓                  | ✓ | ✓ | ✓ | ✓  | –  | –  |
| LVCMOS12                        | ✓                  | ✓ | ✓ | – | –  | –  | –  |

## Boundary-Scan Capability

All Spartan-3 FPGA IOBs support boundary-scan testing compatible with IEEE 1149.1 standards. During boundary-scan operations such as EXTEST and HIGHZ the I/O pull-down resistor is active. For more information, see [Boundary-Scan \(JTAG\) Mode, page 50](#), and refer to the “Using Boundary-Scan and BSDL Files” chapter in [UG331](#).

## SelectIO Interface Signal Standards

The IOBs support 18 different single-ended signal standards, as listed in [Table 8](#). Furthermore, the majority of IOBs can be used in specific pairs supporting any of eight differential signal standards, as shown in [Table 9](#).

To define the SelectIO™ interface signaling standard in a design, set the IOSTANDARD attribute to the appropriate setting. Xilinx provides a variety of different methods for applying the IOSTANDARD for maximum flexibility. For a full description of different methods of applying attributes to control IOSTANDARD, refer to the “Using I/O Resources” chapter in [UG331](#).

Together with placing the appropriate I/O symbol, two externally applied voltage levels,  $V_{CCO}$  and  $V_{REF}$ , select the desired signal standard. The  $V_{CCO}$  lines provide current to the output driver. The voltage on these lines determines the output voltage swing for all standards except GTL and GTLP.

All single-ended standards except the LVCMOS, LVTTTL, and PCI varieties require a Reference Voltage ( $V_{REF}$ ) to bias the input-switching threshold. Once a configuration data file is loaded into the FPGA that calls for the I/Os of a given bank to use such a signal standard, a few specifically reserved I/O pins on the same bank automatically convert to  $V_{REF}$  inputs. When using one of the LVCMOS standards, these pins remain I/Os because the  $V_{CCO}$  voltage biases the input-switching threshold, so there is no need for  $V_{REF}$ . Select the  $V_{CCO}$  and  $V_{REF}$  levels to suit the desired single-ended standard according to [Table 8](#).

Table 8: Single-Ended I/O Standards

| Signal Standard (IOSTANDARD) | V <sub>CCO</sub> (Volts) |            | V <sub>REF</sub> for Inputs (Volts) <sup>(1)</sup> | Board Termination Voltage (V <sub>TT</sub> ) in Volts |
|------------------------------|--------------------------|------------|--|---|
|                              | For Outputs              | For Inputs |  |   |
| GTL                          | Note 2                   | Note 2     | 0.8  | 1.2   |
| GTLP                         | Note 2                   | Note 2     | 1  | 1.5   |
| HSTL_I                       | 1.5                      | –          | 0.75   | 0.75  |
| HSTL_III                     | 1.5                      | –          | 0.9  | 1.5   |
| HSTL_I_18                    | 1.8                      | –          | 0.9  | 0.9   |
| HSTL_II_18                   | 1.8                      | –          | 0.9  | 0.9   |
| HSTL_III_18                  | 1.8                      | –          | 1.1  | 1.8   |
| LVC MOS12                    | 1.2                      | 1.2        | –  | –   |
| LVC MOS15                    | 1.5                      | 1.5        | –  | –   |
| LVC MOS18                    | 1.8                      | 1.8        | –  | –   |
| LVC MOS25                    | 2.5                      | 2.5        | –  | –   |
| LVC MOS33                    | 3.3                      | 3.3        | –  | –   |
| LVTTTL                       | 3.3                      | 3.3        | –  | –   |
| PCI33_3                      | 3.0                      | 3.0        | –  | –   |
| SSTL18_I                     | 1.8                      | –          | 0.9  | 0.9   |
| SSTL18_II                    | 1.8                      | –          | 0.9  | 0.9   |
| SSTL2_I                      | 2.5                      | –          | 1.25   | 1.25  |
| SSTL2_II                     | 2.5                      | –          | 1.25   | 1.25  |

**Notes:**

1. Banks 4 and 5 of any Spartan-3 device in a VQ100 package do not support signal standards using V<sub>REF</sub>
2. The V<sub>CCO</sub> level used for the GTL and GTLP standards must be no lower than the termination voltage (V<sub>TT</sub>), nor can it be lower than the voltage at the I/O pad.
3. See Table 10 for a listing of the single-ended DCI standards.

Differential standards employ a pair of signals, one the opposite polarity of the other. The noise canceling (e.g., Common-Mode Rejection) properties of these standards permit exceptionally high data transfer rates. This section introduces the differential signaling capabilities of Spartan-3 devices.

Each device-package combination designates specific I/O pairs that are specially optimized to support differential standards. A unique “L-number”, part of the pin name, identifies the line-pairs associated with each bank (see Figure 40, page 112). For each pair, the letters ‘P’ and ‘N’ designate the true and inverted lines, respectively. For example, the pin names IO\_L43P\_7 and IO\_L43N\_7 indicate the true and inverted lines comprising the line pair L43 on Bank 7. The V<sub>CCO</sub> lines provide current to the outputs. The V<sub>CCAUX</sub> lines supply power to the differential inputs, making them independent of the V<sub>CCO</sub> voltage for an I/O bank. The V<sub>REF</sub> lines are not used. Select the V<sub>CCO</sub> level to suit the desired differential standard according to Table 9.



Table 9: Differential I/O Standards

| Signal Standard<br>(IOSTANDARD) | V <sub>CCO</sub> (Volts) |            | V <sub>REF</sub> for Inputs (Volts) |
|---------------------------------|--------------------------|------------|-------------------------------------|
|                                 | For Outputs              | For Inputs |                                     |
| LDT_25 (ULVDS_25)               | 2.5                      | –          | –                                   |
| LVDS_25                         | 2.5                      | –          | –                                   |
| BLVDS_25                        | 2.5                      | –          | –                                   |
| LVDSEXT_25                      | 2.5                      | –          | –                                   |
| LVPECL_25                       | 2.5                      | –          | –                                   |
| RSDS_25                         | 2.5                      | –          | –                                   |
| DIFF_HSTL_II_18                 | 1.8                      | –          | –                                   |
| DIFF_SSTL2_II                   | 2.5                      | –          | –                                   |

**Notes:**

1. See [Table 10](#) for a listing of the differential DCI standards.

The need to supply V<sub>REF</sub> and V<sub>CCO</sub> imposes constraints on which standards can be used in the same bank. See [The Organization of IOBs into Banks](#) section for additional guidelines concerning the use of the V<sub>CCO</sub> and V<sub>REF</sub> lines.

## Digitally Controlled Impedance (DCI)

When the round-trip delay of an output signal—i.e., from output to input and back again—exceeds rise and fall times, it is common practice to add termination resistors to the line carrying the signal. These resistors effectively match the impedance of a device's I/O to the characteristic impedance of the transmission line, thereby preventing reflections that adversely affect signal integrity. However, with the high I/O counts supported by modern devices, adding resistors requires significantly more components and board area. Furthermore, for some packages—e.g., ball grid arrays—it may not always be possible to place resistors close to pins.

DCI answers these concerns by providing two kinds of on-chip terminations: Parallel terminations make use of an integrated resistor network. Series terminations result from controlling the impedance of output drivers. DCI actively adjusts both parallel and series terminations to accurately match the characteristic impedance of the transmission line. This adjustment process compensates for differences in I/O impedance that can result from normal variation in the ambient temperature, the supply voltage and the manufacturing process. When the output driver turns off, the series termination, by definition, approaches a very high impedance; in contrast, parallel termination resistors remain at the targeted values.

DCI is available only for certain I/O standards, as listed in [Table 10](#). DCI is selected by applying the appropriate I/O standard extensions to symbols or components. There are five basic ways to configure terminations, as shown in [Table 11](#). The DCI I/O standard determines which of these terminations is put into effect.

HSTL\_I\_DCI-, HSTL\_III\_DCI-, and SSTL2\_I\_DCI-type outputs do not require the VRN and VRP reference resistors. Likewise, LVDCI-type inputs do not require the VRN and VRP reference resistors. In a bank without any DCI I/O or a bank containing non-DCI I/O and purely HSTL\_I\_DCI- or HSTL\_III\_DCI-type outputs, or SSTL2\_I\_DCI-type outputs or LVDCI-type inputs, the associated VRN and VRP pins can be used as general-purpose I/O pins.

The HSLVDCI (High-Speed LVDCI) standard is intended for bidirectional use. The driver is identical to LVDCI, while the input is identical to HSTL. By using a V<sub>REF</sub>-referenced input, HSLVDCI allows greater input sensitivity at the receiver than when using a single-ended LVCMOS-type receiver.

Table 10: DCI I/O Standards

| Category of Signal Standard                 | Signal Standard (IOSTANDARD)          | V <sub>CC0</sub> (V) |            | V <sub>REF</sub> for Inputs (V) | Termination Type                      |                            |
|---|---------------------------------------|----------------------|------------|---------------------------------|---------------------------------------|----------------------------|
|   |                                       | For Outputs          | For Inputs |                                 | At Output                             | At Input                   |
| <b>Single-Ended</b>                         |                                       |                      |            |                                 |                                       |                            |
| Gunning Transceiver Logic                   | GTL_DCI                               | 1.2                  | 1.2        | 0.8                             | Single                                | Single                     |
|   | GTLP_DCI                              | 1.5                  | 1.5        | 1.0                             |                                       |                            |
| High-Speed Transceiver Logic                | HSTL_I_DCI                            | 1.5                  | 1.5        | 0.75                            | None                                  | Split                      |
|   | HSTL_III_DCI                          | 1.5                  | 1.5        | 0.9                             | None                                  | Single                     |
|   | HSTL_I_DCI_18                         | 1.8                  | 1.8        | 0.9                             | None                                  | Split                      |
|   | HSTL_II_DCI_18<br>DIFF_HSTL_II_18_DCI | 1.8                  | 1.8        | 0.9                             | Split                                 |                            |
|   | HSTL_III_DCI_18                       | 1.8                  | 1.8        | 1.1                             | None                                  | Single                     |
| Low-Voltage CMOS                            | LVDCI_15                              | 1.5                  | 1.5        | –                               | Controlled impedance driver           | None                       |
|   | LVDCI_18                              | 1.8                  | 1.8        | –                               |                                       |                            |
|   | LVDCI_25                              | 2.5                  | 2.5        | –                               |                                       |                            |
|   | LVDCI_33 <sup>(2)</sup>               | 3.3                  | 3.3        | –                               |                                       |                            |
|   | LVDCI_DV2_15                          | 1.5                  | 1.5        | –                               | Controlled driver with half-impedance |                            |
|   | LVDCI_DV2_18                          | 1.8                  | 1.8        | –                               |                                       |                            |
|   | LVDCI_DV2_25                          | 2.5                  | 2.5        | –                               |                                       |                            |
|   | LVDCI_DV2_33                          | 3.3                  | 3.3        | –                               |                                       |                            |
| Hybrid HSTL Input and LVCMOS Output         | HSLVDCI_15                            | 1.5                  | 1.5        | 0.75                            | Controlled impedance driver           | None                       |
|   | HSLVDCI_18                            | 1.8                  | 1.8        | 0.9                             |                                       |                            |
|   | HSLVDCI_25                            | 2.5                  | 2.5        | 1.25                            |                                       |                            |
|   | HSLVDCI_33                            | 3.3                  | 3.3        | 1.65                            |                                       |                            |
| Stub Series Terminated Logic <sup>(3)</sup> | SSTL18_I_DCI                          | 1.8                  | 1.8        | 0.9                             | 25Ω driver                            | Split                      |
|   | SSTL2_I_DCI                           | 2.5                  | 2.5        | 1.25                            | 25Ω driver                            |                            |
|   | SSTL2_II_DCI<br>DIFF_SSTL2_II_DCI     | 2.5                  | 2.5        | 1.25                            | Split with 25Ω driver                 |                            |
| <b>Differential</b>                         |                                       |                      |            |                                 |                                       |                            |
| Low-Voltage Differential Signaling          | LVDS_25_DCI                           | N/A                  | 2.5        | –                               | None                                  | Split on each line of pair |
|   | LVDS_25_DCI                           | N/A                  | 2.5        | –                               |                                       |                            |

**Notes:**

- DCI signal standards are not supported in Bank 5 of any Spartan-3 FPGA packaged in a VQ100, CP132, or TQ144 package.
- Equivalent to LVTTTL DCI.
- The SSTL18\_II signal standard does not have a DCI equivalent.

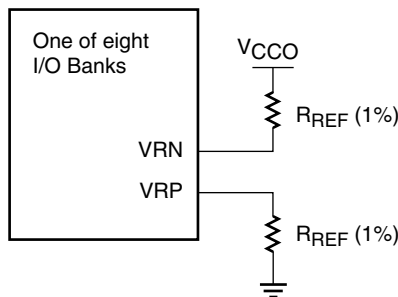
Table 11: DCI Terminations

| Termination   | Schematic <sup>(1)</sup>   | Signal Standards (IOSTANDARD)  |
|---|--|--|
| Controlled impedance output driver                        | <p style="text-align: right; font-size: small;">ds099_06a_070903</p> | LVDCI_15<br>LVDCI_18<br>LVDCI_25<br>LVDCI_33<br>HSLVDCI_15<br>HSLVDCI_18<br>HSLVDCI_25<br>HSLVDCI_33   |
| Controlled output driver with half impedance              | <p style="text-align: right; font-size: small;">ds099_06b_070903</p> | LVDCI_DV2_15<br>LVDCI_DV2_18<br>LVDCI_DV2_25<br>LVDCI_DV2_33   |
| Single resistor   | <p style="text-align: right; font-size: small;">ds099_06c_070903</p> | GTL_DCI<br>GTLP_DCI<br>HSTL_III_DCI <sup>(2)</sup><br>HSTL_III_DCI_18 <sup>(2)</sup>   |
| Split resistors   | <p style="text-align: right; font-size: small;">ds099_06d_070903</p> | HSTL_I_DCI <sup>(2)</sup><br>HSTL_I_DCI_18 <sup>(2)</sup><br>HSTL_II_DCI_18<br>DIFF_HSTL_II_18_DCI<br>DIFF_SSTL2_II_DCI<br>LVDS_25_DCI<br>LVDSEXT_25_DCI |
| Split resistors with output driver impedance fixed to 25Ω | <p style="text-align: right; font-size: small;">ds099_06e_070903</p> | SSTL18_I_DCI <sup>(3)</sup><br>SSTL2_I_DCI <sup>(3)</sup><br>SSTL2_II_DCI  |

**Notes:**

1. The value of R is equivalent to the characteristic impedance of the line connected to the I/O. It is also equal to half the value of RREF for the DV2 standards and RREF for all other DCI standards.
2. For DCI using HSTL Classes I and III, terminations only go into effect at inputs (not at outputs).
3. For DCI using SSTL Class I, the split termination only goes into effect at inputs (not at outputs).

The DCI feature operates independently for each of the device’s eight banks. Each bank has an ‘N’ reference pin (VRN) and a ‘P’ reference pin, (VRP), to calibrate driver and termination resistance. Only when using a DCI standard on a given bank do these two pins function as VRN and VRP. When not using a DCI standard, the two pins function as user I/Os. As shown in [Figure 9](#), add an external reference resistor to pull the VRN pin up to  $V_{CCO}$  and another reference resistor to pull the VRP pin down to GND. Also see [Figure 42, page 116](#). Both resistors have the same value—commonly  $50\Omega$ —with one-percent tolerance, which is either the characteristic impedance of the line or twice that, depending on the DCI standard in use. Standards having a symbol name that contains the letters “DV2” use a reference resistor value that is twice the line impedance. DCI adjusts the output driver impedance to match the reference resistors’ value or half that, according to the standard. DCI always adjusts the on-chip termination resistors to directly match the reference resistors’ value.



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Figure 9: Connection of Reference Resistors ( $R_{REF}$ )

The rules guiding the use of DCI standards on banks are as follows:

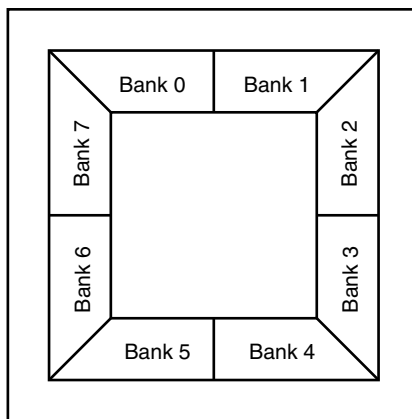
- No more than one DCI I/O standard with a Single Termination is allowed per bank.
- No more than one DCI I/O standard with a Split Termination is allowed per bank.
- Single Termination, Split Termination, Controlled- Impedance Driver, and Controlled-Impedance Driver with Half Impedance can co-exist in the same bank.

See also [The Organization of IOBs into Banks](#), immediately below, and [DCI: User I/O or Digitally Controlled Impedance Resistor Reference Input, page 115](#).

### The Organization of IOBs into Banks

IOBs are allocated among eight banks, so that each side of the device has two banks, as shown in [Figure 10](#). For all packages, each bank has independent  $V_{REF}$  lines. For example,  $V_{REF}$  Bank 3 lines are separate from the  $V_{REF}$  lines going to all other banks.

For the Very Thin Quad Flat Pack (VQ), Plastic Quad Flat Pack (PQ), Fine Pitch Thin Ball Grid Array (FT), and Fine Pitch Ball Grid Array (FG) packages, each bank has dedicated  $V_{CCO}$  lines. For example, the  $V_{CCO}$  Bank 7 lines are separate from the  $V_{CCO}$  lines going to all other banks. Thus, Spartan-3 devices in these packages support eight independent  $V_{CCO}$  supplies.



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Figure 10: Spartan-3 FPGA I/O Banks (Top View)

In contrast, the 144-pin Thin Quad Flat Pack (TQ144) package and the 132-pin Chip-Scale Package (CP132) tie  $V_{CCO}$  together internally for the pair of banks on each side of the device. For example, the  $V_{CCO}$  Bank 0 and the  $V_{CCO}$  Bank 1 lines are tied together. The interconnected bank-pairs are 0/1, 2/3, 4/5, and 6/7. As a result, Spartan-3 devices in the CP132 and TQ144 packages support four independent  $V_{CCO}$  supplies.

**Note:** The CP132 package is discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

## Spartan-3 FPGA Compatibility

Within the Spartan-3 family, all devices are pin-compatible by package. When the need for future logic resources outgrows the capacity of the Spartan-3 device in current use, a larger device in the same package can serve as a direct replacement. Larger devices may add extra  $V_{REF}$  and  $V_{CCO}$  lines to support a greater number of I/Os. In the larger device, more pins can convert from user I/Os to  $V_{REF}$  lines. Also, additional  $V_{CCO}$  lines are bonded out to pins that were “not connected” in the smaller device. Thus, it is important to plan for future upgrades at the time of the board’s initial design by laying out connections to the extra pins.

The Spartan-3 family is not pin-compatible with any previous Xilinx FPGA family or with other platforms among the Spartan-3 Generation FPGAs.

## Rules Concerning Banks

When assigning I/Os to banks, it is important to follow the following  $V_{CCO}$  rules:

- Leave no  $V_{CCO}$  pins unconnected on the FPGA.
- Set all  $V_{CCO}$  lines associated with the (interconnected) bank to the same voltage level.
- The  $V_{CCO}$  levels used by all standards assigned to the I/Os of the (interconnected) bank(s) must agree. The Xilinx development software checks for this. Tables 8, 9, and 10 describe how different standards use the  $V_{CCO}$  supply.
- Only one of the following standards is allowed on outputs per bank: LVDS, LDT, LVDS\_EXT, or RSDS. This restriction is for the eight banks in each device, even if the  $V_{CCO}$  levels are shared across banks, as in the CP132 and TQ144 packages.
- If none of the standards assigned to the I/Os of the (interconnected) bank(s) uses  $V_{CCO}$ , tie all associated  $V_{CCO}$  lines to 2.5V.
- In general, apply 2.5V to  $V_{CCO}$  Bank 4 from power-on to the end of configuration. Apply the same voltage to  $V_{CCO}$  Bank 5 during parallel configuration or a Readback operation. For information on how to program the FPGA using 3.3V signals and power, see the [3.3V-Tolerant Configuration Interface](#) section.

If any of the standards assigned to the Inputs of the bank use  $V_{REF}$  then observe the following additional rules:

- Connect *all*  $V_{REF}$  pins within the bank to the same voltage level.
- The  $V_{REF}$  levels used by all standards assigned to the Inputs of the bank must agree. The Xilinx development software checks for this. Tables 8 and 10 describe how different standards use the  $V_{REF}$  supply.

If none of the standards assigned to the Inputs of a bank use  $V_{REF}$  for biasing input switching thresholds, all associated  $V_{REF}$  pins function as User I/Os.

## Exceptions to Banks Supporting I/O Standards

Bank 5 of any Spartan-3 device in a VQ100, CP132, or TQ144 package does not support DCI signal standards. In this case, bank 5 has neither VRN nor VRP pins.

Furthermore, banks 4 and 5 of any Spartan-3 device in a VQ100 package do not support signal standards using  $V_{REF}$  (see [Table 8](#)). In this case, the two banks do not have any  $V_{REF}$  pins.

## Supply Voltages for the IOBs

Three different supplies power the IOBs:

- The  $V_{CCO}$  supplies, one for each of the FPGA's I/O banks, power the output drivers, except when using the GTL and GTLP signal standards. The voltage on the  $V_{CCO}$  pins determines the voltage swing of the output signal.
- $V_{CCINT}$  is the main power supply for the FPGA's internal logic.
- The  $V_{CCAUX}$  is an auxiliary source of power, primarily to optimize the performance of various FPGA functions such as I/O switching.

## The I/Os During Power-On, Configuration, and User Mode

With no power applied to the FPGA, all I/Os are in a high-impedance state. The  $V_{CCINT}$  (1.2V),  $V_{CCAUX}$  (2.5V), and  $V_{CCO}$  supplies may be applied in any order. Before power-on can finish,  $V_{CCINT}$ ,  $V_{CCO}$  Bank 4, and  $V_{CCAUX}$  must have reached their respective minimum recommended operating levels (see [Table 29, page 59](#)). At this time, all I/O drivers also will be in a high-impedance state.  $V_{CCO}$  Bank 4,  $V_{CCINT}$ , and  $V_{CCAUX}$  serve as inputs to the internal Power-On Reset circuit (POR).

A Low level applied to the HSWAP\_EN input enables pull-up resistors on User I/Os from power-on throughout configuration. A High level on HSWAP\_EN disables the pull-up resistors, allowing the I/Os to float. If the HSWAP\_EN pin is floating, then an internal pull-up resistor pulls HSWAP\_EN High. As soon as power is applied, the FPGA begins initializing its configuration memory. At the same time, the FPGA internally asserts the Global Set-Reset (GSR), which asynchronously resets all IOB storage elements to a Low state.

Upon the completion of initialization, INIT\_B goes High, sampling the M0, M1, and M2 inputs to determine the configuration mode. At this point, the configuration data is loaded into the FPGA. The I/O drivers remain in a high-impedance state (with or without pull-up resistors, as determined by the HSWAP\_EN input) throughout configuration.

The Global Three State (GTS) net is released during Start-Up, marking the end of configuration and the beginning of design operation in the User mode. At this point, those I/Os to which signals have been assigned go active while all unused I/Os remain in a high-impedance state. The release of the GSR net, also part of Start-up, leaves the IOB registers in a Low state by default, unless the loaded design reverses the polarity of their respective RS inputs.

In User mode, all internal pull-up resistors on the I/Os are disabled and HSWAP\_EN becomes a “don't care” input. If it is desirable to have pull-up or pull-down resistors on I/Os carrying signals, the appropriate symbol—e.g., PULLUP, PULLDOWN—must be placed at the appropriate pads in the design. The Bitstream Generator (Bitgen) option UnusedPin available in the Xilinx development software determines whether unused I/Os collectively have pull-up resistors, pull-down resistors, or no resistors in User mode.

## CLB Overview

For more details on the CLBs, refer to the chapter entitled “Using Configurable Logic Blocks” in [UG331](#).

The Configurable Logic Blocks (CLBs) constitute the main logic resource for implementing synchronous as well as combinatorial circuits. Each CLB comprises four interconnected slices, as shown in [Figure 11](#). These slices are grouped in pairs. Each pair is organized as a column with an independent carry chain.

The nomenclature that the FPGA Editor—part of the Xilinx development software—uses to designate slices is as follows: The letter ‘X’ followed by a number identifies columns of slices. The ‘X’ number counts up in sequence from the left side of the die to the right. The letter ‘Y’ followed by a number identifies the position of each slice in a pair as well as indicating the CLB row. The ‘Y’ number counts slices starting from the bottom of the die according to the sequence: 0, 1, 0, 1 (the first CLB row); 2, 3, 2, 3 (the second CLB row); etc. [Figure 11](#) shows the CLB located in the lower left-hand corner of the die. Slices X0Y0 and X0Y1 make up the column-pair on the left where as slices X1Y0 and X1Y1 make up the column-pair on the right. For each CLB, the term “left-hand” (or SLICEM) indicates the pair of slices labeled with an even ‘X’ number, such as X0, and the term “right-hand” (or SLICEL) designates the pair of slices with an odd ‘X’ number, e.g., X1.



Figure 11: Arrangement of Slices within the CLB

## Elements Within a Slice

All four slices have the following elements in common: two logic function generators, two storage elements, wide-function multiplexers, carry logic, and arithmetic gates, as shown in [Figure 12, page 24](#). Both the left-hand and right-hand slice pairs use these elements to provide logic, arithmetic, and ROM functions. Besides these, the left-hand pair supports two additional functions: storing data using Distributed RAM and shifting data with 16-bit registers. [Figure 12](#) is a diagram of the left-hand slice; therefore, it represents a superset of the elements and connections to be found in all slices. See [Function Generator, page 25](#) for more information.

The RAM-based function generator—also known as a Look-Up Table or LUT—is the main resource for implementing logic functions. Furthermore, the LUTs in each left-hand slice pair can be configured as Distributed RAM or a 16-bit shift register. For information on the former, refer to the chapter entitled “Using Look-Up Tables as Distributed RAM” in [UG331](#); for information on the latter, refer to the chapter entitled “Using Look-Up Tables as Shift Registers” in [UG331](#). The function generators located in the upper and lower portions of the slice are referred to as the “G” and “F”, respectively.

The storage element, which is programmable as either a D-type flip-flop or a level-sensitive latch, provides a means for synchronizing data to a clock signal, among other uses. The storage elements in the upper and lower portions of the slice are called FFY and FFX, respectively.

Wide-function multiplexers effectively combine LUTs in order to permit more complex logic operations. Each slice has two of these multiplexers with F5MUX in the lower portion of the slice and FiMUX in the upper portion. Depending on the slice, FiMUX takes on the name F6MUX, F7MUX, or F8MUX. For more details on the multiplexers, refer to the chapter entitled “Using Dedicated Multiplexers” in [UG331](#).

The carry chain, together with various dedicated arithmetic logic gates, support fast and efficient implementations of math operations. The carry chain enters the slice as CIN and exits as COUT. Five multiplexers control the chain: CYINIT, CY0F, and CYMUXF in the lower portion as well as CY0G and CYMUXG in the upper portion. The dedicated arithmetic logic includes the exclusive-OR gates XORG and XORF (upper and lower portions of the slice, respectively) as well as the AND gates GAND and FAND (upper and lower portions, respectively). For more details on the carry logic, refer to the chapter entitled “Using Carry and Arithmetic Logic” in [UG331](#).

## Main Logic Paths

Central to the operation of each slice are two nearly identical data paths, distinguished using the terms *top* and *bottom*. The description that follows uses names associated with the bottom path. (The top path names appear in parentheses.) The basic path originates at an interconnect-switch matrix outside the CLB. Four lines, F1 through F4 (or G1 through G4 on the



upper path), enter the slice and connect directly to the LUT. Once inside the slice, the lower 4-bit path passes through a function generator 'F' (or 'G') that performs logic operations. The function generator's Data output, 'D', offers five possible paths:

- Exit the slice via line 'X' (or 'Y') and return to interconnect.
- Inside the slice, 'X' (or 'Y') serves as an input to the DXMUX (DYMUX) which feeds the data input, 'D', of the FFX (FFY) storage element. The 'Q' output of the storage element drives the line XQ (or YQ) which exits the slice.
- Control the CYMUXF (or CYMUXG) multiplexer on the carry chain.
- With the carry chain, serve as an input to the XORF (or XORG) exclusive-OR gate that performs arithmetic operations, producing a result on 'X' (or 'Y').
- Drive the multiplexer F5MUX to implement logic functions wider than four bits. The 'D' outputs of both the F-LUT and G-LUT serve as data inputs to this multiplexer.

In addition to the main logic paths described above, there are two bypass paths that enter the slice as BX and BY. Once inside the FPGA, BX in the bottom half of the slice (or BY in the top half) can take any of several possible branches:

- Bypass both the LUT and the storage element, then exit the slice as BXOUT (or BYOUT) and return to interconnect.
- Bypass the LUT, then pass through a storage element via the D input before exiting as XQ (or YQ).
- Control the wide function multiplexer F5MUX (or F6MUX).
- Via multiplexers, serve as an input to the carry chain.
- Drives the DI input of the LUT.
- BY can control the REV inputs of both the FFY and FFX storage elements.
- Finally, the DIG\_MUX multiplexer can switch BY onto the DIG line, which exits the slice.

Other slice signals shown in [Figure 12](#) are discussed in the sections that follow.



## Function Generator

Each of the two LUTs (F and G) in a slice have four logic inputs (A1-A4) and a single output (D). This permits any four-variable Boolean logic operation to be programmed into them. Furthermore, wide function multiplexers can be used to effectively combine LUTs within the same CLB or across different CLBs, making logic functions with still more input variables possible.

The LUTs in both the right-hand and left-hand slice-pairs not only support the logic functions described above, but also can function as ROM that is initialized with data at the time of configuration.

The LUTs in the left-hand slice-pair (even-numbered columns such as X0 in [Figure 11](#)) of each CLB support two additional functions that the right-hand slice-pair (odd-numbered columns such as X1) do not.

First, it is possible to program the “left-hand LUTs” as distributed RAM. This type of memory affords moderate amounts of data buffering anywhere along a data path. One left-hand LUT stores 16 bits. Multiple left-hand LUTs can be combined in various ways to store larger amounts of data. A dual port option combines two LUTs so that memory access is possible from two independent data lines. A Distributed ROM option permits pre-loading the memory with data during FPGA configuration.

Second, it is possible to program each left-hand LUT as a 16-bit shift register. Used in this way, each LUT can delay serial data anywhere from one to 16 clock cycles. The four left-hand LUTs of a single CLB can be combined to produce delays up to 64 clock cycles. The SHIFTIN and SHIFTOUT lines cascade LUTs to form larger shift registers. It is also possible to combine shift registers across more than one CLB. The resulting programmable delays can be used to balance the timing of data pipelines.

## Block RAM Overview

All Spartan-3 devices support block RAM, which is organized as configurable, synchronous 18Kbit blocks. Block RAM stores relatively large amounts of data more efficiently than the distributed RAM feature described earlier. (The latter is better suited for buffering small amounts of data anywhere along signal paths.) This section describes basic Block RAM functions. For more information, refer to the chapter entitled “Using Block RAM” in [UG331](#).

The aspect ratio—i.e., width vs. depth—of each block RAM is configurable. Furthermore, multiple blocks can be cascaded to create still wider and/or deeper memories.

A choice among primitives determines whether the block RAM functions as dual- or single-port memory. A name of the form RAMB16\_S[w<sub>A</sub>]<sub>S</sub>[w<sub>B</sub>] calls out the dual-port primitive, where the integers w<sub>A</sub> and w<sub>B</sub> specify the total data path width at ports w<sub>A</sub> and w<sub>B</sub>, respectively. Thus, a RAMB16\_S9\_S18 is a dual-port RAM with a 9-bit-wide Port A and an 18-bit-wide Port B. A name of the form RAMB16\_S[w] identifies the single-port primitive, where the integer w specifies the total data path width of the lone port. A RAMB16\_S18 is a single-port RAM with an 18-bit-wide port. Other memory functions—e.g., FIFOs, data path width conversion, ROM, etc.—are readily available using the CORE Generator™ software, part of the Xilinx development software.

## Arrangement of RAM Blocks on Die

The XC3S50 has one column of block RAM. The Spartan-3 devices ranging from the XC3S200 to XC3S2000 have two columns of block RAM. The XC3S4000 and XC3S5000 have four columns. The position of the columns on the die is shown in [Figure 1, page 3](#). For a given device, the total available RAM blocks are distributed equally among the columns. [Table 12](#) shows the number of RAM blocks, the data storage capacity, and the number of columns for each device.

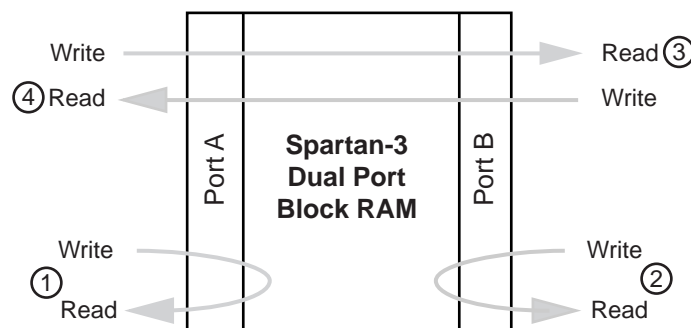
Table 12: Number of RAM Blocks by Device

| Device   | Total Number of RAM Blocks | Total Addressable Locations (Bits) | Number of Columns |
|----------|----------------------------|------------------------------------|-------------------|
| XC3S50   | 4                          | 73,728                             | 1                 |
| XC3S200  | 12                         | 221,184                            | 2                 |
| XC3S400  | 16                         | 294,912                            | 2                 |
| XC3S1000 | 24                         | 442,368                            | 2                 |
| XC3S1500 | 32                         | 589,824                            | 2                 |
| XC3S2000 | 40                         | 737,280                            | 2                 |
| XC3S4000 | 96                         | 1,769,472                          | 4                 |
| XC3S5000 | 104                        | 1,916,928                          | 4                 |

Block RAM and multipliers have interconnects between them that permit simultaneous operation; however, since the multiplier shares inputs with the upper data bits of block RAM, the maximum data path width of the block RAM is 18 bits in this case.

## The Internal Structure of the Block RAM

The block RAM has a dual port structure. The two identical data ports called A and B permit independent access to the common RAM block, which has a maximum capacity of 18,432 bits—or 16,384 bits when no parity lines are used. Each port has its own dedicated set of data, control and clock lines for synchronous read and write operations. There are four basic data paths, as shown in [Figure 13](#): (1) write to and read from Port A, (2) write to and read from Port B, (3) data transfer from Port A to Port B, and (4) data transfer from Port B to Port A.

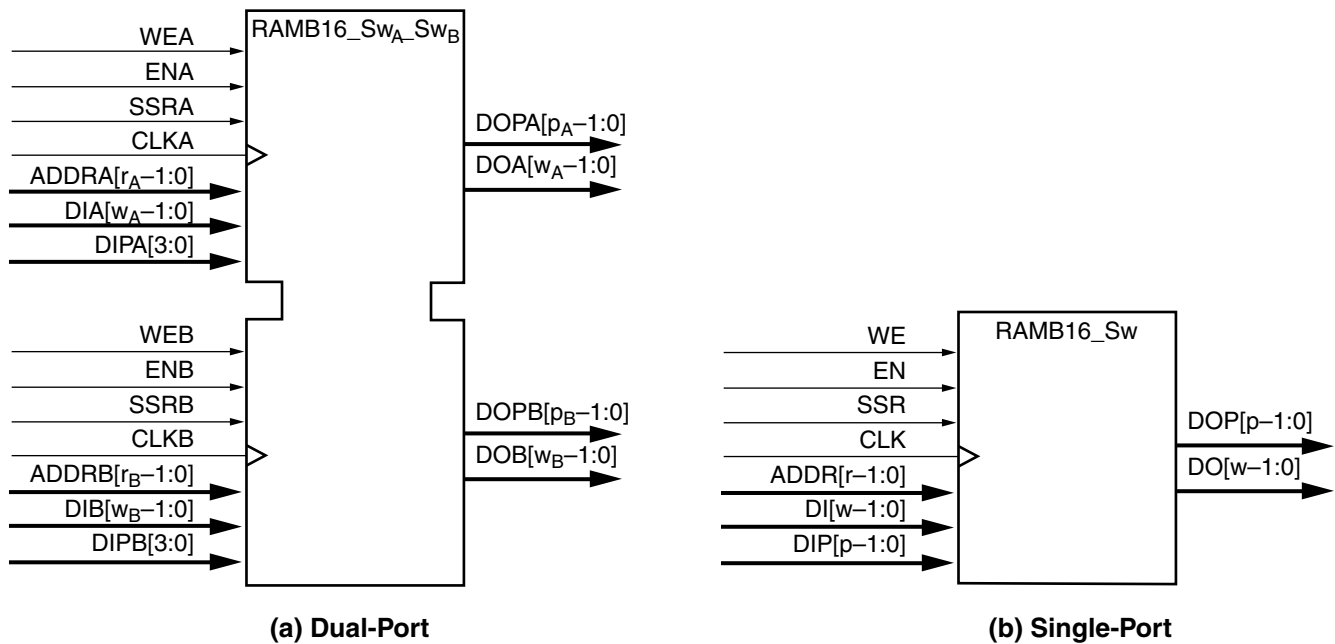


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Figure 13: Block RAM Data Paths

## Block RAM Port Signal Definitions

Representations of the dual-port primitive  $RAMB16\_S[w_A]_S[w_B]$  and the single-port primitive  $RAMB16\_S[w]$  with their associated signals are shown in [Figure 14](#). These signals are defined in [Table 13](#).



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**Notes:**

1.  $w_A$  and  $w_B$  are integers representing the total data path width (i.e., data bits plus parity bits) at ports A and B, respectively.
2.  $p_A$  and  $p_B$  are integers that indicate the number of data path lines serving as parity bits.
3.  $r_A$  and  $r_B$  are integers representing the address bus width at ports A and B, respectively.
4. The control signals CLK, WE, EN, and SSR on both ports have the option of inverted polarity.

Figure 14: Block RAM Primitives

Table 13: Block RAM Port Signals

| Signal Description   | Port A Signal Name | Port B Signal Name | Direction | Function   |
|----------------------|--------------------|--------------------|-----------|--|
| Address Bus          | ADDRA              | ADDRB              | Input     | The Address Bus selects a memory location for read or write operations. The width ( $w$ ) of the port's associated data path determines the number of available address lines ( $r$ ).<br>Whenever a port is enabled ( $ENA$ or $ENB = \text{High}$ ), address transitions must meet the data sheet setup and hold times with respect to the port clock ( $CLKA$ or $CLKB$ ). This requirement must be met, even if the RAM read output is of no interest.   |
| Data Input Bus       | DIA                | DIB                | Input     | Data at the DI input bus is written to the addressed memory location addressed on an enabled active CLK edge.<br>It is possible to configure a port's total data path width ( $w$ ) to be 1, 2, 4, 9, 18, or 36 bits. This selection applies to both the DI and DO paths of a given port. Each port is independent. For a port assigned a width ( $w$ ), the number of addressable locations is $16,384/(w-p)$ where " $p$ " is the number of parity bits. Each memory location has a width of " $w$ " (including parity bits). See the DIP signal description for more information of parity. |
| Parity Data Input(s) | DIPA               | DIPB               | Input     | Parity inputs represent additional bits included in the data input path to support error detection. The number of parity bits " $p$ " included in the DI (same as for the DO bus) depends on a port's total data path width ( $w$ ). See Table 14.   |

Table 13: Block RAM Port Signals (Cont'd)

| Signal Description    | Port A Signal Name | Port B Signal Name | Direction | Function  |
|-----------------------|--------------------|--------------------|-----------|---|
| Data Output Bus       | DOA                | DOB                | Output    | Basic data access occurs whenever WE is inactive. The DO outputs mirror the data stored in the addressed memory location.<br>Data access with WE asserted is also possible if one of the following two attributes is chosen: WRITE_FIRST and READ_FIRST. WRITE_FIRST simultaneously presents the new input data on the DO output port and writes the data to the address RAM location. READ_FIRST presents the previously stored RAM data on the DO output port while writing new data to RAM.<br>A third attribute, NO_CHANGE, latches the DO outputs upon the assertion of WE.<br>It is possible to configure a port's total data path width (w) to be 1, 2, 4, 9, 18, or 36 bits. This selection applies to both the DI and DO paths. See the DI signal description. |
| Parity Data Output(s) | DOPA               | DOPB               | Output    | Parity inputs represent additional bits included in the data input path to support error detection. The number of parity bits "p" included in the DI (same as for the DO bus) depends on a port's total data path width (w). See Table 14.  |
| Write Enable          | WEA                | WEB                | Input     | When asserted together with EN, this input enables the writing of data to the RAM. In this case, the data access attributes WRITE_FIRST, READ_FIRST or NO_CHANGE determines if and how data is updated on the DO outputs. See the DO signal description.<br>When WE is inactive with EN asserted, read operations are still possible. In this case, a transparent latch passes data from the addressed memory location to the DO outputs.   |
| Clock Enable          | ENA                | ENB                | Input     | When asserted, this input enables the CLK signal to synchronize Block RAM functions as follows: the writing of data to the DI inputs (when WE is also asserted), the updating of data at the DO outputs as well as the setting/resetting of the DO output latches.<br>When de-asserted, the above functions are disabled.   |
| Set/Reset             | SSRA               | SSRB               | Input     | When asserted, this pin forces the DO output latch to the value that the SRVAL attribute is set to. A Set/Reset operation on one port has no effect on the other ports functioning, nor does it disturb the memory's data contents. It is synchronized to the CLK signal.   |
| Clock                 | CLKA               | CLKB               | Input     | This input accepts the clock signal to which read and write operations are synchronized. All associated port inputs are required to meet setup times with respect to the clock signal's active edge. The data output bus responds after a clock-to-out delay referenced to the clock signal's active edge.  |

## Port Aspect Ratios

On a given port, it is possible to select a number of different possible widths ( $w - p$ ) for the DI/DO buses as shown in Table 14. These two buses always have the same width. This data bus width selection is independent for each port. If the data bus width of Port A differs from that of Port B, the Block RAM automatically performs a bus-matching function. When data are written to a port with a narrow bus, then read from a port with a wide bus, the latter port will effectively combine "narrow" words to form "wide" words. Similarly, when data are written into a port with a wide bus, then read from a port with a narrow bus, the latter port will divide "wide" words to form "narrow" words. When the data bus width is eight bits or greater, extra parity bits become available. The width of the total data path ( $w$ ) is the sum of the DI/DO bus width and any parity bits ( $p$ ).

The width selection made for the DI/DO bus determines the number of address lines according to the relationship expressed below:

$$r = 14 - \lceil \log(w-p) / \log(2) \rceil \tag{Equation 1}$$

In turn, the number of address lines delimits the total number ( $n$ ) of addressable locations or depth according to the following equation:

$$n = 2^r \tag{Equation 2}$$

The product of  $w$  and  $n$  yields the total block RAM capacity. Equation 1 and Equation 2 show that as the data bus width increases, the number of address lines along with the number of addressable memory locations decreases. Using the permissible DI/DO bus widths as inputs to these equations provides the bus width and memory capacity measures shown in Table 14.

Table 14: Port Aspect Ratios for Port A or B

| DI/DO Bus Width (w – p Bits) | DIP/DOP Bus Width (p Bits) | Total Data Path Width (w Bits) | ADDR Bus Width (r Bits) | No. of Addressable Locations (n) | Block RAM Capacity (Bits) |
|------------------------------|----------------------------|--------------------------------|-------------------------|----------------------------------|---------------------------|
| 1                            | 0                          | 1                              | 14                      | 16,384                           | 16,384                    |
| 2                            | 0                          | 2                              | 13                      | 8,192                            | 16,384                    |
| 4                            | 0                          | 4                              | 12                      | 4,096                            | 16,384                    |
| 8                            | 1                          | 9                              | 11                      | 2,048                            | 18,432                    |
| 16                           | 2                          | 18                             | 10                      | 1,024                            | 18,432                    |
| 32                           | 4                          | 36                             | 9                       | 512                              | 18,432                    |

### Block RAM Data Operations

Writing data to and accessing data from the block RAM are synchronous operations that take place independently on each of the two ports.

The waveforms for the write operation are shown in the top half of the Figure 15, Figure 16, and Figure 17. When the WE and EN signals enable the active edge of CLK, data at the DI input bus is written to the block RAM location addressed by the ADDR lines.

There are a number of different conditions under which data can be accessed at the DO outputs. Basic data access always occurs when the WE input is inactive. Under this condition, data stored in the memory location addressed by the ADDR lines passes through a transparent output latch to the DO outputs. The timing for basic data access is shown in the portions of Figure 15, Figure 16, and Figure 17 during which WE is Low.

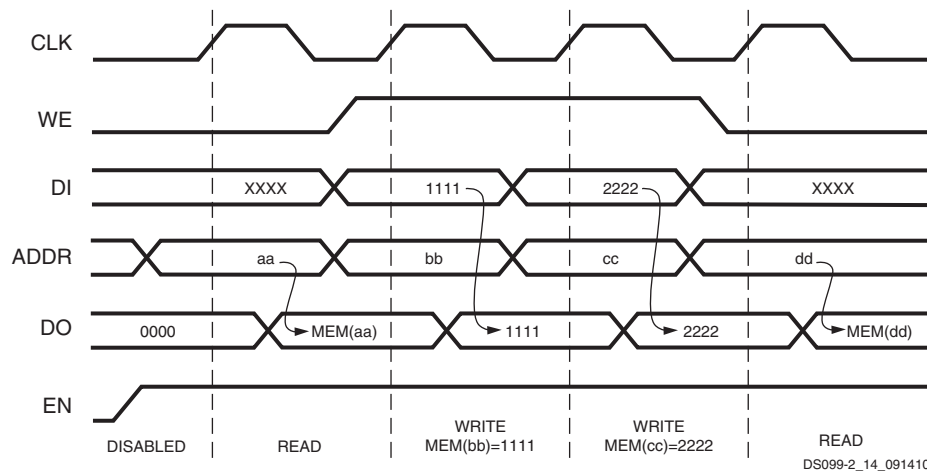


Figure 15: Waveforms of Block RAM Data Operations with WRITE\_FIRST Selected

Data can also be accessed on the DO outputs when asserting the WE input. This is accomplished using two different attributes:

Choosing the WRITE\_FIRST attribute, data is written to the addressed memory location on an enabled active CLK edge and is also passed to the DO outputs. WRITE\_FIRST timing is shown in the portion of Figure 15 during which WE is High.

Choosing the READ\_FIRST attribute, data already stored in the addressed location pass to the DO outputs before that location is overwritten with new data from the DI inputs on an enabled active CLK edge. READ\_FIRST timing is shown in the portion of Figure 16 during which WE is High.



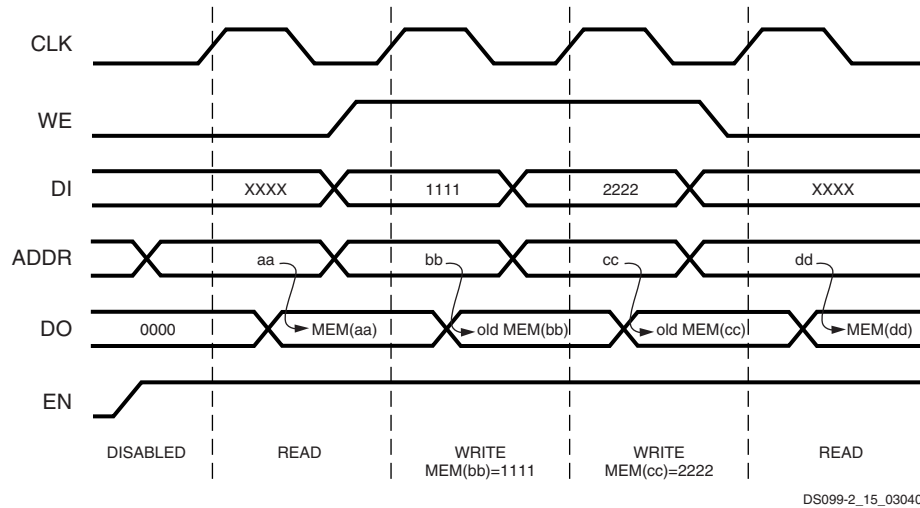


Figure 16: Waveforms of Block RAM Data Operations with READ\_FIRST Selected

Choosing a third attribute called NO\_CHANGE puts the DO outputs in a latched state when asserting WE. Under this condition, the DO outputs will retain the data driven just before WE was asserted. NO\_CHANGE timing is shown in the portion of Figure 17 during which WE is High.

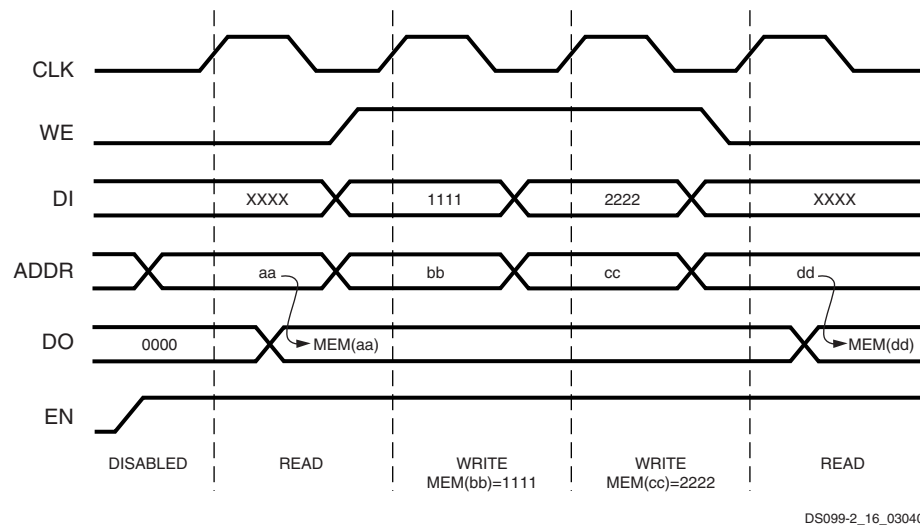


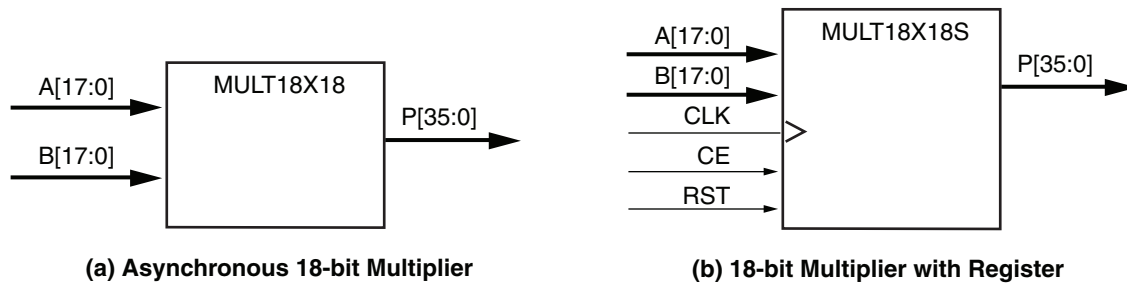
Figure 17: Waveforms of Block RAM Data Operations with NO\_CHANGE Selected

## Dedicated Multipliers

All Spartan-3 devices provide embedded multipliers that accept two 18-bit words as inputs to produce a 36-bit product. This section provides an introduction to multipliers. For further details, refer to the chapter entitled “Using Embedded Multipliers” in [UG331](#).

The input buses to the multiplier accept data in two’s-complement form (either 18-bit signed or 17-bit unsigned). One such multiplier is matched to each block RAM on the die. The close physical proximity of the two ensures efficient data handling. Cascading multipliers permits multiplicands more than three in number as well as wider than 18-bits. The multiplier is placed in a design using one of two primitives: an asynchronous version called MULT18X18 and a version with a register called MULT18X18S, as shown in [Figure 18](#). The signals for these primitives are defined in [Table 15](#).

The CORE Generator system produces multipliers based on these primitives that can be configured to suit a wide range of requirements.



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Figure 18: Embedded Multiplier Primitives

Table 15: Embedded Multiplier Primitives Descriptions

| Signal Name | Direction            | Function   |
|-------------|----------------------|--|
| A[17:0]     | Input                | Apply one 18-bit multiplicand to these inputs. The MULT18X18S primitive requires a setup time before the enabled rising edge of CLK.                               |
| B[17:0]     | Input                | Apply the other 18-bit multiplicand to these inputs. The MULT18X18S primitive requires a setup time before the enabled rising edge of CLK.                         |
| P[35:0]     | Output               | The output on the P bus is a 36-bit product of the multiplicands A and B. In the case of the MULT18X18S primitive, an enabled rising CLK edge updates the P bus.   |
| CLK         | Input <sup>(1)</sup> | CLK is only an input to the MULT18X18S primitive. The clock signal applied to this input, when enabled by CE, updates the output register that drives the P bus.   |
| CE          | Input <sup>(1)</sup> | CE is only an input to the MULT18X18S primitive. Enable for the CLK signal. Asserting this input enables the CLK signal to update the P bus.                       |
| RST         | Input <sup>(1)</sup> | RST is only an input to the MULT18X18S primitive. Asserting this input resets the output register on an enabled, rising CLK edge, forcing the P bus to all zeroes. |

**Notes:**

1. The control signals CLK, CE and RST have the option of inverted polarity.

## Digital Clock Manager (DCM)

Spartan-3 devices provide flexible, complete control over clock frequency, phase shift and skew through the use of the DCM feature. To accomplish this, the DCM employs a Delay-Locked Loop (DLL), a fully digital control system that uses feedback to maintain clock signal characteristics with a high degree of precision despite normal variations in operating temperature and voltage. This section provides a fundamental description of the DCM. For further information, refer to the chapter entitled “Using Digital Clock Managers” in [UG331](#).

Each member of the Spartan-3 family has four DCMs, except the smallest, the XC3S50, which has two DCMs. The DCMs are located at the ends of the outermost Block RAM column(s). See [Figure 1, page 3](#). The Digital Clock Manager is placed in a design as the “DCM” primitive.

The DCM supports three major functions:

- **Clock-skew Elimination:** Clock skew describes the extent to which clock signals may, under normal circumstances, deviate from zero-phase alignment. It occurs when slight differences in path delays cause the clock signal to arrive at different points on the die at different times. This clock skew can increase set-up and hold time requirements as well as clock-to-out time, which may be undesirable in applications operating at a high frequency, when timing is critical. The DCM eliminates clock skew by aligning the output clock signal it generates with another version of the clock signal that is fed back. As a result, the two clock signals establish a zero-phase relationship. This effectively cancels out clock distribution delays that may lie in the signal path leading from the clock output of the DCM to its feedback input.
- **Frequency Synthesis:** Provided with an input clock signal, the DCM can generate a wide range of different output clock frequencies. This is accomplished by either multiplying and/or dividing the frequency of the input clock signal by any of several different factors.

- **Phase Shifting:** The DCM provides the ability to shift the phase of all its output clock signals with respect to its input clock signal.

The DCM has four functional components: the Delay-Locked Loop (DLL), the Digital Frequency Synthesizer (DFS), the Phase Shifter (PS), and the Status Logic. Each component has its associated signals, as shown in Figure 19.

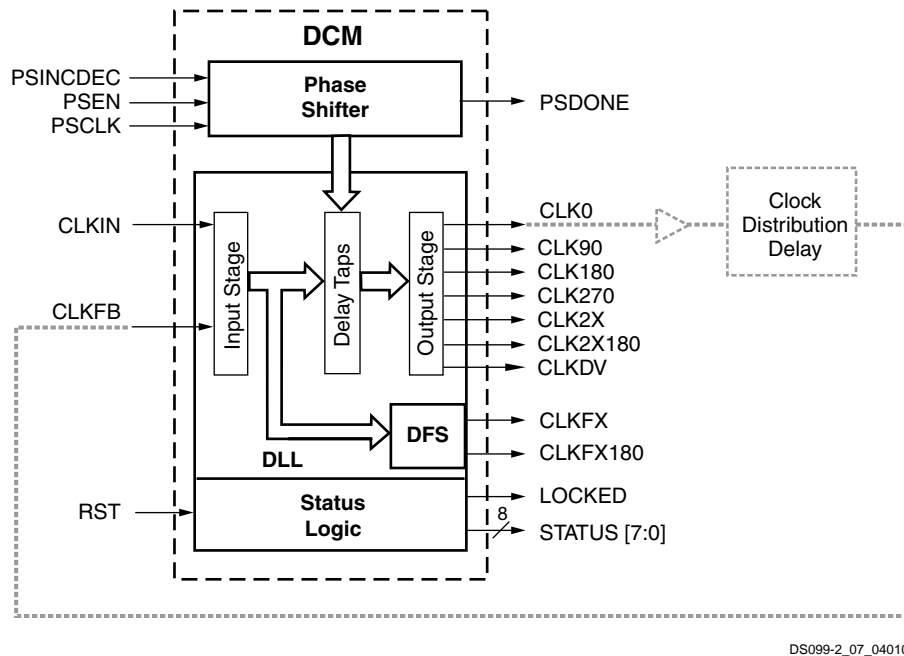


Figure 19: DCM Functional Blocks and Associated Signals

### Delay-Locked Loop (DLL)

The most basic function of the DLL component is to eliminate clock skew. The main signal path of the DLL consists of an input stage, followed by a series of discrete delay elements or *taps*, which in turn leads to an output stage. This path together with logic for phase detection and control forms a system complete with feedback as shown in Figure 20.

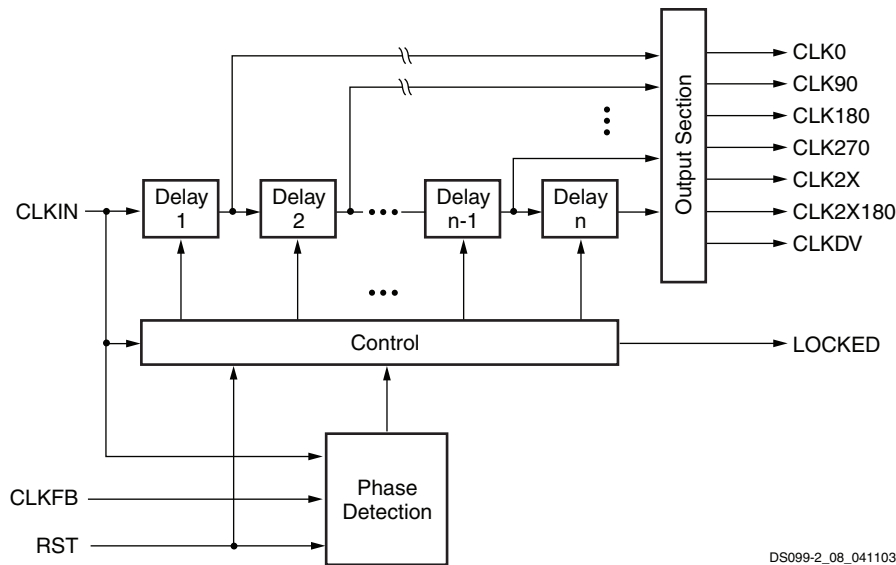


Figure 20: Simplified Functional Diagram of DLL

The DLL component has two clock inputs, CLKIN and CLKFB, as well as seven clock outputs, CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, and CLKDV as described in [Table 16](#). The clock outputs drive simultaneously; however, the High Frequency mode only supports a subset of the outputs available in the Low Frequency mode. See [DLL Frequency Modes](#), page 35. Signals that initialize and report the state of the DLL are discussed in [The Status Logic Component](#), page 41.

Table 16: DLL Signals

| Signal   | Direction | Description  | Mode Support  |                |
|----------|-----------|--|---------------|----------------|
|          |           |  | Low Frequency | High Frequency |
| CLKIN    | Input     | Accepts original clock signal.   | Yes           | Yes            |
| CLKFB    | Input     | Accepts either CLK0 or CLK2X as feed back signal. (Set CLK_FEEDBACK attribute accordingly).                                | Yes           | Yes            |
| CLK0     | Output    | Generates clock signal with same frequency and phase as CLKIN.   | Yes           | Yes            |
| CLK90    | Output    | Generates clock signal with same frequency as CLKIN, only phase-shifted 90°.   | Yes           | No             |
| CLK180   | Output    | Generates clock signal with same frequency as CLKIN, only phase-shifted 180°.  | Yes           | Yes            |
| CLK270   | Output    | Generates clock signal with same frequency as CLKIN, only phase-shifted 270°.  | Yes           | No             |
| CLK2X    | Output    | Generates clock signal with same phase as CLKIN, only twice the frequency.   | Yes           | No             |
| CLK2X180 | Output    | Generates clock signal with twice the frequency of CLKIN, phase-shifted 180° with respect to CLKIN.                        | Yes           | No             |
| CLKDV    | Output    | Divides the CLKIN frequency by CLKDV_DIVIDE value to generate lower frequency clock signal that is phase-aligned to CLKIN. | Yes           | Yes            |

The clock signal supplied to the CLKIN input serves as a reference waveform, with which the DLL seeks to align the feedback signal at the CLKFB input. When eliminating clock skew, the common approach to using the DLL is as follows: The CLK0 signal is passed through the clock distribution network to all the registers it synchronizes. These registers are either internal or external to the FPGA. After passing through the clock distribution network, the clock signal returns to the DLL via a feedback line called CLKFB. The control block inside the DLL measures the phase error between CLKFB and CLKIN. This phase error is a measure of the clock skew that the clock distribution network introduces. The control block activates the appropriate number of delay elements to cancel out the clock skew. Once the DLL has brought the CLK0 signal in phase with the CLKIN signal, it asserts the LOCKED output, indicating a “lock” on to the CLKIN signal.

### DLL Attributes and Related Functions

A number of different functional options can be set for the DLL component through the use of the attributes described in [Table 17](#). Each attribute is described in detail in the sections that follow:

Table 17: DLL Attributes

| Attribute             | Description  | Values   |
|-----------------------|--|--|
| CLK_FEEDBACK          | Chooses either the CLK0 or CLK2X output to drive the CLKFB input                                 | NONE, 1X, 2X   |
| DLL_FREQUENCY_MODE    | Chooses between High Frequency and Low Frequency modes   | LOW, HIGH  |
| CLKIN_DIVIDE_BY_2     | Halves the frequency of the CLKIN signal just as it enters the DCM                               | TRUE, FALSE  |
| CLKDV_DIVIDE          | Selects constant used to divide the CLKIN input frequency to generate the CLKDV output frequency | 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6.0, 6.5, 7.0, 7.5, 8, 9, 10, 11, 12, 13, 14, 15, and 16. |
| DUTY_CYCLE_CORRECTION | Enables 50% duty cycle correction for the CLK0, CLK90, CLK180, and CLK270 outputs                | TRUE, FALSE  |

## DLL Clock Input Connections

An external clock source enters the FPGA using a Global Clock Input Buffer (IBUFG), which directly accesses the global clock network or an Input Buffer (IBUF). Clock signals within the FPGA drive a global clock net using a Global Clock Multiplexer Buffer (BUFGMUX). The global clock net connects directly to the CLKIN input. The internal and external connections are shown in the [a] and [c] sections, respectively, of [Figure 21](#). A differential clock (e.g., LVDS) can serve as an input to CLKIN.

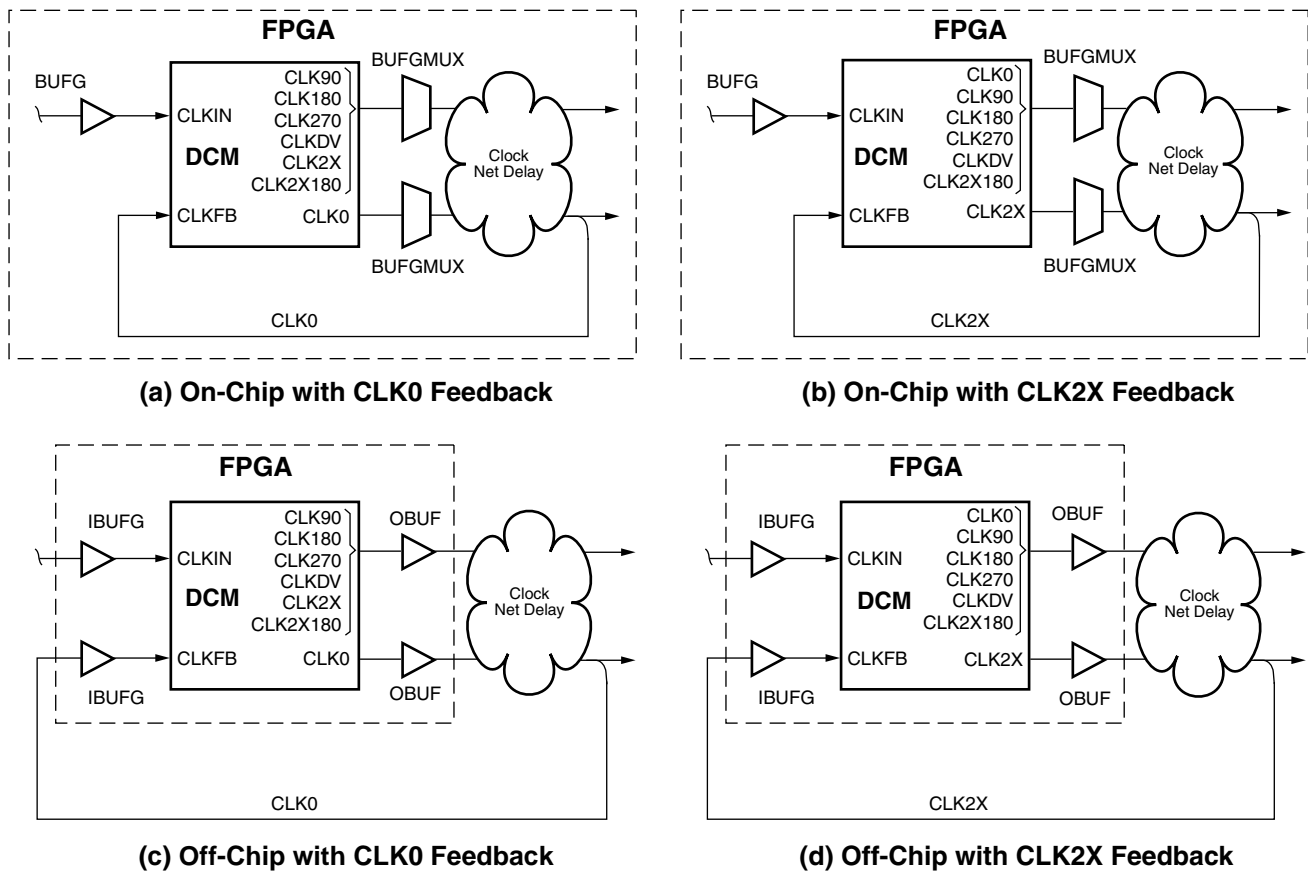
## DLL Clock Output and Feedback Connections

As many as four of the nine DCM clock outputs can simultaneously drive the four BUFGMUX buffers on the same die edge (top or bottom). All DCM clock outputs can simultaneously drive general routing resources, including interconnect leading to OBUF buffers.

The feedback loop is essential for DLL operation and is established by driving the CLKFB input with either the CLK0 or the CLK2X signal so that any undesirable clock distribution delay is included in the loop. It is possible to use either of these two signals for synchronizing any of the seven DLL outputs: CLK0, CLK90, CLK180, CLK270, CLKDV, CLK2X, or CLK2X180. The value assigned to the CLK\_FEEDBACK attribute must agree with the physical feedback connection: a value of 1X for the CLK0 case, 2X for the CLK2X case. If the DCM is used in an application that does not require the DLL—i.e., only the DFS is used—then there is no feedback loop so CLK\_FEEDBACK is set to NONE.

CLK2X feedback is only supported on all mask revision 'E' and later devices (see [Mask and Fab Revisions, page 58](#)), on devices with the "GQ" fabrication code, and on all versions of the XC3S50 and XC3S1000.

There are two basic cases that determine how to connect the DLL clock outputs and feedback connections: on-chip synchronization and off-chip synchronization, which are illustrated in [Figure 21](#).



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**Notes:**

1. In the Low Frequency mode, all seven DLL outputs are available. In the High Frequency mode, only the CLK0, CLK180, and CLKDV outputs are available.

*Figure 21: Input Clock, Output Clock, and Feedback Connections for the DLL*

In the on-chip synchronization case (the [a] and [b] sections of Figure 21), it is possible to connect any of the DLL’s seven output clock signals through general routing resources to the FPGA’s internal registers. Either a Global Clock Buffer (BUFG) or a BUFGMUX affords access to the global clock network. As shown in the [a] section of Figure 21, the feedback loop is created by routing CLK0 (or CLK2X, in the [b] section) to a global clock net, which in turn drives the CLKFB input.

In the off-chip synchronization case (the [c] and [d] sections of Figure 21), CLK0 (or CLK2X) plus any of the DLL’s other output clock signals exit the FPGA using output buffers (OBUF) to drive an external clock network plus registers on the board. As shown in the [c] section of Figure 21, the feedback loop is formed by feeding CLK0 (or CLK2X, in the [d] section) back into the FPGA using an IBUFG, which directly accesses the global clock network, or an IBUF. Then, the global clock net is connected directly to the CLKFB input.

**DLL Frequency Modes**

The DLL supports two distinct operating modes, High Frequency and Low Frequency, with each specified over a different clock frequency range. The DLL\_FREQUENCY\_MODE attribute chooses between the two modes. When the attribute is set to LOW, the Low Frequency mode permits all seven DLL clock outputs to operate over a low-to-moderate frequency range. When the attribute is set to HIGH, the High Frequency mode allows the CLK0, CLK180 and CLKDV outputs to operate at the highest possible frequencies. The remaining DLL clock outputs are not available for use in High Frequency mode.

**Accommodating High Input Frequencies**

If the frequency of the CLKIN signal is high such that it exceeds the maximum permitted, divide it down to an acceptable value using the CLKIN\_DIVIDE\_BY\_2 attribute. When this attribute is set to TRUE, the CLKIN frequency is divided by a factor of two just as it enters the DCM.

## Coarse Phase Shift Outputs of the DLL Component

In addition to CLK0 for zero-phase alignment to the CLKIN signal, the DLL also provides the CLK90, CLK180 and CLK270 outputs for 90°, 180° and 270° phase-shifted signals, respectively. These signals are described in [Table 16, page 33](#). Their relative timing in the Low Frequency Mode is shown in [Figure 22, page 37](#). The CLK90, CLK180 and CLK270 outputs are not available when operating in the High Frequency mode. (See the description of the DLL\_FREQUENCY\_MODE attribute in [Table 17, page 33](#).) For control in finer increments than 90°, see [Phase Shifter \(PS\), page 39](#).

## Basic Frequency Synthesis Outputs of the DLL Component

The DLL component provides basic options for frequency multiplication and division in addition to the more flexible synthesis capability of the DFS component, described in a later section. These operations result in output clock signals with frequencies that are either a fraction (for division) or a multiple (for multiplication) of the incoming clock frequency. The CLK2X output produces an in-phase signal that is twice the frequency of CLKIN. The CLK2X180 output also doubles the frequency, but is 180° out-of-phase with respect to CLKIN. The CLKDIV output generates a clock frequency that is a predetermined fraction of the CLKIN frequency. The CLKDV\_DIVIDE attribute determines the factor used to divide the CLKIN frequency. The attribute can be set to various values as described in [Table 17](#). The basic frequency synthesis outputs are described in [Table 16](#). Their relative timing in the Low Frequency Mode is shown in [Figure 22](#).

The CLK2X and CLK2X180 outputs are not available when operating in the High Frequency mode. See the description of the DLL\_FREQUENCY\_MODE attribute in [Table 18](#).

## Duty Cycle Correction of DLL Clock Outputs

The CLK2X<sup>(1)</sup>, CLK2X180, and CLKDV<sup>(2)</sup> output signals ordinarily exhibit a 50% duty cycle—even if the incoming CLKIN signal has a different duty cycle. A 50% duty cycle means that the High and Low times of each clock cycle are equal. The DUTY\_CYCLE\_CORRECTION attribute determines whether or not duty cycle correction is applied to the CLK0, CLK90, CLK180 and CLK270 outputs. If DUTY\_CYCLE\_CORRECTION is set to TRUE, then the duty cycle of these four outputs is corrected to 50%. If DUTY\_CYCLE\_CORRECTION is set to FALSE, then these outputs exhibit the same duty cycle as the CLKIN signal. [Figure 22](#) compares the characteristics of the DLL's output signals to those of the CLKIN signal.

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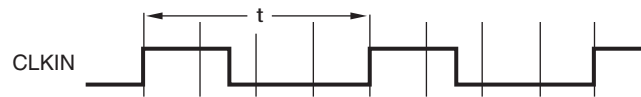
1. The CLK2X output generates a 25% duty cycle clock at the same frequency as the CLKIN signal until the DLL has achieved lock.

2. The duty cycle of the CLKDV outputs may differ somewhat from 50% (i.e., the signal will be High for less than 50% of the period) when the CLKDV\_DIVIDE attribute is set to a non-integer value *and* the DLL is operating in the High Frequency mode.

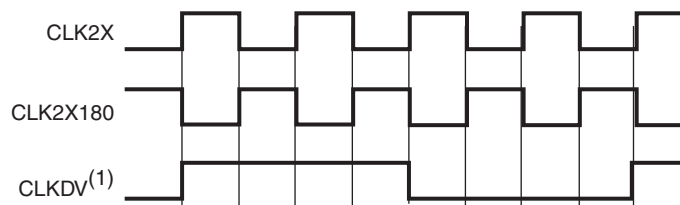


Phase: 0° 90° 180° 270° 0° 90° 180° 270° 0°

Input Signal (40% Duty Cycle)

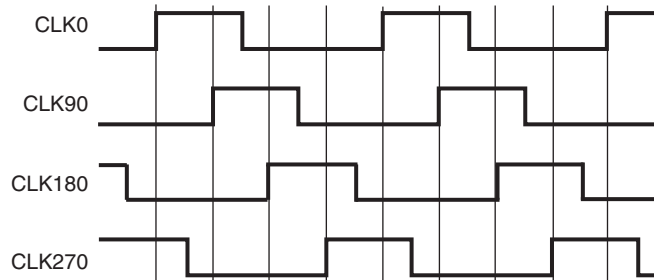


Output Signal - Duty Cycle is Always Corrected

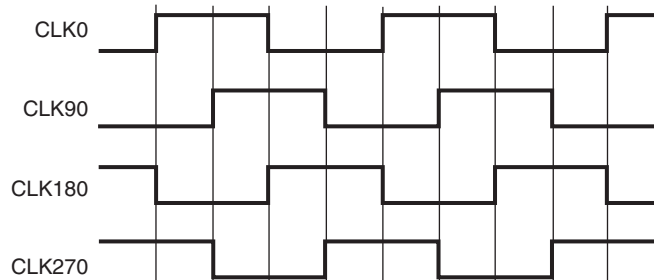


Output Signal - Attribute Corrects Duty Cycle

DUTY\_CYCLE\_CORRECTION = FALSE



DUTY\_CYCLE\_CORRECTION = TRUE



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Figure 22: Characteristics of the DLL Clock Outputs

## Digital Frequency Synthesizer (DFS)

The DFS component generates clock signals the frequency of which is a product of the clock frequency at the CLKIN input and a ratio of two user-determined integers. Because of the wide range of possible output frequencies such a ratio permits, the DFS feature provides still further flexibility than the DLL's basic synthesis options as described in the preceding section. The DFS component's two dedicated outputs, CLKFX and CLKFX180, are defined in Table 19.

The signal at the CLKFX180 output is essentially an inversion of the CLKFX signal. These two outputs always exhibit a 50% duty cycle. This is true even when the CLKIN signal does not. These DFS clock outputs are driven at the same time as the DLL's seven clock outputs.

The numerator of the ratio is the integer value assigned to the attribute CLKFX\_MULTIPLY and the denominator is the integer value assigned to the attribute CLKFX\_DIVIDE. These attributes are described in Table 18.

The output frequency ( $f_{CLKFX}$ ) can be expressed as a function of the incoming clock frequency ( $f_{CLKIN}$ ) as follows:

$$f_{CLKFX} = f_{CLKIN}(\text{CLKFX\_MULTIPLY}/\text{CLKFX\_DIVIDE}) \quad \text{Equation 3}$$

Regarding the two attributes, it is possible to assign any combination of integer values, provided that two conditions are met:

- The two values fall within their corresponding ranges, as specified in [Table 18](#).
- The  $f_{CLKFX}$  frequency calculated from the above expression accords with the DCM's operating frequency specifications.

For example, if  $\text{CLKFX\_MULTIPLY} = 5$  and  $\text{CLKFX\_DIVIDE} = 3$ , then the frequency of the output clock signal would be 5/3 that of the input clock signal.

### DFS Frequency Modes

The DFS supports two operating modes, High Frequency and Low Frequency, with each specified over a different clock frequency range. The  $\text{DFS\_FREQUENCY\_MODE}$  attribute chooses between the two modes. When the attribute is set to LOW, the Low Frequency mode permits the two DFS outputs to operate over a low-to-moderate frequency range. When the attribute is set to HIGH, the High Frequency mode allows both these outputs to operate at the highest possible frequencies.

### DFS With or Without the DLL

The DFS component can be used with or without the DLL component:

Without the DLL, the DFS component multiplies or divides the CLKIN signal frequency according to the respective  $\text{CLKFX\_MULTIPLY}$  and  $\text{CLKFX\_DIVIDE}$  values, generating a clock with the new target frequency on the CLKFX and CLKFX180 outputs. Though classified as belonging to the DLL component, the CLKIN input is shared with the DFS component. This case does not employ feedback loop; therefore, it cannot correct for clock distribution delay.

With the DLL, the DFS operates as described in the preceding case, only with the additional benefit of eliminating the clock distribution delay. In this case, a feedback loop from the CLK0 output to the CLKFB input must be present.

The DLL and DFS components work together to achieve this phase correction as follows: Given values for the  $\text{CLKFX\_MULTIPLY}$  and  $\text{CLKFX\_DIVIDE}$  attributes, the DLL selects the delay element for which the output clock edge coincides with the input clock edge whenever mathematically possible. For example, when  $\text{CLKFX\_MULTIPLY} = 5$  and  $\text{CLKFX\_DIVIDE} = 3$ , the input and output clock edges will coincide every three input periods, which is equivalent in time to five output periods.

Smaller  $\text{CLKFX\_MULTIPLY}$  and  $\text{CLKFX\_DIVIDE}$  values achieve faster lock times. With no factors common to the two attributes, alignment will occur once with every number of cycles equal to the  $\text{CLKFX\_DIVIDE}$  value. Therefore, it is recommended that the user reduce these values by factoring wherever possible. For example, given  $\text{CLKFX\_MULTIPLY} = 9$  and  $\text{CLKFX\_DIVIDE} = 6$ , removing a factor of three yields  $\text{CLKFX\_MULTIPLY} = 3$  and  $\text{CLKFX\_DIVIDE} = 2$ . While both value-pairs will result in the multiplication of clock frequency by 3/2, the latter value-pair will enable the DLL to lock more quickly.

Table 18: DFS Attributes

| Attribute          | Description  | Values               |
|--------------------|--|----------------------|
| DFS_FREQUENCY_MODE | Chooses between High Frequency and Low Frequency modes | Low, High            |
| CLKFX_MULTIPLY     | Frequency multiplier constant                          | Integer from 2 to 32 |
| CLKFX_DIVIDE       | Frequency divisor constant                             | Integer from 1 to 32 |

Table 19: DFS Signals

| Signal   | Direction | Description   |
|----------|-----------|---|
| CLKFX    | Output    | Multiplies the CLKIN frequency by the attribute-value ratio ( $\text{CLKFX\_MULTIPLY}/\text{CLKFX\_DIVIDE}$ ) to generate a clock signal with a new target frequency. |
| CLKFX180 | Output    | Generates a clock signal with same frequency as CLKFX, only shifted 180° out-of-phase.  |

## DFS Clock Output Connections

There are two basic cases that determine how to connect the DFS clock outputs: on-chip and off-chip, which are illustrated in sections [a] and [c], respectively, of [Figure 21](#). This is similar to what has already been described for the DLL component. See [DLL Clock Output and Feedback Connections, page 34](#).

In the on-chip case, it is possible to connect either of the DFS's two output clock signals through general routing resources to the FPGA's internal registers. Either a Global Clock Buffer (BUFG) or a BUFGMUX affords access to the global clock network. The optional feedback loop is formed in this way, routing CLK0 to a global clock net, which in turn drives the CLKFB input.

In the off-chip case, the DFS's two output clock signals, plus CLK0 for an optional feedback loop, can exit the FPGA using output buffers (OBUF) to drive a clock network plus registers on the board. The feedback loop is formed by feeding the CLK0 signal back into the FPGA using an IBUFG, which directly accesses the global clock network, or an IBUF. Then, the global clock net is connected directly to the CLKFB input.

## Phase Shifter (PS)

The DCM provides two approaches to controlling the phase of a DCM clock output signal relative to the CLKIN signal: First, there are nine clock outputs that employ the DLL to achieve a desired phase relationship: CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, CLKDV CLKFX, and CLKFX180. These outputs afford "coarse" phase control.

The second approach uses the PS component described in this section to provide a still finer degree of control. The PS component is only available when the DLL is operating in its low-frequency mode. The PS component phase shifts the DCM output clocks by introducing a "fine phase shift" ( $T_{PS}$ ) between the CLKFB and CLKIN signals inside the DLL component. The user can control this fine phase shift down to a resolution of 1/256 of a CLKIN cycle or one tap delay (DCM\_TAP), whichever is greater. When in use, the PS component shifts the phase of all nine DCM clock output signals together. If the PS component is used together with a DCM clock output such as the CLK90, CLK180, CLK270, CLK2X180 and CLKFX180, then the fine phase shift of the former gets added to the coarse phase shift of the latter.

## PS Component Enabling and Mode Selection

The CLKOUT\_PHASE\_SHIFT attribute enables the PS component for use in addition to selecting between two operating modes. As described in [Table 20](#), this attribute has three possible values: NONE, FIXED and VARIABLE. When CLKOUT\_PHASE\_SHIFT is set to NONE, the PS component is disabled and its inputs, PSEN, PSCLK, and PSINCDEC, must be tied to GND. The set of waveforms in section [a] of [Figure 22](#) shows the disabled case, where the DLL maintains a zero-phase alignment of signals CLKFB and CLKIN upon which the PS component has no effect. The PS component is enabled by setting the attribute to either the FIXED or VARIABLE values, which select the Fixed Phase mode and the Variable Phase mode, respectively. These two modes are described in the sections that follow

## Determining the Fine Phase Shift

The user controls the phase shift of CLKFB relative to CLKIN by setting and/or adjusting the value of the PHASE\_SHIFT attribute. This value must be an integer ranging from -255 to +255. The PS component uses this value to calculate the desired fine phase shift ( $T_{PS}$ ) as a fraction of the CLKIN period ( $T_{CLKIN}$ ). Given values for PHASE-SHIFT and  $T_{CLKIN}$ , it is possible to calculate  $T_{PS}$  as follows:

$$T_{PS} = T_{CLKIN}(\text{PHASE\_SHIFT}/256) \quad \text{Equation 4}$$

Both the Fixed Phase and Variable Phase operating modes employ this calculation. If the PHASE\_SHIFT value is zero, then CLKFB and CLKIN will be in phase, the same as when the PS component is disabled. When the PHASE\_SHIFT value is positive, the CLKFB signal will be shifted later in time with respect to CLKIN. If the attribute value is negative, the CLKFB signal will be shifted earlier in time with respect to CLKIN.

## The Fixed Phase Mode

This mode fixes the desired fine phase shift to a fraction of the  $T_{CLKIN}$ , as determined by [Equation 4](#) and its user-selected PHASE\_SHIFT value P. The set of waveforms in section [b] of [Figure 22](#) illustrates the relationship between CLKFB and CLKIN in the Fixed Phase mode. In the Fixed Phase mode, the PSEN, PSCLK and PSINCDEC inputs are not used and must be tied to GND. Fixed phase shift requires ISE software version 10.1.03 or later.

Table 20: PS Attributes

| Attribute          | Description  | Values                                    |
|--------------------|--|---|
| CLKOUT_PHASE_SHIFT | Disables PS component or chooses between Fixed Phase and Variable Phase modes. | NONE, FIXED, VARIABLE                     |
| PHASE_SHIFT        | Determines size and direction of initial fine phase shift.                     | Integers from -255 to +255 <sup>(1)</sup> |

**Notes:**

- The practical range of values will be less when  $T_{CLKIN} > FINE\_SHIFT\_RANGE$  in the Fixed Phase mode, also when  $T_{CLKIN} > (FINE\_SHIFT\_RANGE)/2$  in the Variable Phase mode. the  $FINE\_SHIFT\_RANGE$  represents the sum total delay of all taps.

**The Variable Phase Mode**

The “Variable Phase” mode dynamically adjusts the fine phase shift over time using three inputs to the PS component, namely PSEN, PSCLK and PSINCDEC, as defined in Table 21.

After device configuration, the PS component initially determines  $T_{PS}$  by evaluating Equation (4) for the value assigned to the PHASE\_SHIFT attribute. Then to dynamically adjust that phase shift, use the three PS inputs to increase or decrease the fine phase shift.

PSINCDEC is synchronized to the PSCLK clock signal, which is enabled by asserting PSEN. It is possible to drive the PSCLK input with the CLKIN signal or any other clock signal. A request for phase adjustment is entered as follows: For each PSCLK cycle that PSINCDEC is High, the PS component adds 1/256 of a CLKIN cycle to  $T_{PS}$ . Similarly, for each enabled PSCLK cycle that PSINCDEC is Low, the PS component subtracts 1/256 of a CLKIN cycle from  $T_{PS}$ . The phase adjustment may require as many as 100 CLKIN cycles plus three PSCLK cycles to take effect, at which point the output PSDONE goes High for one PSCLK cycle. This pulse indicates that the PS component has finished the present adjustment and is now ready for the next request. Asserting the Reset (RST) input, returns  $T_{PS}$  to its original shift time, as determined by the PHASE\_SHIFT attribute value. The set of waveforms in section [c] of Figure 23, page 41 illustrates the relationship between CLKFB and CLKIN in the Variable Phase mode.

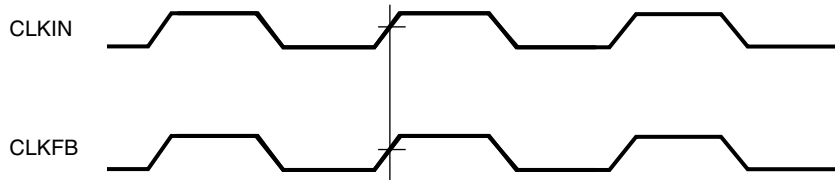
Table 21: Signals for Variable Phase Mode

| Signal                  | Direction | Description  |
|-------------------------|-----------|--|
| PSEN <sup>(1)</sup>     | Input     | Enables PSCLK for variable phase adjustment.   |
| PSCLK <sup>(1)</sup>    | Input     | Clock to synchronize phase shift adjustment.   |
| PSINCDEC <sup>(1)</sup> | Input     | Chooses between increment and decrement for phase adjustment. It is synchronized to the PSCLK signal.  |
| PSDONE                  | Output    | Goes High to indicate that present phase adjustment is complete and PS component is ready for next phase adjustment request. It is synchronized to the PSCLK signal. |

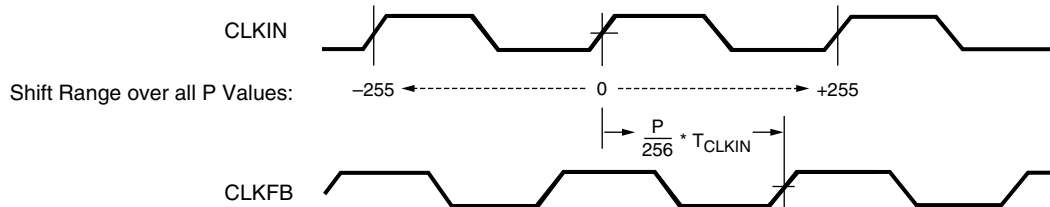
**Notes:**

- It is possible to program this input for either a true or inverted polarity

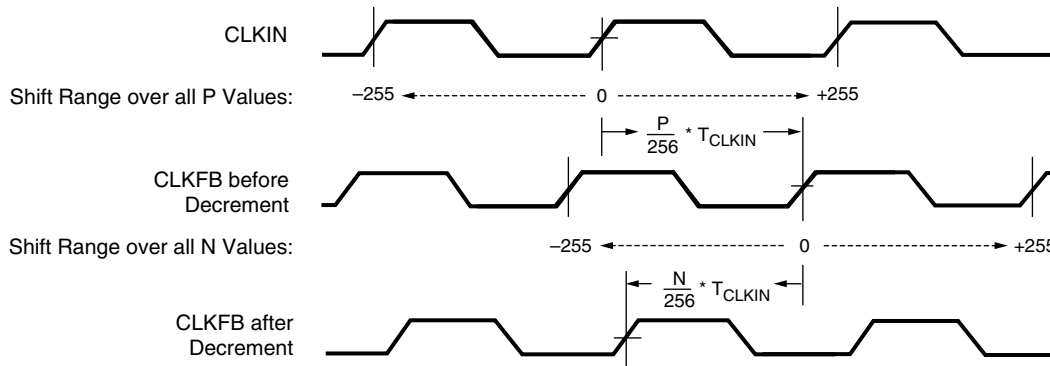
a. CLKOUT\_PHASE\_SHIFT = NONE



b. CLKOUT\_PHASE\_SHIFT = FIXED



c. CLKOUT\_PHASE\_SHIFT = VARIABLE



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Notes:

1. P represents the integer value ranging from -255 to +255 to which the PHASE\_SHIFT attribute is assigned.
2. N is an integer value ranging from -255 to +255 that represents the net phase shift effect from a series of increment and/or decrement operations.  
 $N = \{\text{Total number of increments}\} - \{\text{Total number of decrements}\}$   
 A positive value for N indicates a net increment; a negative value indicates a net decrement.

Figure 23: Phase Shifter Waveforms

## The Status Logic Component

The Status Logic component not only reports on the state of the DCM but also provides a means of resetting the DCM to an initial known state. The signals associated with the Status Logic component are described in [Table 22](#).

As a rule, the Reset (RST) input is asserted only upon configuring the device or changing the CLKIN frequency. A DCM reset does not affect attribute values (e.g., CLKFX\_MULTIPLY and CLKFX\_DIVIDE). If not used, RST must be tied to GND.

The eight bits of the STATUS bus are defined in [Table 23](#).

Table 22: Status Logic Signals

| Signal      | Direction | Description   |
|-------------|-----------|---|
| RST         | Input     | A High resets the entire DCM to its initial power-on state. Initializes the DLL taps for a delay of zero. Sets the LOCKED output Low. This input is asynchronous. |
| STATUS[7:0] | Output    | The bit values on the STATUS bus provide information regarding the state of DLL and PS operation  |
| LOCKED      | Output    | Indicates that the CLKIN and CLKFB signals are in phase by going High. The two signals are out-of-phase when Low.   |

Table 23: DCM STATUS Bus

| Bit | Name                                   | Description  |
|-----|--|--|
| 0   | Phase Shift Overflow                   | A value of 1 indicates a phase shift overflow when one of two conditions occurs: Incrementing (or decrementing) TPS beyond 255/256 of a CLKIN cycle. The DLL is producing its maximum possible phase shift (i.e., all delay taps are active). <sup>(1)</sup> |
| 1   | CLKIN Input Stopped Toggling           | A value of 1 indicates that the CLKIN input signal is not toggling. A value of 0 indicates toggling. This bit functions only when the CLKFB input is connected. <sup>(2)</sup>   |
| 2   | CLKFX/CLKFX180 Output Stopped Toggling | A value of 1 indicates that the CLKFX or CLKFX180 output signals are not toggling. A value of 0 indicates toggling. This bit functions only when using the Digital Frequency Synthesizer (DFS).  |
| 3:7 | Reserved                               | —  |

**Notes:**

1. The DLL phase shift with all delay taps active is specified as the parameter FINE\_SHIFT\_RANGE.
2. If only the DFS clock outputs are used, but none of the DLL clock outputs, this bit will not go High when the CLKIN signal stops.

Table 24: Status Attributes

| Attribute    | Description   | Values      |
|--------------|---|-------------|
| STARTUP_WAIT | Delays transition from configuration to user mode until lock condition is achieved. | TRUE, FALSE |

**Stabilizing DCM Clocks Before User Mode**

It is possible to delay the completion of device configuration until after the DLL has achieved a lock condition using the STARTUP\_WAIT attribute described in Table 24. This option ensures that the FPGA does not enter user mode—i.e., begin functional operation—until all system clocks generated by the DCM are stable. In order to achieve the delay, it is necessary to set the attribute to TRUE as well as set the BitGen option LCK\_cycle to one of the six cycles making up the Startup phase of configuration. The selected cycle defines the point at which configuration will halt until the LOCKED output goes High.

**Global Clock Network**

Spartan-3 devices have eight Global Clock inputs called GCLK0 - GCLK7. These inputs provide access to a low-capacitance, low-skew network that is well-suited to carrying high-frequency signals. The Spartan-3 FPGAs clock network is shown in Figure 23. GCLK0 through GCLK3 are located in the center of the bottom edge. GCLK4 through GCLK7 are located in the center of the top edge.

Eight Global Clock Multiplexers (also called BUFGMUX elements) are provided that accept signals from Global Clock inputs and route them to the internal clock network as well as DCMs. Four BUFGMUX elements are located in the center of the bottom edge, just above the GCLK0 - GCLK3 inputs. The remaining four BUFGMUX elements are located in the center of the top edge, just below the GCLK4 - GCLK7 inputs.

Pairs of BUFGMUX elements share global inputs, as shown in Figure 24. For example, the GCLK4 and GCLK5 inputs both potentially connect to BUFGMUX4 and BUFGMUX5 located in the upper right center. A differential clock input uses a pair of GCLK inputs to connect to a single BUFGMUX element.

Each BUFGMUX element, shown in [Figure 24](#), is a 2-to-1 multiplexer that can receive signals from any of the four following sources:

- One of the four Global Clock inputs on the same side of the die—top or bottom—as the BUFGMUX element in use.
- Any of four nearby horizontal Double lines.
- Any of four outputs from the DCM in the right-hand quadrant that is on the same side of the die as the BUFGMUX element in use.
- Any of four outputs from the DCM in the left-hand quadrant that is on the same side of the die as the BUFGMUX element in use.

The multiplexer select line, S, chooses which of the two inputs, I0 or I1, drives the BUFGMUX's output signal, O, as described in [Table 25](#). The switching from one clock to the other is glitchless, and done in such a way that the output High and Low times are never shorter than the shortest High or Low time of either input clock.

*Table 25: BUFGMUX Select Mechanism*

| S Input | O Output |
|---------|----------|
| 0       | I0 Input |
| 1       | I1 Input |

The two clock inputs can be asynchronous with regard to each other, and the S input can change at any time, except for a short setup time prior to the rising edge of the presently selected clock (I0 or I1). Violating this setup time requirement can result in an undefined runt pulse output.

The BUFG clock buffer primitive drives a single clock signal onto the clock network and is essentially the same element as a BUFGMUX, just without the clock select mechanism. Similarly, the BUFGCE primitive creates an enabled clock buffer using the BUFGMUX select mechanism.

Each BUFGMUX buffers incoming clock signals to two possible destinations:

- The vertical spine belonging to the same side of the die—top or bottom—as the BUFGMUX element in use. The two spines—top and bottom—each comprise four vertical clock lines, each running from one of the BUFGMUX elements on the same side towards the center of the die. At the center of the die, clock signals reach the eight-line horizontal spine, which spans the width of the die. In turn, the horizontal spine branches out into a subsidiary clock interconnect that accesses the CLBs.
- The clock input of either DCM on the same side of the die—top or bottom—as the BUFGMUX element in use.

Use either a BUFGMUX element or a BUFG (Global Clock Buffer) element to place a Global input in the design. For the purpose of minimizing the dynamic power dissipation of the clock network, the Xilinx development software automatically disables all clock line segments that a design does not use.

A global clock line ideally drives clock inputs on the various clocked elements within the FPGA, such as CLB or IOB flip-flops or block RAMs. A global clock line also optionally drives combinatorial inputs. However, doing so provides additional loading on the clock line that might also affect clock jitter. Ideally, drive combinatorial inputs using the signal that also drives the input to the BUFGMUX or BUFG element.

For more details, refer to the chapter entitled “Using Global Clock Resources” in [UG331](#).

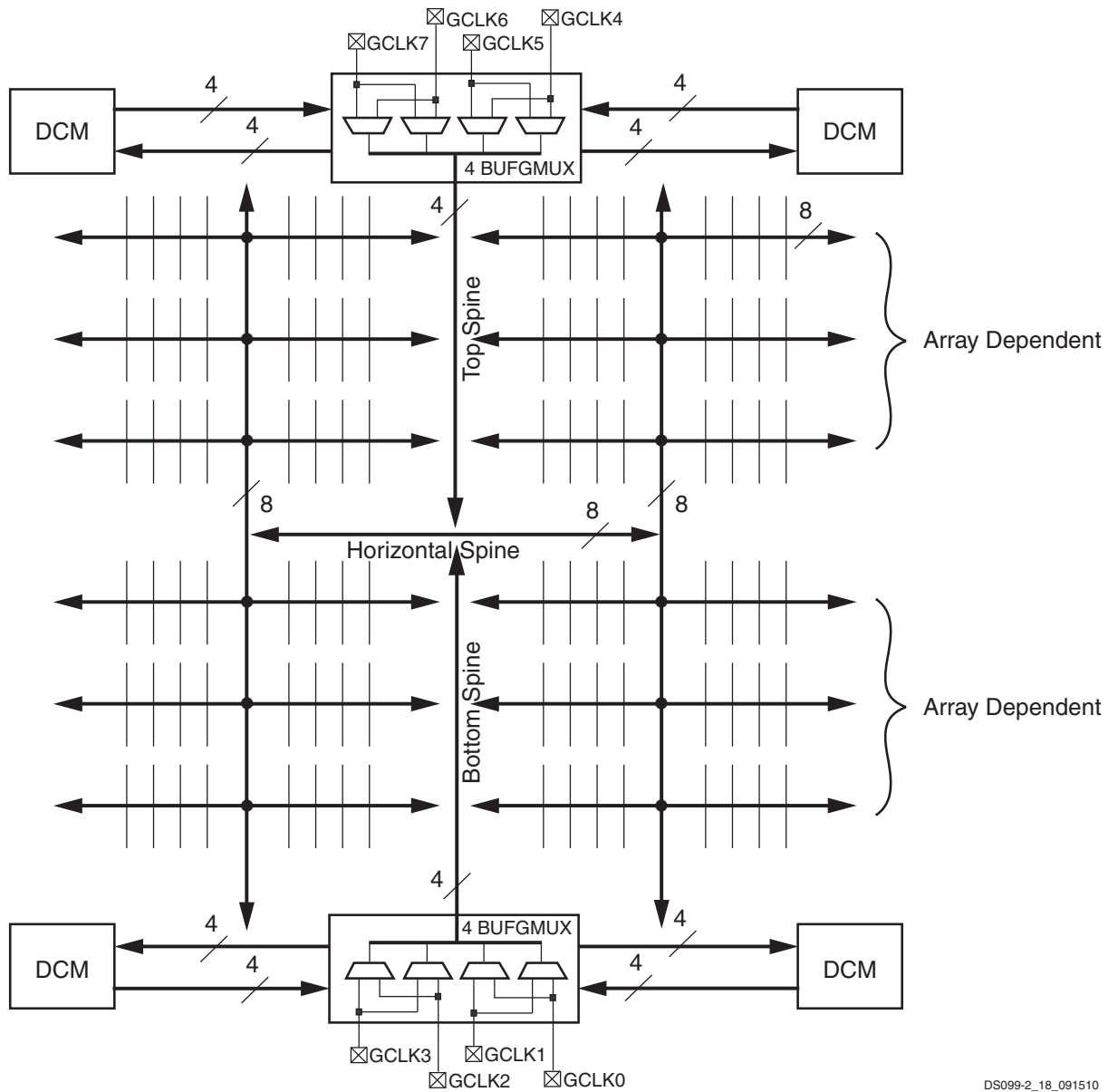


Figure 24: Spartan-3 FPGAs Clock Network (Top View)

DS099-2\_18\_091510



## Interconnect

Interconnect (or routing) passes signals among the various functional elements of Spartan-3 devices. There are four kinds of interconnect: Long lines, Hex lines, Double lines, and Direct lines.

Long lines connect to one out of every six CLBs (see section [a] of Figure 25). Because of their low capacitance, these lines are well-suited for carrying high-frequency signals with minimal loading effects (e.g. skew). If all eight Global Clock Inputs are already committed and there remain additional clock signals to be assigned, Long lines serve as a good alternative.

Hex lines connect one out of every three CLBs (see section [b] of Figure 25). These lines fall between Long lines and Double lines in terms of capability: Hex lines approach the high-frequency characteristics of Long lines at the same time, offering greater connectivity.

Double lines connect to every other CLB (see section [c] of Figure 25). Compared to the types of lines already discussed, Double lines provide a higher degree of flexibility when making connections.

Direct lines afford any CLB direct access to neighboring CLBs (see section [d] of Figure 25). These lines are most often used to conduct a signal from a "source" CLB to a Double, Hex, or Long line and then from the longer interconnect back to a Direct line accessing a "destination" CLB.

For more details, refer to the "Using Interconnect" chapter in [UG331](#).

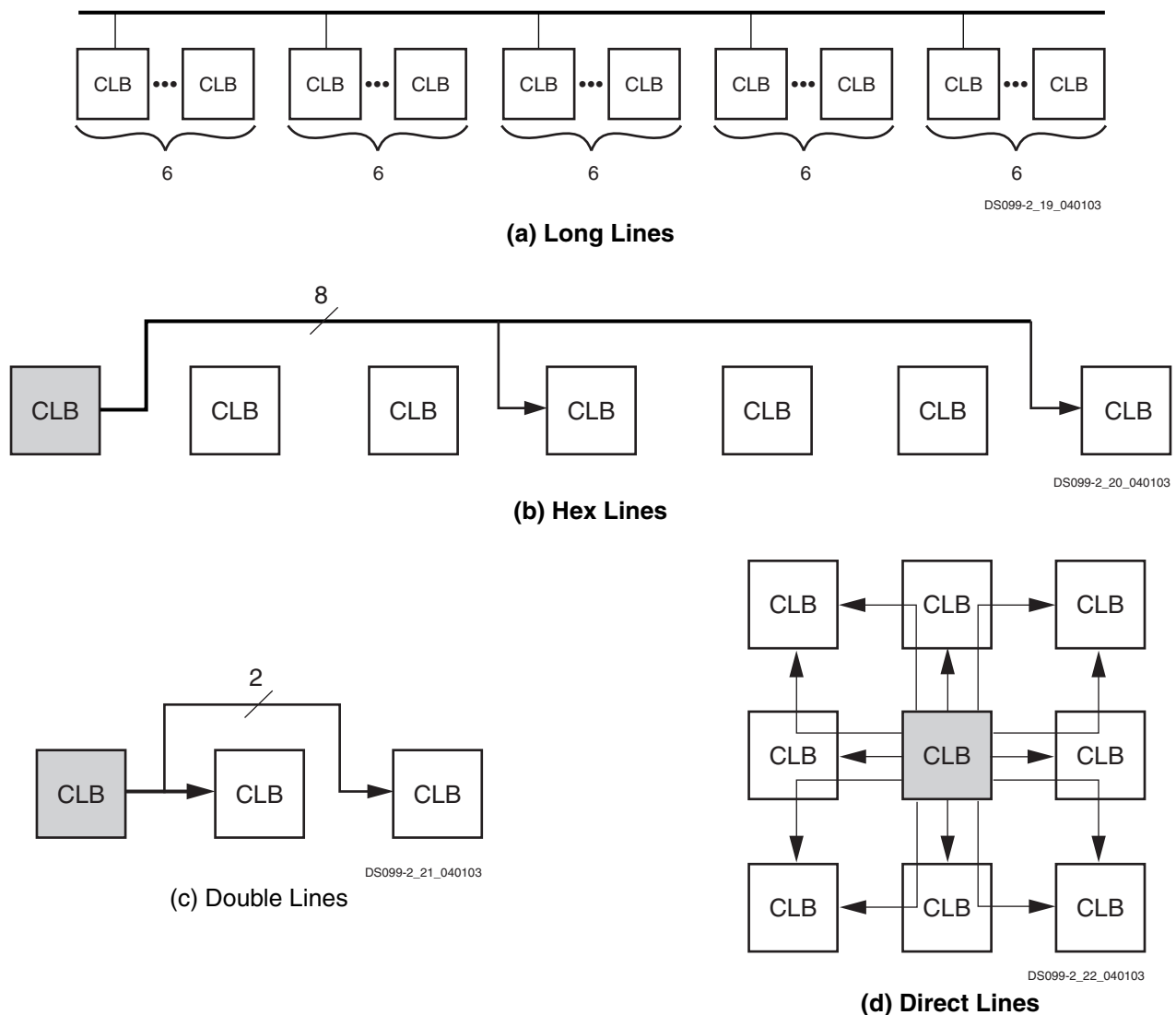


Figure 25: Types of Interconnect

## Configuration

Spartan-3 devices are configured by loading application specific configuration data into the internal configuration memory. Configuration is carried out using a subset of the device pins, some of which are "Dedicated" to one function only, while others, indicated by the term "Dual-Purpose", can be re-used as general-purpose User I/Os once configuration is complete.

Depending on the system design, several configuration modes are supported, selectable via mode pins. The mode pins M0, M1, and M2 are Dedicated pins. The mode pin settings are shown in [Table 26](#).

**Table 26: Spartan-3 FPGAs Configuration Mode Pin Settings**

| Configuration Mode <sup>(1)</sup> | M0 | M1 | M2 | Synchronizing Clock | Data Width | Serial DOUT <sup>(2)</sup> |
|-----------------------------------|----|----|----|---------------------|------------|----------------------------|
| Master Serial                     | 0  | 0  | 0  | CCLK Output         | 1          | Yes                        |
| Slave Serial                      | 1  | 1  | 1  | CCLK Input          | 1          | Yes                        |
| Master Parallel                   | 1  | 1  | 0  | CCLK Output         | 8          | No                         |
| Slave Parallel                    | 0  | 1  | 1  | CCLK Input          | 8          | No                         |
| JTAG                              | 1  | 0  | 1  | TCK Input           | 1          | No                         |

### Notes:

1. The voltage levels on the M0, M1, and M2 pins select the configuration mode.
2. The daisy chain is possible only in the Serial modes when DOUT is used.

The HSWAP\_EN input pin defines whether the I/O pins that are not actively used during configuration have pull-up resistors during configuration. By default, HSWAP\_EN is tied High (via an internal pull-up resistor if left floating) which shuts off the pull-up resistors on the user I/O pins during configuration. When HSWAP\_EN is tied Low, user I/Os have pull-ups during configuration. The Dedicated configuration pins (CCLK, DONE, PROG\_B, M2, M1, M0, HSWAP\_EN) and the JTAG pins (TDI, TMS, TCK, and TDO) always have a pull-up resistor to VCCAUX during configuration, regardless of the value on the HSWAP\_EN pin. Similarly, the dual-purpose INIT\_B pin has an internal pull-up resistor to VCCO\_4 or VCCO\_BOTTOM, depending on the package style.

Depending on the chosen configuration mode, the FPGA either generates a CCLK output, or CCLK is an input accepting an externally generated clock.

A persist option is available which can be used to force the configuration pins to retain their configuration function even after device configuration is complete. If the persist option is not selected then the configuration pins with the exception of CCLK, PROG\_B, and DONE can be used as user I/O in normal operation. The persist option does not apply to the boundary-scan related pins. The persist feature is valuable in applications that readback configuration data after entering the User mode.

[Table 27](#) lists the total number of bits required to configure each FPGA as well as the PROMs suitable for storing those bits. See [DS123: Platform Flash In-System Programmable Configuration PROMs](#) data sheet for more information.

**Table 27: Spartan-3 FPGA Configuration Data**

| Device   | File Sizes | Xilinx Platform Flash PROM |                        |
|----------|------------|----------------------------|------------------------|
|          |            | Serial Configuration       | Parallel Configuration |
| XC3S50   | 439,264    | XCF01S                     | XCF08P                 |
| XC3S200  | 1,047,616  | XCF01S                     | XCF08P                 |
| XC3S400  | 1,699,136  | XCF02S                     | XCF08P                 |
| XC3S1000 | 3,223,488  | XCF04S                     | XCF08P                 |
| XC3S1500 | 5,214,784  | XCF08P                     | XCF08P                 |
| XC3S2000 | 7,673,024  | XCF08P                     | XCF08P                 |
| XC3S4000 | 11,316,864 | XCF16P                     | XCF16P                 |
| XC3S5000 | 13,271,936 | XCF16P                     | XCF16P                 |

The maximum bitstream length that Spartan-3 FPGAs support in serial daisy-chains is 4,294,967,264 bits (4 Gbits), roughly equivalent to a daisy-chain with 323 XC3S5000 FPGAs. This is a limit only for serial daisy-chains where configuration data is passed via the FPGA's DOUT pin. There is no such limit for JTAG chains.

## The Standard Configuration Interface

Configuration signals belong to one of two different categories: Dedicated or Dual-Purpose. Which category determines which of the FPGA's power rails supplies the signal's driver and, thus, helps describe the electrical characteristics at the pin.

The Dedicated configuration pins include PROG\_B, HSWAP\_EN, TDI, TMS, TCK, TDO, CCLK, DONE, and M0-M2. These pins are powered by the  $V_{CCAUX}$  supply.

The Dual-Purpose configuration pins comprise INIT\_B, DOUT, BUSY, RDWR\_B, CS\_B, and DIN/D0-D7. Each of these pins, according to its bank placement, uses the  $V_{CCO}$  lines for either Bank 4 ( $V_{CCO\_4}$  on most packages,  $V_{CCO\_BOTTOM}$  on TQ144 and CP132 packages) or Bank 5 ( $V_{CCO\_5}$ ). All the signals used in the serial configuration modes rely on  $V_{CCO\_4}$  power. Signals used in the parallel configuration modes and Readback require from  $V_{CCO\_5}$  as well as from  $V_{CCO\_4}$ .

Both the Dedicated signals described above and the Dual-Purpose signals constitute the configuration interface. The Dedicated pins, powered by the 2.5V  $V_{CCAUX}$  supply, always use the LVCMOS25 I/O standard. The Dual-Purpose signals, however, are powered by the  $V_{CCO\_4}$  supply and also by the  $V_{CCO\_5}$  supply in the Parallel configuration modes. The simplest configuration interface uses 2.5V for  $V_{CCO\_4}$  and  $V_{CCO\_5}$ , if required. However,  $V_{CCO\_4}$  and, if needed,  $V_{CCO\_5}$  can be voltages other than 2.5V but then the configuration interface will have two voltage levels: 2.5V for  $V_{CCAUX}$  and a separate  $V_{CCO}$  supply. The Dual-Purpose signals default to the LVCMOS input and output levels for the associated  $V_{CCO}$  voltage supply.

## 3.3V-Tolerant Configuration Interface

A 3.3V-tolerant configuration interface simply requires adding a few external resistors as described in detail in [XAPP453: The 3.3V Configuration of Spartan-3 FPGAs](#).

The 3.3V-tolerance is implemented as follows (a similar approach can be used for other supply voltage levels):

Apply 3.3V to  $V_{CCO\_4}$  and, in some configuration modes, to  $V_{CCO\_5}$  to power the Dual-Purpose configuration pins. This scales the output voltages and input thresholds associated with these pins so that they become 3.3V-compatible.

Apply 2.5V to  $V_{CCAUX}$  to power the Dedicated configuration pins. For 3.3V-tolerance, the Dedicated inputs require series resistors to limit the incoming current to 10 mA or less. The Dedicated outputs have reduced noise margin when the FPGA drives a High logic level into another device's 3.3V receiver. Choose a power regulator or supply that can tolerate reverse current on the  $V_{CCAUX}$  lines.

## Configuration Modes

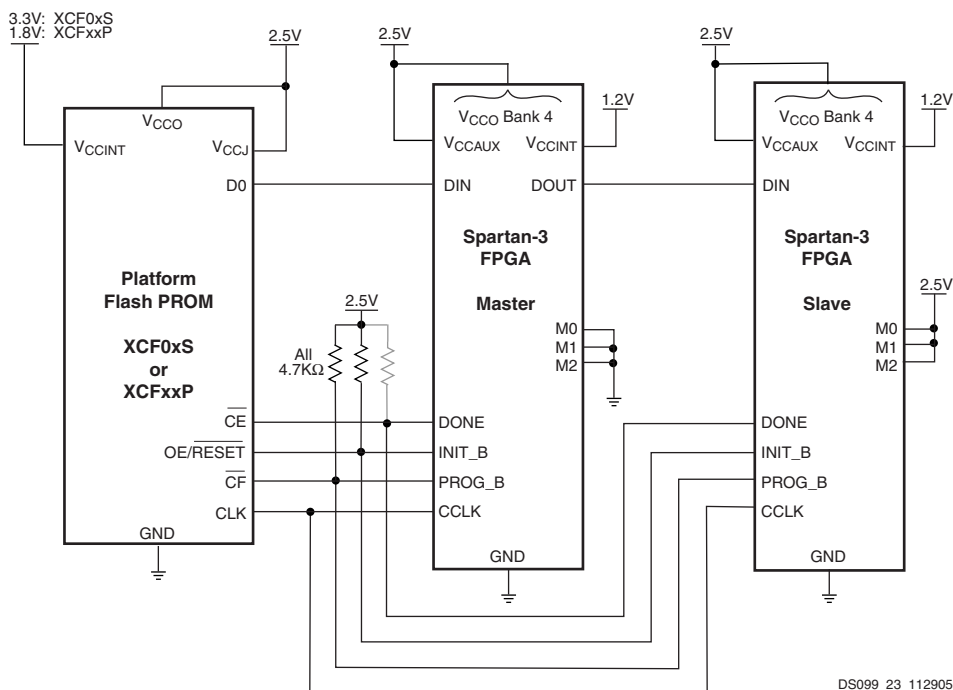
Spartan-3 FPGAs support the following five configuration modes:

- Slave Serial mode
- Master Serial mode
- Slave Parallel (SelectMAP) mode
- Master Parallel (SelectMAP) mode
- Boundary-Scan (JTAG) mode (IEEE 1532/IEEE 1149.1)

### Slave Serial Mode

In Slave Serial mode, the FPGA receives configuration data in bit-serial form from a serial PROM or other serial source of configuration data. The FPGA on the far right of [Figure 26](#) is set for the Slave Serial mode. The CCLK pin on the FPGA is an input in this mode. The serial bitstream must be set up at the DIN input pin a short time before each rising edge of the externally generated CCLK.

Multiple FPGAs can be daisy-chained for configuration from a single source. After a particular FPGA has been configured, the data for the next device is routed internally to the DOUT pin. The data on the DOUT pin changes on the falling edge of CCLK.



**Notes:**

1. There are two ways to use the DONE line. First, one may set the BitGen option DriveDone to "Yes" only for the last FPGA to be configured in the chain shown above (or for the single FPGA as may be the case). This enables the DONE pin to drive High; thus, no pull-up resistor is necessary. DriveDone is set to "No" for the remaining FPGAs in the chain. Second, DriveDone can be set to "No" for all FPGAs. Then all DONE lines are open-drain and require the pull-up resistor shown in grey. In most cases, a value between 3.3KΩ to 4.7KΩ is sufficient. However, when using DONE synchronously with a long chain of FPGAs, cumulative capacitance may necessitate lower resistor values (e.g. down to 330Ω) in order to ensure a rise time within one clock cycle.
2. For information on how to program the FPGA using 3.3V signals and power, see [3.3V-Tolerant Configuration Interface](#).

Figure 26: Connection Diagram for Master and Slave Serial Configuration

Slave Serial mode is selected by applying <111> to the mode pins (M0, M1, and M2). A pull-up on the mode pins makes slave serial the default mode if the pins are left unconnected.

**Master Serial Mode**

In Master Serial mode, the FPGA drives CCLK pin, which behaves as a bidirectional I/O pin. The FPGA in the center of Figure 26 is set for Master Serial mode and connects to the serial configuration PROM and to the CCLK inputs of any slave FPGAs in a configuration daisy-chain. The master FPGA drives the configuration clock on the CCLK pin to the Xilinx Serial PROM, which, in response, provides bit-serial data to the FPGA's DIN input. The FPGA accepts this data on each rising CCLK edge. After the master FPGA finishes configuring, it passes data on its DOUT pin to the next FPGA device in a daisy-chain. The DOUT data appears after the falling CCLK clock edge.

The Master Serial mode interface is identical to Slave Serial except that an internal oscillator generates the configuration clock (CCLK). A wide range of frequencies can be selected for CCLK, which always starts at a default frequency of 6 MHz. Configuration bits then switch CCLK to a higher frequency for the remainder of the configuration.

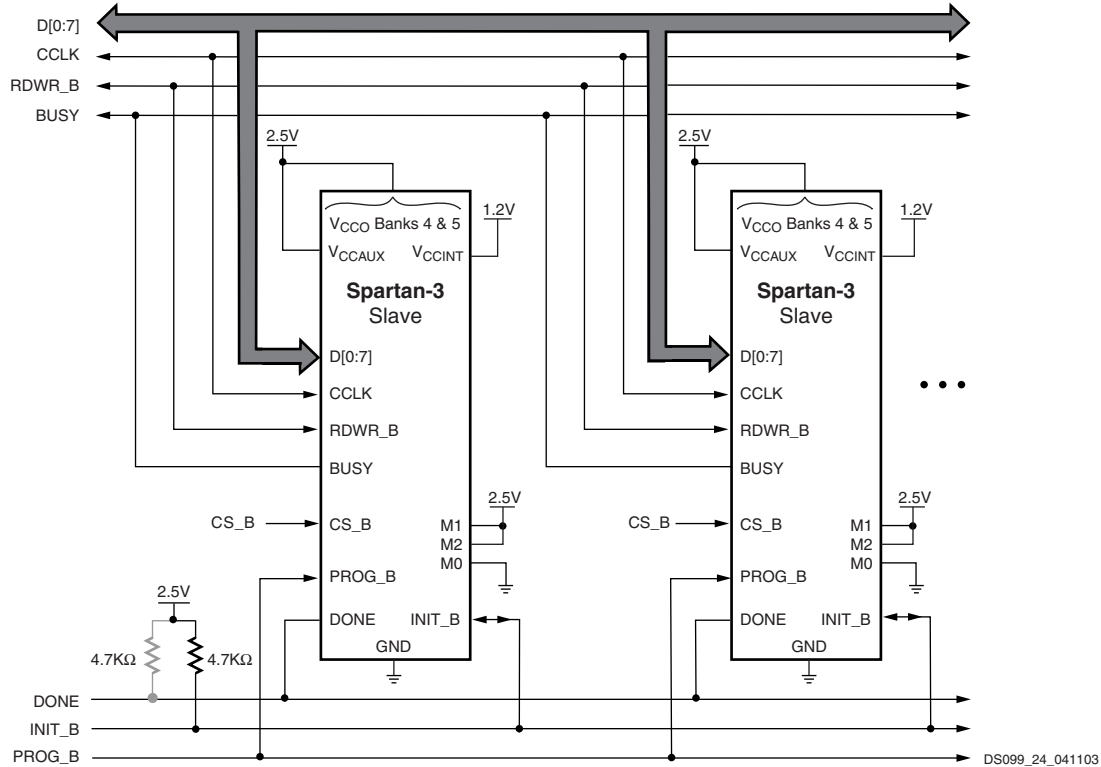
**Slave Parallel Mode (SelectMAP)**

The Parallel or SelectMAP modes support the fastest configuration. Byte-wide data is written into the FPGA with a BUSY flag controlling the flow of data. An external source provides 8-bit-wide data, CCLK, an active-Low Chip Select (CS\_B) signal and an active-Low Write signal (RDWR\_B). If BUSY is asserted (High) by the FPGA, the data must be held until BUSY goes Low. Data can also be read using the Slave Parallel mode. If RDWR\_B is asserted, configuration data is read out of the FPGA as part of a readback operation.

After configuration, it is possible to use any of the Multipurpose pins (DIN/D0-D7, DOUT/BUSY, INIT\_B, CS\_B, and RDWR\_B) as User I/Os. To do this, simply set the BitGen option *Persist* to *No* and assign the desired signals to multipurpose configuration pins using the Xilinx development software. Alternatively, it is possible to continue using the configuration port

(e.g. all configuration pins taken together) when operating in the User mode. This is accomplished by setting the *Persist* option to *Yes*.

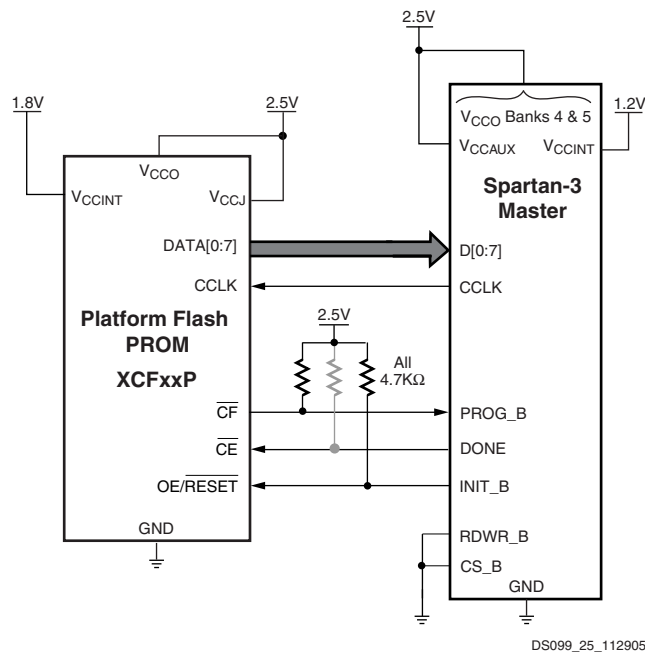
Multiple FPGAs can be configured using the Slave Parallel mode and can be made to start-up simultaneously. Figure 27 shows the device connections. To configure multiple devices in this way, wire the individual CCLK, Data, RDWR\_B, and BUSY pins of all the devices in parallel. The individual devices are loaded separately by deasserting the CS\_B pin of each device in turn and writing the appropriate data.



**Notes:**

1. There are two ways to use the DONE line. First, one may set the BitGen option DriveDone to "Yes" only for the last FPGA to be configured in the chain shown above (or for the single FPGA as may be the case). This enables the DONE pin to drive High; thus, no pull-up resistor is necessary. DriveDone is set to "No" for the remaining FPGAs in the chain. Second, DriveDone can be set to "No" for all FPGAs. Then all DONE lines are open-drain and require the pull-up resistor shown in grey. In most cases, a value between 3.3KΩ to 4.7KΩ is sufficient. However, when using DONE synchronously with a long chain of FPGAs, cumulative capacitance may necessitate lower resistor values (e.g. down to 330Ω) in order to ensure a rise time within one clock cycle.
2. If the FPGAs use different configuration data files, configure them in sequence by first asserting the CS\_B of one FPGA then asserting the CS\_B of the other FPGA.
3. For information on how to program the FPGA using 3.3V signals and power, see [3.3V-Tolerant Configuration Interface](#).

Figure 27: Connection Diagram for Slave Parallel Configuration



**Notes:**

1. There are two ways to use the DONE line. First, one may set the BitGen option DriveDone to "Yes" only for the last FPGA to be configured in the chain shown above (or for the single FPGA as may be the case). This enables the DONE pin to drive High; thus, no pull-up resistor is necessary. DriveDone is set to "No" for the remaining FPGAs in the chain. Second, DriveDone can be set to "No" for all FPGAs. Then all DONE lines are open-drain and require the pull-up resistor shown in grey. In most cases, a value between 3.3KΩ to 4.7KΩ is sufficient. However, when using DONE synchronously with a long chain of FPGAs, cumulative capacitance may necessitate lower resistor values (e.g. down to 330Ω) in order to ensure a rise time within one clock cycle.

Figure 28: Connection Diagram for Master Parallel Configuration

**Master Parallel Mode**

In this mode, the FPGA configures from byte-wide data, and the FPGA supplies the CCLK configuration clock. In Master configuration modes, CCLK behaves as a bidirectional I/O pin. Timing is similar to the Slave Parallel mode except that CCLK is supplied by the FPGA. The device connections are shown in Figure 28.

**Boundary-Scan (JTAG) Mode**

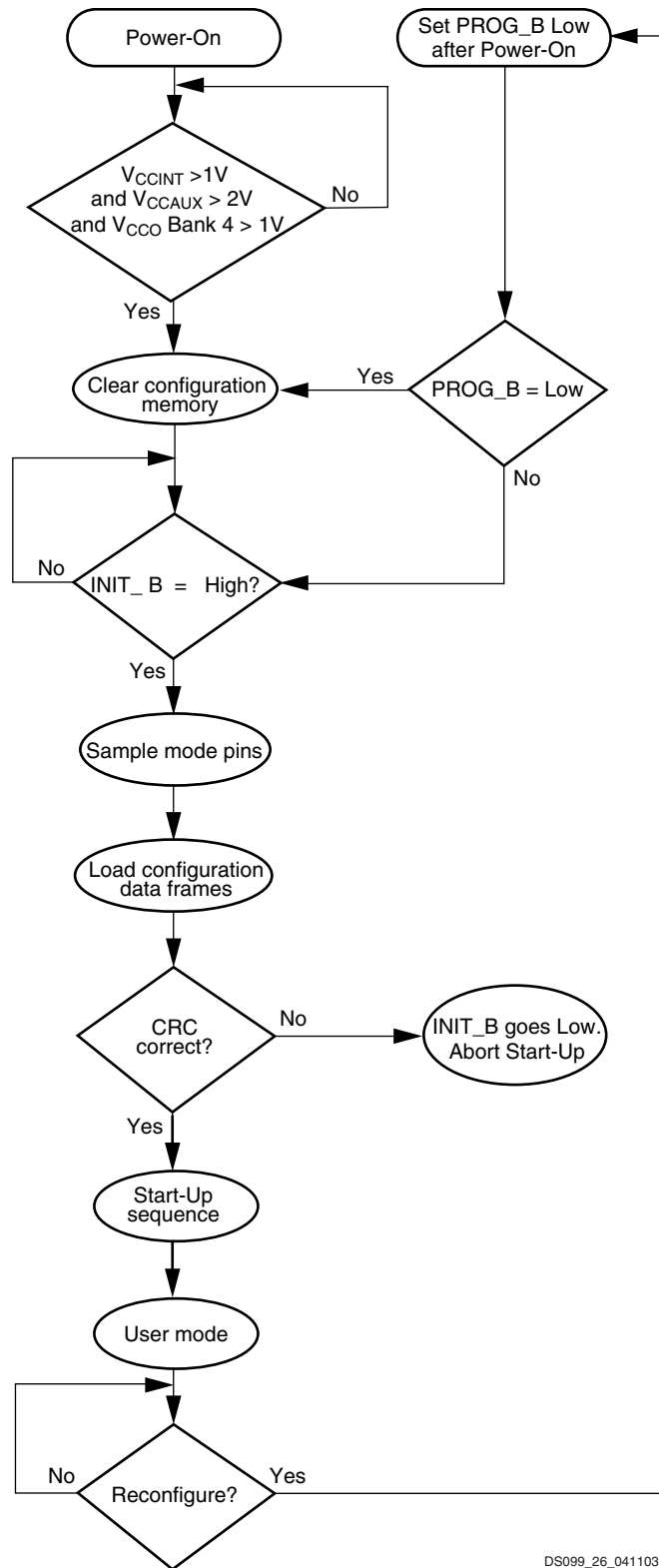
In Boundary-Scan mode, dedicated pins are used for configuring the FPGA. The configuration is done entirely through the IEEE 1149.1 Test Access Port (TAP). FPGA configuration using the Boundary-Scan mode is compatible with the IEEE Std 1149.1-1993 standard and IEEE Std 1532 for In-System Configurable (ISC) devices.

Configuration through the boundary-scan port is always available, regardless of the selected configuration mode. In some cases, however, the mode pin setting may affect proper programming of the device due to various interactions. For example, if the mode pins are set to Master Serial or Master Parallel mode, and the associated PROM is already programmed with a valid configuration image, then there is potential for configuration interference between the JTAG and PROM data. Selecting the Boundary-Scan mode disables the other modes and is the most reliable mode when programming via JTAG.

**Configuration Sequence**

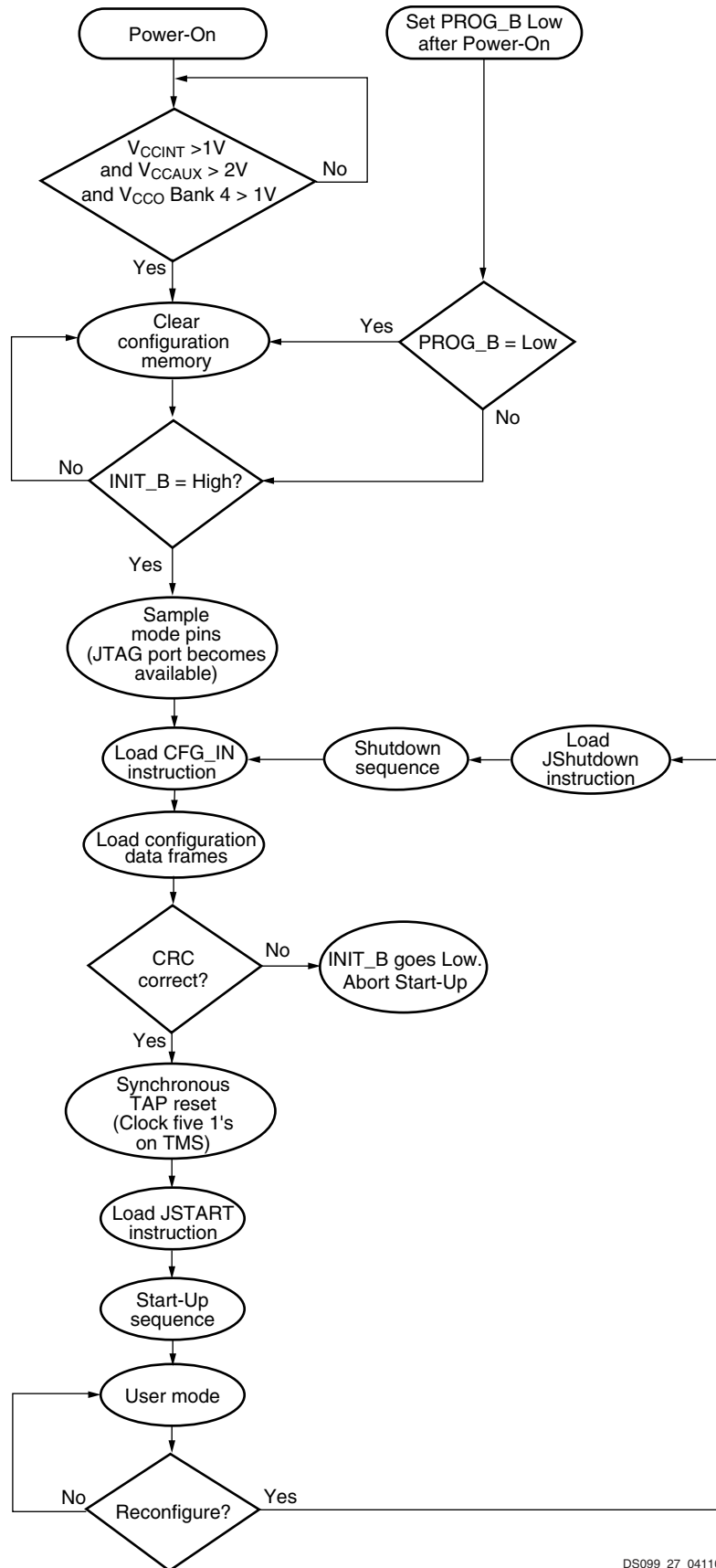
The configuration of Spartan-3 devices is a three-stage process that occurs after Power-On Reset or the assertion of PROG\_B. POR occurs after the V<sub>CCINT</sub>, V<sub>CCAUX</sub>, and V<sub>CCO</sub> Bank 4 supplies have reached their respective maximum input threshold levels (see Table 29, page 59). After POR, the three-stage process begins.

First, the configuration memory is cleared. Next, configuration data is loaded into the memory, and finally, the logic is activated by a start-up process. A flow diagram for the configuration sequence of the Serial and Parallel modes is shown in Figure 29. The flow diagram for the Boundary-Scan configuration sequence appears in Figure 30.



DS099\_26\_041103

Figure 29: Configuration Flow Diagram for the Serial and Parallel Modes



DS099\_27\_041103

Figure 30: Boundary-Scan Configuration Flow Diagram



Configuration is automatically initiated after power-on unless it is delayed by the user. INIT\_B is an open-drain line that the FPGA holds Low during the clearing of the configuration memory. Extending the time that the pin is Low causes the configuration sequencer to wait. Thus, configuration is delayed by preventing entry into the phase where data is loaded.

The configuration process can also be initiated by asserting the PROG\_B pin. The end of the memory-clearing phase is signaled by the INIT\_B pin going High. At this point, the configuration data is written to the FPGA. The FPGA pulses the Global Set/Reset (GSR) signal at the end of configuration, resetting all flip-flops. The completion of the entire process is signaled by the DONE pin going High.

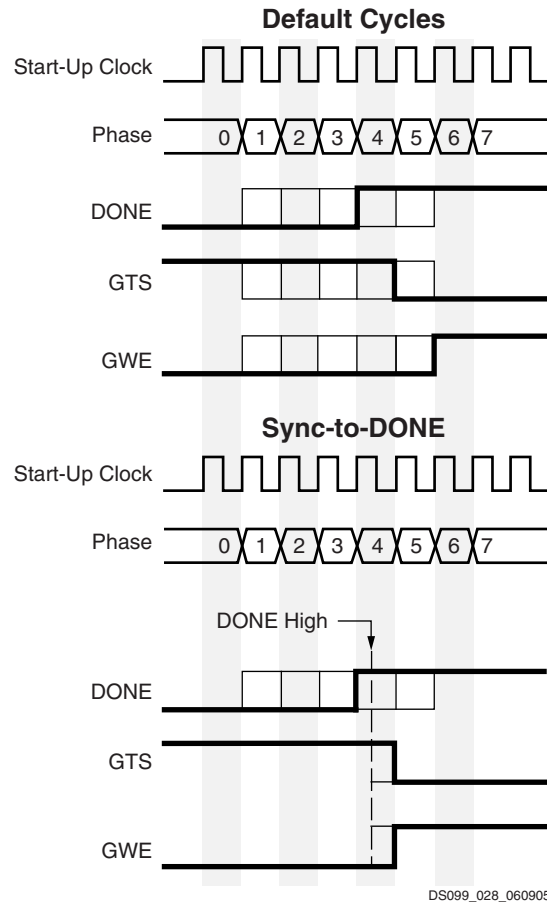


Figure 31: Default Start-Up Sequence

The default start-up sequence, shown in Figure 31, serves as a transition to the User mode. The default start-up sequence is that one CCLK cycle after DONE goes High, the Global Three-State signal (GTS) is released. This permits device outputs to which signals have been assigned to become active. One CCLK cycle later, the Global Write Enable (GWE) signal is released. This permits the internal storage elements to begin changing state in response to the design logic and the user clock.

The relative timing of configuration events can be changed via the BitGen options in the Xilinx development software. In addition, the GTS and GWE events can be made dependent on the DONE pins of multiple devices all going High, forcing the devices to start synchronously. The sequence can also be paused at any stage, until lock has been achieved on any DCM.

**Readback**

Using Slave Parallel mode, configuration data from the FPGA can be read back. Readback is supported only in the Slave Parallel and Boundary-Scan modes.

Along with the configuration data, it is possible to read back the contents of all registers, distributed RAM, and block RAM resources. This capability is used for real-time debugging.

## Additional Configuration Details

Additional details about the Spartan-3 FPGA configuration architecture and command set are available in [UG332: Spartan-3 Generation Configuration User Guide](#) and in application note [XAPP452: Spartan-3 Advanced Configuration Architecture](#).

## Powering Spartan-3 FPGAs

### Voltage Regulators

Various power supply manufacturers offer complete power solutions for Xilinx FPGAs, including some with integrated multi-rail regulators specifically designed for Spartan-3 FPGAs. The [Xilinx Power Corner](#) web page provides links to vendor solution guides as well as Xilinx power estimation and analysis tools.

### Power Distribution System (PDS) Design and Bypass/Decoupling Capacitors

Good power distribution system (PDS) design is important for all FPGA designs, especially for high-performance applications. Proper design results in better overall performance, lower clock and DCM jitter, and a generally more robust system. Before designing the printed circuit board (PCB) for the FPGA design, review application note [XAPP623: Power Distribution System \(PDS\) Design: Using Bypass/Decoupling Capacitors](#).

### Power-On Behavior

Spartan-3 FPGAs have a built-in Power-On Reset (POR) circuit that monitors the three power rails required to successfully configure the FPGA. At power-up, the POR circuit holds the FPGA in a reset state until the  $V_{CCINT}$ ,  $V_{CCAUX}$ , and  $V_{CCO}$  Bank 4 supplies reach their respective input threshold levels (see [Table 29, page 59](#)). After all three supplies reach their respective threshold, the POR reset is released and the FPGA begins its configuration process.

Because the three supply inputs must be valid to release the POR reset and can be supplied in any order, there are no specific voltage sequencing requirements. However, applying the FPGA's  $V_{CCAUX}$  supply before the  $V_{CCINT}$  supply uses the least  $I_{CCINT}$  current.

Once all three supplies are valid, the minimum current required to power-on the FPGA is equal to the worst-case quiescent current, as specified in [Table 34, page 62](#). Spartan-3 FPGAs do not require Power-On Surge (POS) current to successfully configure.

### Surplus $I_{CCINT}$ if $V_{CCINT}$ Applied before $V_{CCAUX}$

If the  $V_{CCINT}$  supply is applied before the  $V_{CCAUX}$  supply, the FPGA may draw a surplus  $I_{CCINT}$  current in addition to the  $I_{CCINT}$  quiescent current levels specified in [Table 34](#). The momentary additional  $I_{CCINT}$  surplus current might be a few hundred milliamperes under nominal conditions, significantly less than the instantaneous current consumed by the bypass capacitors at power-on. However, the surplus current immediately disappears when the  $V_{CCAUX}$  supply is applied, and, in response, the FPGA's  $I_{CCINT}$  quiescent current demand drops to the levels specified in [Table 34](#). The FPGA does not use nor does it require the surplus current to successfully power-on and configure. If applying  $V_{CCINT}$  before  $V_{CCAUX}$ , ensure that the regulator does not have a foldback feature that could inadvertently shut down in the presence of the surplus current.

### Maximum Allowed $V_{CCINT}$ Ramp Rate on Early Devices, if $V_{CCINT}$ Supply is Last in Sequence

All devices with a mask revision code 'E' or later do not have a  $V_{CCINT}$  ramp rate requirement. See [Mask and Fab Revisions, page 58](#).

Early Spartan-3 FPGAs were produced at a 200 mm wafer production facility and are identified by a fabrication/process code of "FQ" on the device top marking, as shown in [Package Marking, page 5](#). These "FQ" devices have a maximum  $V_{CCINT}$  ramp rate requirement if and only if  $V_{CCINT}$  is the last supply to ramp, after the  $V_{CCAUX}$  and  $V_{CCO}$  Bank 4 supplies. This maximum ramp rate appears as  $T_{CCINT}$  in [Table 30, page 60](#).

### Minimum Allowed $V_{CCO}$ Ramp Rate on Early Devices

Devices shipped since 2006 essentially have no  $V_{CCO}$  ramp rate limits, shown in [Table 30, page 60](#). Similarly, all devices with a mask revision code 'E' or later do not have a  $V_{CCO}$  ramp rate limit. See [Mask and Fab Revisions, page 58](#).

Initial Spartan-3 FPGA mask revisions have a limit on how fast the  $V_{CCO}$  supply can ramp. The minimum allowed  $V_{CCO}$  ramp rate appears as  $T_{CCO}$  in [Table 30, page 60](#). The minimum rate is affected by the package inductance. Consequently, the ball grid array and chip-scale packages (CP132, FT256, FG456, FG676, and FG900) allow a faster ramp rate than the quad-flat packages (VQ100, TQ144, and PQ208).

## Configuration Data Retention, Brown-Out

The FPGA's configuration data is stored in robust CMOS configuration latches. The data in these latches is retained even when the voltages drop to the minimum levels necessary to preserve RAM contents. This is specified in [Table 31, page 60](#).

If, after configuration, the  $V_{CCAUX}$  or  $V_{CCINT}$  supply drops below its data retention voltage, clear the current device configuration using one of the following methods:

- Force the  $V_{CCAUX}$  or  $V_{CCINT}$  supply voltage below the minimum Power On Reset (POR) voltage threshold [Table 29, page 59](#)).
- Assert PROG\_B Low.

The POR circuit does not monitor the VCCO\_4 supply after configuration. Consequently, dropping the VCCO\_4 voltage does not reset the device by triggering a Power-On Reset (POR) event.

## No Internal Charge Pumps or Free-Running Oscillators

Some system applications are sensitive to sources of analog noise. Spartan-3 FPGA circuitry is fully static and does not employ internal charge pumps.

The CCLK configuration clock is active during the FPGA configuration process. After configuration completes, the CCLK oscillator is automatically disabled unless the Bitstream Generator (BitGen) option **Persist=Yes**. See Module 4: [Table 80, page 125](#).

Spartan-3 FPGAs optionally support a feature called [Digitally Controlled Impedance \(DCI\)](#). When used in an application, the DCI logic uses an internal oscillator. The DCI logic is only enabled if the FPGA application specifies an I/O standard that requires DCI (LVDCI\_33, LVDCI\_25, etc.). If DCI is not used, the associated internal oscillator is also disabled.

In summary, unless an application uses the **Persist=Yes** option or specifies a DCI I/O standard, an FPGA with no external switching remains fully static.

## Revision History

| Date       | Version No. | Description  |
|------------|-------------|--|
| 04/11/2003 | 1.0         | Initial Xilinx release   |
| 05/19/2003 | 1.1         | Added Block RAM column, DCMs, and multipliers to XC3S50 descriptions.  |
| 07/11/2003 | 1.2         | Explained the configuration port <i>Persist</i> option in <a href="#">Slave Parallel Mode (SelectMAP)</a> section. Updated <a href="#">Figure 8</a> and <a href="#">Double-Data-Rate Transmission</a> section to indicate that DDR clocking for the XC3S50 is the same as that for all other Spartan-3 devices. Updated description of I/O voltage tolerance in <a href="#">ESD Protection</a> section. In <a href="#">Table 10</a> , changed input termination type for DCI version of the LVCMOS standard to <i>None</i> . Added additional flexibility for making DLL connections in <a href="#">Figure 21</a> and accompanying text. In the <a href="#">Configuration</a> section, inserted an explanation of how to choose power supplies for the configuration interface, including guidelines for achieving 3.3V-tolerance. |
| 08/24/2004 | 1.3         | Showed inversion of 3-state signal ( <a href="#">Figure 7</a> ). Clarified description of pull-up and pull-down resistors ( <a href="#">Table 6</a> and <a href="#">page 13</a> ). Added information on operating block RAM with multipliers to <a href="#">page 26</a> . Corrected output buffer name in <a href="#">Figure 21</a> . Corrected description of how DOUT is synchronized to CCLK ( <a href="#">page 47</a> ).   |
| 08/19/2005 | 1.4         | Corrected description of WRITE_FIRST and READ_FIRST in <a href="#">Table 13</a> . Added note regarding address setup and hold time requirements whenever a block RAM port is enabled ( <a href="#">Table 13</a> ). Added information in the maximum length of a <a href="#">Configuration</a> daisy-chain. Added reference to <a href="#">XAPP453</a> in <a href="#">3.3V-Tolerant Configuration Interface</a> section. Added information on the STATUS[2] DCM output ( <a href="#">Table 23</a> ). Added information on CCLK behavior and termination recommendations to <a href="#">Configuration</a> . Added <a href="#">Additional Configuration Details</a> section. Added <a href="#">Powering Spartan-3 FPGAs</a> section. Removed GSR from <a href="#">Figure 31</a> because its timing is not programmable.               |
| 04/03/2006 | 2.0         | Updated <a href="#">Figure 7</a> . Updated <a href="#">Figure 14</a> . Updated <a href="#">Table 10</a> . Updated <a href="#">Figure 22</a> . Corrected Platform Flash supply voltage name and value in <a href="#">Figure 26</a> and <a href="#">Figure 28</a> . Added <a href="#">No Internal Charge Pumps or Free-Running Oscillators</a> . Corrected a few minor typographical errors.   |
| 04/26/2006 | 2.1         | Added more information on the pull-up resistors that are active during configuration to <a href="#">Configuration</a> . Added information to <a href="#">Boundary-Scan (JTAG) Mode</a> about potential interactions when configuring via JTAG if the mode select pins are set for other than JTAG.   |
| 05/25/2007 | 2.2         | Added <a href="#">Spartan-3 FPGA Design Documentation</a> . Noted SSTL2_I_DCI 25-Ohm driver in <a href="#">Table 10</a> and <a href="#">Table 11</a> . Added note that pull-down is active during boundary scan tests.   |
| 11/30/2007 | 2.3         | Updated links to documentation on xilinx.com.  |
| 06/25/2008 | 2.4         | Added HSLVDCI to <a href="#">Table 10</a> . Updated formatting and links.  |
| 12/04/2009 | 2.5         | Updated HSLVDCI description in <a href="#">Digitally Controlled Impedance (DCI)</a> . Updated the low-voltage differential signaling $V_{CCO}$ values in <a href="#">Table 10</a> . Noted that the CP132 package is being discontinued in <a href="#">The Organization of IOBs into Banks</a> . Updated rule 4 in <a href="#">Rules Concerning Banks</a> . Added software version requirement in <a href="#">The Fixed Phase Mode</a> .  |
| 10/29/2012 | 3.0         | Added <a href="#">Notice of Disclaimer</a> . Per <a href="#">XCN07022</a> , updated the discontinued FG1156 and FGG1156 package discussion throughout document. Per <a href="#">XCN08011</a> , updated the discontinued CP132 and CPG132 package discussion throughout document. This product is not recommended for new designs.  |
| 06/27/2013 | 3.1         | Removed banner. This product IS recommended for new designs.   |

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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. Although speed grades with this designation are considered relatively stable and conservative, some under-reporting might still occur. Use as estimates, not for production.
- **Preliminary:** 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-reported delays is greatly reduced compared to Advance data. Use as estimates, not for production.
- **Production:** These specifications are approved only after silicon has been characterized over numerous production lots. There is no under-reporting of delays, and customers receive formal notification of any subsequent changes. Parameter values are considered stable with no future changes expected.

Production-quality systems must only use FPGA designs compiled with a Production status speed file. FPGA designs using a less mature speed file designation should only be used during system prototyping or preproduction qualification. FPGA designs with speed files designated as 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.

All parameter limits are representative of worst-case supply voltage and junction temperature conditions. **The following applies unless otherwise noted: The parameter values published in this module apply to all Spartan®-3 devices. AC and DC characteristics are specified using the same numbers for both commercial and industrial grades.** All parameters representing voltages are measured with respect to GND.

### Mask and Fab Revisions

Some specifications list different values for one or more mask or fab revisions, indicated by the device top marking (see [Package Marking, page 5](#)). The revision differences involve the power ramp rates, differential DC specifications, and DCM characteristics. The most recent revision (mask rev E and GQ fab/geometry code) is errata-free with improved specifications than earlier revisions.

Mask rev E with fab rev GQ has been shipping since 2005 (see [XCN05009](#)) and has been 100% of Xilinx Spartan-3 device shipments since 2006. SCD 0974 was provided to ensure the receipt of the rev E silicon, but it is no longer needed. Parts ordered under the SCD appended “0974” to the standard part number. For example, “XC3S50-4VQ100C” became “XC3S50-4VQ100C0974”.

Table 28: Absolute Maximum Ratings

| Symbol      | Description   | Conditions                       |                  | Min   | Max               | Units |
|-------------|---|----------------------------------|------------------|-------|-------------------|-------|
| $V_{CCINT}$ | Internal supply voltage relative to GND   |                                  |                  | -0.5  | 1.32              | V     |
| $V_{CCAUX}$ | Auxiliary supply voltage relative to GND  |                                  |                  | -0.5  | 3.00              | V     |
| $V_{CCO}$   | Output driver supply voltage relative to GND  |                                  |                  | -0.5  | 3.75              | V     |
| $V_{REF}$   | Input reference voltage relative to GND   |                                  |                  | -0.5  | $V_{CCO} + 0.5$   | V     |
| $V_{IN}$    | Voltage applied to all User I/O pins and Dual-Purpose pins relative to GND <sup>(2,4)</sup> | Driver in a high-impedance state | Commercial       | -0.95 | 4.4               | V     |
|             |   |                                  | Industrial       | -0.85 | 4.3               |       |
|             | Voltage applied to all Dedicated pins relative to GND <sup>(3)</sup>                        |                                  | All temp. ranges | -0.5  | $V_{CCAUX} + 0.5$ | V     |



Table 28: Absolute Maximum Ratings (Cont'd)

| Symbol    | Description  | Conditions  | Min | Max   | Units |
|-----------|--|---|-----|-------|-------|
| $I_{IK}$  | Input clamp current per I/O pin                      | $-0.5\text{ V} < V_{IN} < (V_{CCO} + 0.5\text{ V})$ | –   | ±100  | mA    |
| $V_{ESD}$ | Electrostatic Discharge Voltage pins relative to GND | Human body model                                    | –   | ±2000 | V     |
|           |  | Charged device model                                | –   | ±500  | V     |
|           |  | Machine model                                       | –   | ±200  | V     |
| $T_J$     | Junction temperature                                 |   | –   | 125   | °C    |
| $T_{SOL}$ | Soldering temperature <sup>(4)</sup>                 |   | –   | 220   | °C    |
| $T_{STG}$ | Storage temperature                                  |   | –65 | 150   | °C    |

**Notes:**

- Stresses beyond those listed under 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 Ratings conditions for extended periods of time adversely affects device reliability.
- All User I/O and Dual-Purpose pins (DIN/D0, D1–D7, CS\_B, RDWR\_B, BUSY/DOOUT, and INIT\_B) draw power from the  $V_{CCO}$  power rail of the associated bank. Keeping  $V_{IN}$  within 500 mV of the associated  $V_{CCO}$  rails or ground rail ensures that the internal diode junctions that exist between each of these pins and the  $V_{CCO}$  and GND rails do not turn on. Table 32 specifies the  $V_{CCO}$  range used to determine the max limit. Input voltages outside the  $-0.5\text{ V}$  to  $V_{CCO}+0.5\text{ V}$  voltage range are permissible provided that the  $I_{IK}$  input clamp diode rating is met and no more than 100 pins exceed the range simultaneously. Prolonged exposure to such current may compromise device reliability. A sustained current of 10 mA will not compromise device reliability. See XAPP459, *Eliminating I/O Coupling Effects when Interfacing Large-Swing Single-Ended Signals to User I/O Pins on Spartan-3 Generation FPGAs* for more details. The  $V_{IN}$  limits apply to both the DC and AC components of signals. Simple application solutions are available that show how to handle overshoot/undershoot as well as achieve PCI compliance. Refer to the following application notes: XAPP457, *Powering and Configuring Spartan-3 Generation FPGAs in Compliant PCI Applications* and XAPP659, *Virtex@-II Pro / Virtex-II Pro X 3.3V I/O Design Guidelines*.
- All Dedicated pins (M0–M2, CCLK, PROG\_B, DONE, HSWAP\_EN, TCK, TDI, TDO, and TMS) draw power from the  $V_{CCAUX}$  rail (2.5V). Meeting the  $V_{IN}$  max limit ensures that the internal diode junctions that exist between each of these pins and the  $V_{CCAUX}$  rail do not turn on. Table 32 specifies the  $V_{CCAUX}$  range used to determine the max limit. When  $V_{CCAUX}$  is at its maximum recommended operating level (2.625V),  $V_{IN}$  max < 3.125V. As long as the  $V_{IN}$  max specification is met, oxide stress is not possible. For information concerning the use of 3.3V signals, see the *3.3V-Tolerant Configuration Interface*, page 47. See also XAPP459.
- For soldering guidelines, see UG112, *Device Packaging and Thermal Characteristics* and XAPP427, *Implementation and Solder Reflow Guidelines for Pb-Free Packages*.

Table 29: 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      | 0.8 | 2.0 | V     |
| $V_{CCO4T}$  | Threshold for the $V_{CCO}$ Bank 4 supply | 0.4 | 1.0 | V     |

**Notes:**

- $V_{CCINT}$ ,  $V_{CCAUX}$ , and  $V_{CCO}$  supplies may be applied in any order. When applying  $V_{CCINT}$  power before  $V_{CCAUX}$  power, the FPGA may draw a surplus current in addition to the quiescent current levels specified in Table 34. Applying  $V_{CCAUX}$  eliminates the surplus current. The FPGA does not use any of the surplus current for the power-on process. For this power sequence, make sure that regulators with foldback features will not shut down inadvertently.
- To ensure successful power-on,  $V_{CCINT}$ ,  $V_{CCO}$  Bank 4, and  $V_{CCAUX}$  supplies must rise through their respective threshold-voltage ranges with no dips at any point.
- If a brown-out condition occurs where  $V_{CCAUX}$  or  $V_{CCINT}$  drops below the retention voltage indicated in Table 31, then  $V_{CCAUX}$  or  $V_{CCINT}$  must drop below the minimum power-on reset voltage in order to clear out the device configuration content.

Table 30: Power Voltage Ramp Time Requirements

| Symbol      | Description  | Device | Package | Min                     | Max                     | Units |
|-------------|--|--------|---------|-------------------------|-------------------------|-------|
| $T_{CCO}$   | $V_{CCO}$ ramp time for all eight banks  | All    | All     | No limit <sup>(4)</sup> | –                       | N/A   |
| $T_{CCINT}$ | $V_{CCINT}$ ramp time, only if $V_{CCINT}$ is last in three-rail power-on sequence | All    | All     | No limit                | No limit <sup>(5)</sup> | N/A   |

**Notes:**

1. If a limit exists, this specification is based on characterization.
2. The ramp time is measured from 10% to 90% of the full nominal voltage swing for all I/O standards.
3. For information on power-on current needs, see [Power-On Behavior, page 54](#)
4. For mask revisions earlier than revision E (see [Mask and Fab Revisions, page 58](#)),  $T_{CCO}$  min is limited to 2.0 ms for the XC3S200 and XC3S400 devices in QFP packages, and limited to 0.6 ms for the XC3S200, XC3S400, XC3S1500, and XC3S4000 devices in the FT and FG packages.
5. For earlier device versions with the FQ fabrication/process code (see [Mask and Fab Revisions, page 58](#)),  $T_{CCINT}$  max is limited to 500  $\mu$ s.

Table 31: Power Voltage Levels Necessary for Preserving RAM Contents

| Symbol      | Description                                   | Min | Units |
|-------------|---|-----|-------|
| $V_{DRINT}$ | $V_{CCINT}$ level required to retain RAM data | 1.0 | V     |
| $V_{DRAUX}$ | $V_{CCAUX}$ level required to retain RAM data | 2.0 | V     |

**Notes:**

1. RAM contents include data stored in CMOS configuration latches.
2. The level of the  $V_{CCO}$  supply has no effect on data retention.
3. If a brown-out condition occurs where  $V_{CCAUX}$  or  $V_{CCINT}$  drops below the retention voltage, then  $V_{CCAUX}$  or  $V_{CCINT}$  must drop below the minimum power-on reset voltage indicated in [Table 29](#) in order to clear out the device configuration content.

Table 32: General Recommended Operating Conditions

| Symbol                            | Description  | Min  | Nom   | Max                              | Units                          |              |
|-----------------------------------|--|--|-------|----------------------------------|--------------------------------|--------------|
| $T_J$                             | Junction temperature   | Commercial                                   | 0     | 25                               | 85                             | $^{\circ}$ C |
|                                   |  | Industrial                                   | –40   | 25                               | 100                            | $^{\circ}$ C |
| $V_{CCINT}$                       | Internal supply voltage  | 1.140  | 1.200 | 1.260                            | V                              |              |
| $V_{CCO}$ <sup>(1)</sup>          | Output driver supply voltage   | 1.140  | –     | 3.465                            | V                              |              |
| $V_{CCAUX}$                       | Auxiliary supply voltage   | 2.375  | 2.500 | 2.625                            | V                              |              |
| $\Delta V_{CCAUX}$ <sup>(2)</sup> | Voltage variance on VCCAUX when using a DCM  | –  | –     | 10                               | mV/ms                          |              |
| $V_{IN}$ <sup>(3)</sup>           | Voltage applied to all User I/O pins and Dual-Purpose pins relative to GND <sup>(4)(6)</sup> | $V_{CCO} = 3.3V$ , IO                        | –0.3  | –                                | 3.75                           | V            |
|                                   |  | $V_{CCO} = 3.3V$ , IO_Lxxy <sup>(7)</sup>    | –0.3  | –                                | 3.75                           | V            |
|                                   |  | $V_{CCO} \leq 2.5V$ , IO                     | –0.3  | –                                | $V_{CCO} + 0.3$ <sup>(4)</sup> | V            |
|                                   |  | $V_{CCO} \leq 2.5V$ , IO_Lxxy <sup>(7)</sup> | –0.3  | –                                | $V_{CCO} + 0.3$ <sup>(4)</sup> | V            |
|                                   | Voltage applied to all Dedicated pins relative to GND <sup>(5)</sup>                         | –0.3   | –     | $V_{CCAUX} + 0.3$ <sup>(5)</sup> | V                              |              |

**Notes:**

1. The  $V_{CCO}$  range given here spans the lowest and highest operating voltages of all supported I/O standards. The recommended  $V_{CCO}$  range specific to each of the single-ended I/O standards is given in [Table 35](#), and that specific to the differential standards is given in [Table 37](#).
2. Only during DCM operation is it recommended that the rate of change of  $V_{CCAUX}$  not exceed 10 mV/ms.
3. Input voltages outside the recommended range are permissible provided that the  $I_{IK}$  input diode clamp diode rating is met. Refer to [Table 28](#).
4. Each of the User I/O and Dual-Purpose pins is associated with one of the  $V_{CCO}$  rails. Meeting the  $V_{IN}$  limit ensures that the internal diode junctions that exist between these pins and their associated  $V_{CCO}$  and GND rails do not turn on. The absolute maximum rating is provided in [Table 28](#).
5. All Dedicated pins (PROG\_B, DONE, TCK, TDI, TDO, and TMS) draw power from the  $V_{CCAUX}$  rail (2.5V). Meeting the  $V_{IN}$  max limit ensures that the internal diode junctions that exist between each of these pins and the  $V_{CCAUX}$  and GND rails do not turn on.
6. See [XAPP459, Eliminating I/O Coupling Effects when Interfacing Large-Swing Single-Ended Signals to User I/O Pins on Spartan-3 Generation FPGAs](#).
7. For single-ended signals that are placed on a differential-capable I/O,  $V_{IN}$  of –0.2V to –0.3V is supported but can cause increased leakage between the two pins. See the *Parasitic Leakage* section in [UG331, Spartan-3 Generation FPGA User Guide](#).



Table 33: General DC Characteristics of User I/O, Dual-Purpose, and Dedicated Pins

| Symbol          | Description  | Test Conditions   | Min                 | Typ   | Max | Units    |            |
|-----------------|--|---|---------------------|-------|-----|----------|------------|
| $I_L^{(2)(4)}$  | Leakage current at User I/O, Dual-Purpose, and Dedicated pins  | Driver is Hi-Z, $V_{IN} = 0V$ or $V_{CCO}$ max, sample-tested | $V_{CCO} \geq 3.0V$ | –     | -   | $\pm 25$ | $\mu A$    |
|                 |  |   | $V_{CCO} < 3.0V$    | –     | -   | $\pm 10$ | $\mu A$    |
| $I_{RPU}^{(3)}$ | Current through pull-up resistor at User I/O, Dual-Purpose, and Dedicated pins                                   | $V_{IN} = 0V, V_{CCO} = 3.3V$                                 |                     | -0.84 | -   | -2.35    | mA         |
|                 |  | $V_{IN} = 0V, V_{CCO} = 3.0V$                                 |                     | -0.69 | -   | -1.99    | mA         |
|                 |  | $V_{IN} = 0V, V_{CCO} = 2.5V$                                 |                     | -0.47 | -   | -1.41    | mA         |
|                 |  | $V_{IN} = 0V, V_{CCO} = 1.8V$                                 |                     | -0.21 | -   | -0.69    | mA         |
|                 |  | $V_{IN} = 0V, V_{CCO} = 1.5V$                                 |                     | -0.13 | -   | -0.43    | mA         |
|                 |  | $V_{IN} = 0V, V_{CCO} = 1.2V$                                 |                     | -0.06 | -   | -0.22    | mA         |
| $R_{PU}^{(3)}$  | Equivalent resistance of pull-up resistor at User I/O, Dual-Purpose, and Dedicated pins, derived from $I_{RPU}$  | $V_{CCO} = 3.0V$ to $3.465V$                                  |                     | 1.27  | -   | 4.11     | k $\Omega$ |
|                 |  | $V_{CCO} = 2.3V$ to $2.7V$                                    |                     | 1.15  | -   | 3.25     | k $\Omega$ |
|                 |  | $V_{CCO} = 1.7V$ to $1.9V$                                    |                     | 2.45  | -   | 9.10     | k $\Omega$ |
|                 |  | $V_{CCO} = 1.4V$ to $1.6V$                                    |                     | 3.25  | -   | 12.10    | k $\Omega$ |
|                 |  | $V_{CCO} = 1.14$ to $1.26V$                                   |                     | 5.15  | -   | 21.00    | k $\Omega$ |
| $I_{RPD}^{(3)}$ | Current through pull-down resistor at User I/O, Dual-Purpose, and Dedicated pins                                 | $V_{IN} = V_{CCO}$  |                     | 0.37  | -   | 1.67     | mA         |
| $R_{PD}^{(3)}$  | Equivalent resistance of pull-down resistor at User I/O, Dual-Purpose, and Dedicated pins, driven from $I_{RPD}$ | $V_{IN} = V_{CCO} = 3.0V$ to $3.465V$                         |                     | 1.75  | -   | 9.35     | k $\Omega$ |
|                 |  | $V_{IN} = V_{CCO} = 2.3V$ to $2.7V$                           |                     | 1.35  | -   | 7.30     | k $\Omega$ |
|                 |  | $V_{IN} = V_{CCO} = 1.7V$ to $1.9V$                           |                     | 1.00  | -   | 5.15     | k $\Omega$ |
|                 |  | $V_{IN} = V_{CCO} = 1.4V$ to $1.6V$                           |                     | 0.85  | -   | 4.35     | k $\Omega$ |
|                 |  | $V_{IN} = V_{CCO} = 1.14$ to $1.26V$                          |                     | 0.68  | -   | 3.465    | k $\Omega$ |
| $R_{DCI}$       | Value of external reference resistor to support DCI I/O standards  |   |                     | 20    | -   | 100      | $\Omega$   |
| $I_{REF}$       | $V_{REF}$ current per pin  | $V_{CCO} \geq 3.0V$   |                     | –     | -   | $\pm 25$ | $\mu A$    |
|                 |  | $V_{CCO} < 3.0V$  |                     | –     | -   | $\pm 10$ | $\mu A$    |
| $C_{IN}$        | Input capacitance  |   |                     | 3     | -   | 10       | pF         |

Notes:

- The numbers in this table are based on the conditions set forth in Table 32.
- The  $I_L$  specification applies to every I/O pin throughout power-on as long as the voltage on that pin stays between the absolute  $V_{IN}$  minimum and maximum values (Table 28). For hot-swap applications, at the time of card connection, be sure to keep all I/O voltages within this range before applying  $V_{CCO}$  power. Consider applying  $V_{CCO}$  power before connecting the signal lines, to avoid turning on the ESD protection diodes, shown in Module 2: Figure 7, page 11. When the FPGA is completely unpowered, the I/O pins are high impedance, but there is a path through the upper and lower ESD protection diodes.
- This parameter is based on characterization. The pull-up resistance  $R_{PU} = V_{CCO} / I_{RPU}$ . The pull-down resistance  $R_{PD} = V_{IN} / I_{RPD}$ . Spartan-3 family values for both resistances are stronger than they have been for previous FPGA families.
- For single-ended signals that are placed on a differential-capable I/O,  $V_{IN}$  of  $-0.2V$  to  $-0.3V$  is supported but can cause increased leakage between the two pins. See the *Parasitic Leakage* section in UG331, *Spartan-3 Generation FPGA User Guide*.

Table 34: Quiescent Supply Current Characteristics

| Symbol              | Description                                 | Device   | Typical <sup>(1)</sup> | Commercial Maximum <sup>(1)</sup> | Industrial Maximum <sup>(1)</sup> | Units |
|---------------------|---|----------|------------------------|-----------------------------------|-----------------------------------|-------|
| I <sub>CCINTQ</sub> | Quiescent V <sub>CCINT</sub> supply current | XC3S50   | 5                      | 24                                | 31                                | mA    |
|                     |   | XC3S200  | 10                     | 54                                | 80                                | mA    |
|                     |   | XC3S400  | 15                     | 110                               | 157                               | mA    |
|                     |   | XC3S1000 | 35                     | 160                               | 262                               | mA    |
|                     |   | XC3S1500 | 45                     | 260                               | 332                               | mA    |
|                     |   | XC3S2000 | 60                     | 360                               | 470                               | mA    |
|                     |   | XC3S4000 | 100                    | 450                               | 810                               | mA    |
|                     |   | XC3S5000 | 120                    | 600                               | 870                               | mA    |
| I <sub>CCOQ</sub>   | Quiescent V <sub>CCO</sub> supply current   | XC3S50   | 1.5                    | 2.0                               | 2.5                               | mA    |
|                     |   | XC3S200  | 1.5                    | 3.0                               | 3.5                               | mA    |
|                     |   | XC3S400  | 1.5                    | 3.0                               | 3.5                               | mA    |
|                     |   | XC3S1000 | 2.0                    | 4.0                               | 5.0                               | mA    |
|                     |   | XC3S1500 | 2.5                    | 4.0                               | 5.0                               | mA    |
|                     |   | XC3S2000 | 3.0                    | 5.0                               | 6.0                               | mA    |
|                     |   | XC3S4000 | 3.5                    | 5.0                               | 6.0                               | mA    |
|                     |   | XC3S5000 | 3.5                    | 5.0                               | 6.0                               | mA    |
| I <sub>CCAUXQ</sub> | Quiescent V <sub>CCAUX</sub> supply current | XC3S50   | 7                      | 20                                | 22                                | mA    |
|                     |   | XC3S200  | 10                     | 30                                | 33                                | mA    |
|                     |   | XC3S400  | 15                     | 40                                | 44                                | mA    |
|                     |   | XC3S1000 | 20                     | 50                                | 55                                | mA    |
|                     |   | XC3S1500 | 35                     | 75                                | 85                                | mA    |
|                     |   | XC3S2000 | 45                     | 90                                | 100                               | mA    |
|                     |   | XC3S4000 | 55                     | 110                               | 125                               | mA    |
|                     |   | XC3S5000 | 70                     | 130                               | 145                               | mA    |

**Notes:**

- The numbers in this table are based on the conditions set forth in [Table 32](#). 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 devices with typical processing at room temperature (T<sub>J</sub> of 25°C at V<sub>CCINT</sub> = 1.2V, V<sub>CCO</sub> = 3.3V, and V<sub>CCAUX</sub> = 2.5V). Maximum values are the production test limits measured for each device at the maximum specified junction temperature and at maximum voltage limits with V<sub>CCINT</sub> = 1.26V, V<sub>CCO</sub> = 3.465V, and V<sub>CCAUX</sub> = 2.625V. The FPGA is programmed with a "blank" configuration data file (i.e., a design with no functional elements instantiated). For conditions other than those described above, (e.g., a design including functional elements, the use of DCI standards, etc.), measured quiescent current levels may be different than the values in the table. Use the XPower Estimator or XPower Analyzer for more accurate estimates. See Note 2.
- There are two recommended ways to estimate the total power consumption (quiescent plus dynamic) for a specific design: a) The [Spartan-3 XPower Estimator](#) provides quick, approximate, typical estimates, and does not require a netlist of the design. b) XPower Analyzer, part of the Xilinx ISE development software, uses the FPGA netlist as input to provide more accurate maximum and typical estimates.
- The maximum numbers in this table also indicate the minimum current each power rail requires in order for the FPGA to power-on successfully, once all three rails are supplied. If V<sub>CCINT</sub> is applied before V<sub>CCAUX</sub>, there may be temporary additional I<sub>CCINT</sub> current until V<sub>CCAUX</sub> is applied. See [Surplus I<sub>CCINT</sub> if V<sub>CCINT</sub> Applied before V<sub>CCAUX</sub>, page 54](#)

Table 35: Recommended Operating Conditions for User I/Os Using Single-Ended Standards

| Signal Standard (IOSTANDARD)   | V <sub>CCO</sub> |         |         | V <sub>REF</sub> |         |         | V <sub>IL</sub>          | V <sub>IH</sub>          |
|--|------------------|---------|---------|------------------|---------|---------|--------------------------|--------------------------|
|  | Min (V)          | Nom (V) | Max (V) | Min (V)          | Nom (V) | Max (V) | Max (V)                  | Min (V)                  |
| GTL <sup>(3)</sup>   | –                | –       | –       | 0.74             | 0.8     | 0.86    | V <sub>REF</sub> – 0.05  | V <sub>REF</sub> + 0.05  |
| GTL_DCI  | –                | 1.2     | –       | 0.74             | 0.8     | 0.86    | V <sub>REF</sub> – 0.05  | V <sub>REF</sub> + 0.05  |
| GTL <sup>(3)</sup>   | –                | –       | –       | 0.88             | 1       | 1.12    | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| GTL <sup>(3)</sup> _DCI  | –                | 1.5     | –       | 0.88             | 1       | 1.12    | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSLVDCI_15   | 1.4              | 1.5     | 1.6     | –                | 0.75    | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSLVDCI_18   | 1.7              | 1.8     | 1.9     | –                | 0.9     | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSLVDCI_25   | 2.3              | 2.5     | 2.7     | –                | 1.25    | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSLVDCI_33   | 3.0              | 3.3     | 3.465   | –                | 1.65    | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSTL_I, HSTL_I_DCI   | 1.4              | 1.5     | 1.6     | 0.68             | 0.75    | 0.9     | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSTL_III, HSTL_III_DCI   | 1.4              | 1.5     | 1.6     | –                | 0.9     | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSTL_I_18, HSTL_I_DCI_18   | 1.7              | 1.8     | 1.9     | 0.8              | 0.9     | 1.1     | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSTL_II_18, HSTL_II_DCI_18   | 1.7              | 1.8     | 1.9     | –                | 0.9     | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| HSTL_III_18, HSTL_III_DCI_18   | 1.7              | 1.8     | 1.9     | –                | 1.1     | –       | V <sub>REF</sub> – 0.1   | V <sub>REF</sub> + 0.1   |
| LVC <sub>MOS</sub> 12  | 1.14             | 1.2     | 1.3     | –                | –       | –       | 0.37V <sub>CCO</sub>     | 0.58V <sub>CCO</sub>     |
| LVC <sub>MOS</sub> 15, LVDCI_15, LVDCI_DV2_15                                  | 1.4              | 1.5     | 1.6     | –                | –       | –       | 0.30V <sub>CCO</sub>     | 0.70V <sub>CCO</sub>     |
| LVC <sub>MOS</sub> 18, LVDCI_18, LVDCI_DV2_18                                  | 1.7              | 1.8     | 1.9     | –                | –       | –       | 0.30V <sub>CCO</sub>     | 0.70V <sub>CCO</sub>     |
| LVC <sub>MOS</sub> 25 <sup>(4,5)</sup> , LVDCI_25, LVDCI_DV2_25 <sup>(4)</sup> | 2.3              | 2.5     | 2.7     | –                | –       | –       | 0.7                      | 1.7                      |
| LVC <sub>MOS</sub> 33, LVDCI_33, LVDCI_DV2_33 <sup>(4)</sup>                   | 3.0              | 3.3     | 3.465   | –                | –       | –       | 0.8                      | 2.0                      |
| LVTTTL   | 3.0              | 3.3     | 3.465   | –                | –       | –       | 0.8                      | 2.0                      |
| PCI33_3 <sup>(7)</sup>   | 3.0              | 3.3     | 3.465   | –                | –       | –       | 0.30V <sub>CCO</sub>     | 0.50V <sub>CCO</sub>     |
| SSTL18_I, SSTL18_I_DCI   | 1.7              | 1.8     | 1.9     | 0.833            | 0.900   | 0.969   | V <sub>REF</sub> – 0.125 | V <sub>REF</sub> + 0.125 |
| SSTL18_II  | 1.7              | 1.8     | 1.9     | 0.833            | 0.900   | 0.969   | V <sub>REF</sub> – 0.125 | V <sub>REF</sub> + 0.125 |
| SSTL2_I, SSTL2_I_DCI   | 2.3              | 2.5     | 2.7     | 1.15             | 1.25    | 1.35    | V <sub>REF</sub> – 0.15  | V <sub>REF</sub> + 0.15  |
| SSTL2_II, SSTL2_II_DCI   | 2.3              | 2.5     | 2.7     | 1.15             | 1.25    | 1.35    | V <sub>REF</sub> – 0.15  | V <sub>REF</sub> + 0.15  |

**Notes:**

- Descriptions of the symbols used in this table are as follows:  
V<sub>CCO</sub> – the supply voltage for output drivers as well as LVC<sub>MOS</sub>, LVTTTL, and PCI inputs  
V<sub>REF</sub> – the reference voltage for setting the input switching threshold  
V<sub>IL</sub> – the input voltage that indicates a Low logic level  
V<sub>IH</sub> – the input voltage that indicates a High logic level
- For device operation, the maximum signal voltage (V<sub>IH</sub> max) may be as high as V<sub>IN</sub> max. See [Table 28](#).
- Because the GTL and GTLP standards employ open-drain output buffers, V<sub>CCO</sub> lines do not supply current to the I/O circuit, rather this current is provided using an external pull-up resistor connected from the I/O pin to a termination voltage (V<sub>TT</sub>). Nevertheless, the voltage applied to the associated V<sub>CCO</sub> lines must always be at or above V<sub>TT</sub> and I/O pad voltages.
- There is approximately 100 mV of hysteresis on inputs using LVC<sub>MOS</sub>25 or LVC<sub>MOS</sub>33 standards.
- All dedicated pins (M0-M2, CCLK, PROG\_B, DONE, HSWAP\_EN, TCK, TDI, TDO, and TMS) use the LVC<sub>MOS</sub> standard and draw power from the V<sub>CCAUX</sub> rail (2.5V). The dual-purpose configuration pins (DIN/D0, D1-D7, CS\_B, RDWR\_B, BUSY/DOUT, and INIT\_B) use the LVC<sub>MOS</sub> standard before the user mode. For these pins, apply 2.5V to the V<sub>CCO</sub> Bank 4 and V<sub>CCO</sub> Bank 5 rails at power-on and throughout configuration. For information concerning the use of 3.3V signals, see [3.3V-Tolerant Configuration Interface, page 47](#).
- The Global Clock Inputs (GCLK0-GCLK7) are dual-purpose pins to which any signal standard can be assigned.
- For more information, see [XAPP457](#).

Table 36: DC Characteristics of User I/Os Using Single-Ended Standards

| Signal Standard (IOSTANDARD) and Current Drive Attribute (mA) |    | Test Conditions      |                      | Logic Level Characteristics |                         |
|---|----|----------------------|----------------------|-----------------------------|-------------------------|
|   |    | I <sub>OL</sub> (mA) | I <sub>OH</sub> (mA) | V <sub>OL</sub> Max (V)     | V <sub>OH</sub> Min (V) |
| GTL   |    | 32                   | –                    | 0.4                         | –                       |
| GTL_DCI   |    | Note 3               | Note 3               |                             |                         |
| GTL_P   |    | 36                   | –                    | 0.6                         | –                       |
| GTL_P_DCI   |    | Note 3               | Note 3               |                             |                         |
| HSLVDCI_15  |    | Note 3               | Note 3               | 0.4                         | V <sub>CCO</sub> – 0.4  |
| HSLVDCI_18  |    |                      |                      |                             |                         |
| HSLVDCI_25  |    |                      |                      |                             |                         |
| HSLVDCI_33  |    |                      |                      |                             |                         |
| HSTL_I  |    | 8                    | –8                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
| HSTL_I_DCI  |    | Note 3               | Note 3               |                             |                         |
| HSTL_III  |    | 24                   | –8                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
| HSTL_III_DCI  |    | Note 3               | Note 3               |                             |                         |
| HSTL_I_18   |    | 8                    | –8                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
| HSTL_I_DCI_18   |    | Note 3               | Note 3               |                             |                         |
| HSTL_II_18  |    | 16                   | –16                  | 0.4                         | V <sub>CCO</sub> – 0.4  |
| HSTL_II_DCI_18  |    | Note 3               | Note 3               |                             |                         |
| HSTL_III_18   |    | 24                   | –8                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
| HSTL_III_DCI_18   |    | Note 3               | Note 3               |                             |                         |
| LVCMOS12 <sup>(4)</sup>                                       | 2  | 2                    | –2                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
|   | 4  | 4                    | –4                   |                             |                         |
|   | 6  | 6                    | –6                   |                             |                         |
| LVCMOS15 <sup>(4)</sup>                                       | 2  | 2                    | –2                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
|   | 4  | 4                    | –4                   |                             |                         |
|   | 6  | 6                    | –6                   |                             |                         |
|   | 8  | 8                    | –8                   |                             |                         |
|   | 12 | 12                   | –12                  |                             |                         |
| LVDCI_15, LVDCI_DV2_15  |    | Note 3               | Note 3               |                             |                         |
| LVCMOS18 <sup>(4)</sup>                                       | 2  | 2                    | –2                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
|   | 4  | 4                    | –4                   |                             |                         |
|   | 6  | 6                    | –6                   |                             |                         |
|   | 8  | 8                    | –8                   |                             |                         |
|   | 12 | 12                   | –12                  |                             |                         |
|   | 16 | 16                   | –16                  |                             |                         |
| LVDCI_18, LVDCI_DV2_18  |    | Note 3               | Note 3               |                             |                         |
| LVCMOS25 <sup>(4,5)</sup>                                     | 2  | 2                    | –2                   | 0.4                         | V <sub>CCO</sub> – 0.4  |
|   | 4  | 4                    | –4                   |                             |                         |
|   | 6  | 6                    | –6                   |                             |                         |
|   | 8  | 8                    | –8                   |                             |                         |
|   | 12 | 12                   | –12                  |                             |                         |
|   | 16 | 16                   | –16                  |                             |                         |
|   | 24 | 24                   | –24                  |                             |                         |
| LVDCI_25, LVDCI_DV2_25  |    | Note 3               | Note 3               |                             |                         |

Table 36: DC Characteristics of User I/Os Using Single-Ended Standards (Cont'd)

| Signal Standard (IOSTANDARD) and Current Drive Attribute (mA) |    | Test Conditions      |                      | Logic Level Characteristics |                         |
|---|----|----------------------|----------------------|-----------------------------|-------------------------|
|   |    | I <sub>OL</sub> (mA) | I <sub>OH</sub> (mA) | V <sub>OL</sub> Max (V)     | V <sub>OH</sub> Min (V) |
| LVCMOS33 <sup>(4)</sup>                                       | 2  | 2                    | -2                   | 0.4                         | V <sub>CCO</sub> - 0.4  |
|   | 4  | 4                    | -4                   |                             |                         |
|   | 6  | 6                    | -6                   |                             |                         |
|   | 8  | 8                    | -8                   |                             |                         |
|   | 12 | 12                   | -12                  |                             |                         |
|   | 16 | 16                   | -16                  |                             |                         |
|   | 24 | 24                   | -24                  |                             |                         |
| LVDCI_33, LVDCI_DV2_33  |    | Note 3               | Note 3               |                             |                         |
| LVTTTL <sup>(4)</sup>   | 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                  |                             |                         |
| PCI33_3   |    | Note 6               | Note 6               | 0.10V <sub>CCO</sub>        | 0.90V <sub>CCO</sub>    |
| SSTL18_I  |    | 6.7                  | -6.7                 | V <sub>TT</sub> - 0.475     | V <sub>TT</sub> + 0.475 |
| SSTL18_I_DCI  |    | Note 3               | Note 3               |                             |                         |
| SSTL18_II   |    | 13.4                 | -13.4                | V <sub>TT</sub> - 0.475     | V <sub>TT</sub> + 0.475 |
| SSTL2_I   |    | 8.1                  | -8.1                 | V <sub>TT</sub> - 0.61      | V <sub>TT</sub> + 0.61  |
| SSTL2_I_DCI   |    | Note 3               | Note 3               |                             |                         |
| SSTL2_II <sup>(7)</sup>                                       |    | 16.2                 | -16.2                | V <sub>TT</sub> - 0.81      | V <sub>TT</sub> + 0.81  |
| SSTL2_II_DCI <sup>(7)</sup>                                   |    | Note 3               | Note 3               |                             |                         |

**Notes:**

- The numbers in this table are based on the conditions set forth in Table 32 and Table 35.
- Descriptions of the symbols used in this table are as follows:  
 I<sub>OL</sub> – the output current condition under which V<sub>OL</sub> is tested  
 I<sub>OH</sub> – the output current condition under which V<sub>OH</sub> is tested  
 V<sub>OL</sub> – the output voltage that indicates a Low logic level  
 V<sub>OH</sub> – the output voltage that indicates a High logic level  
 V<sub>IL</sub> – the input voltage that indicates a Low logic level  
 V<sub>IH</sub> – the input voltage that indicates a High logic level  
 V<sub>CCO</sub> – the supply voltage for output drivers as well as LVCMOS, LVTTTL, and PCI inputs  
 V<sub>REF</sub> – the reference voltage for setting the input switching threshold  
 V<sub>TT</sub> – the voltage applied to a resistor termination
- Tested according to the standard's relevant specifications. When using the DCI version of a standard on a given I/O bank, that bank will consume more power than if the non-DCI version had been used instead. The additional power is drawn for the purpose of impedance-matching at the I/O pins. A portion of this power is dissipated in the two RREF resistors.
- For the LVCMOS and LVTTTL standards: the same V<sub>OL</sub> and V<sub>OH</sub> limits apply for both the Fast and Slow slew attributes.
- All dedicated output pins (CCLK, DONE, and TDO) and dual-purpose totem-pole output pins (D0-D7 and BUSY/DOUT) exhibit the characteristics of LVCMOS25 with 12 mA drive and slow slew rate. For information concerning the use of 3.3V signals, see [3.3V-Tolerant Configuration Interface, page 47](#).
- Tested according to the relevant PCI specifications. For more information, see [XAPP457](#).
- The minimum usable V<sub>TT</sub> voltage is 1.25V.

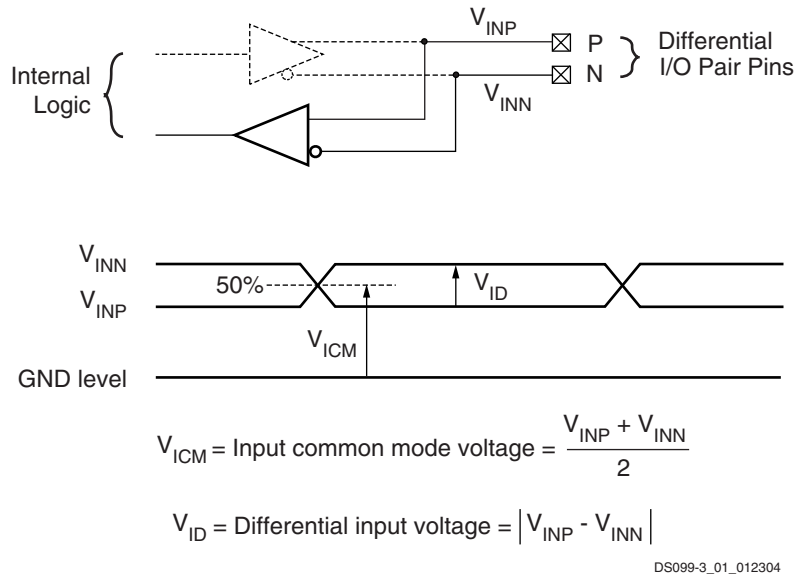


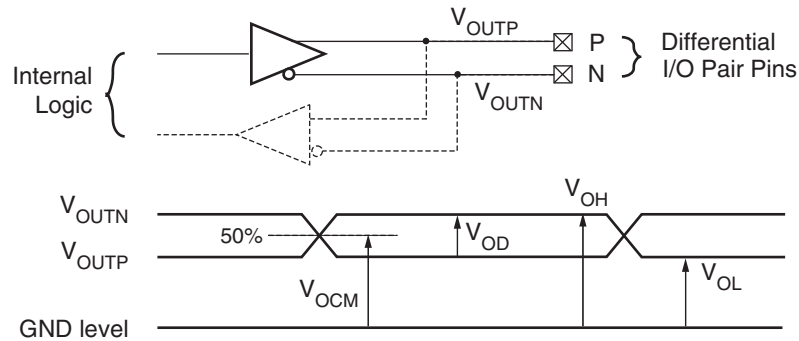
Figure 32: Differential Input Voltages

Table 37: Recommended Operating Conditions for User I/Os Using Differential Signal Standards

| Signal Standard (IOSTANDARD)         | V <sub>CCO</sub> <sup>(1)</sup> |         |         | V <sub>ID</sub> <sup>(3)</sup> |          |          | V <sub>ICM</sub> |         |         |
|--------------------------------------|---------------------------------|---------|---------|--------------------------------|----------|----------|------------------|---------|---------|
|                                      | Min (V)                         | Nom (V) | Max (V) | Min (mV)                       | Nom (mV) | Max (mV) | Min (V)          | Nom (V) | Max (V) |
| LDT_25 (ULVDS_25)                    | 2.375                           | 2.50    | 2.625   | 200                            | 600      | 1000     | 0.44             | 0.60    | 0.78    |
| LVDS_25, LVDS_25_DCI                 | 2.375                           | 2.50    | 2.625   | 100                            | 350      | 600      | 0.30             | 1.25    | 2.20    |
| BLVDS_25                             | 2.375                           | 2.50    | 2.625   | -                              | 350      | -        | -                | 1.25    | -       |
| LVDSEXT_25, LVDSEXT_25_DCI           | 2.375                           | 2.50    | 2.625   | 100                            | 540      | 1000     | 0.30             | 1.20    | 2.20    |
| LVPECL_25                            | 2.375                           | 2.50    | 2.625   | 100                            | -        | -        | 0.30             | 1.20    | 2.00    |
| RSDS_25                              | 2.375                           | 2.50    | 2.625   | 100                            | 200      | -        | -                | 1.20    | -       |
| DIFF_HSTL_II_18, DIFF_HSTL_II_18_DCI | 1.70                            | 1.80    | 1.90    | 200                            | -        | -        | 0.80             | -       | 1.00    |
| DIFF_SSTL2_II, DIFF_SSTL2_II_DCI     | 2.375                           | 2.50    | 2.625   | 300                            | -        | -        | 1.05             | -       | 1.45    |

**Notes:**

1. V<sub>CCO</sub> only supplies differential output drivers, not input circuits.
2. V<sub>REF</sub> inputs are not used for any of the differential I/O standards.
3. V<sub>ID</sub> is a differential measurement.



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

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

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

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

DS099-3\_02\_091710

Figure 33: Differential Output Voltages

Table 38: DC Characteristics of User I/Os Using Differential Signal Standards

| Signal Standard          | Mask <sup>(3)</sup> Revision | $V_{OD}$           |          |          | $V_{OCM}$ |         |         | $V_{OH}$         | $V_{OL}$        |
|--------------------------|------------------------------|--------------------|----------|----------|-----------|---------|---------|------------------|-----------------|
|                          |                              | Min (mV)           | Typ (mV) | Max (mV) | Min (V)   | Typ (V) | Max (V) | Min (V)          | Max (V)         |
| LDT_25 (ULVDS_25)        | All                          | 430 <sup>(4)</sup> | 600      | 670      | 0.495     | 0.600   | 0.715   | 0.71             | 0.50            |
| LVDS_25                  | All                          | 100                | –        | 600      | 0.80      | –       | 1.6     | 0.85             | 1.55            |
|                          | 'E'                          | 200                | –        | 500      | 1.0       | –       | 1.5     | 1.10             | 1.40            |
| BLVDS_25 <sup>(5)</sup>  | All                          | 250                | 350      | 450      | –         | 1.20    | –       | –                | –               |
| LVDSEXT_25               | All                          | 100                | –        | 600      | 0.80      | –       | 1.6     | 0.85             | 1.55            |
|                          | 'E'                          | 300                | –        | 700      | 1.0       | –       | 1.5     | 1.15             | 1.35            |
| LVPECL_25 <sup>(5)</sup> | All                          | –                  | –        | –        | –         | –       | –       | 1.35             | 1.005           |
| RSDS_25 <sup>(6)</sup>   | All                          | 100                | –        | 600      | 0.80      | –       | 1.6     | 0.85             | 1.55            |
|                          | 'E'                          | 200                | –        | 500      | 1.0       | –       | 1.5     | 1.10             | 1.40            |
| DIFF_HSTL_II_18          | All                          | –                  | –        | –        | –         | –       | –       | $V_{CC0} - 0.40$ | 0.40            |
| DIFF_SSTL2_II            | All                          | –                  | –        | –        | –         | –       | –       | $V_{TT} + 0.80$  | $V_{TT} - 0.80$ |

Notes:

- The numbers in this table are based on the conditions set forth in Table 32 and Table 37.
- 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.
- Mask revision E devices have tighter output ranges but can be used in any design that was in a previous revision. See Mask and Fab Revisions, page 58.
- This value must be compatible with the receiver to which the FPGA's output pair is connected.
- Each LVPECL\_25 or BLVDS\_25 output-pair requires three external resistors for proper output operation as shown in Figure 34. Each LVPECL\_25 or BLVDS\_25 input-pair uses a 100Ω termination resistor at the receiver.
- Only one of the differential standards RSDS\_25, LDT\_25, LVDS\_25, and LVDSEXT\_25 may be used for outputs within a bank. Each differential standard input-pair requires an external 100Ω termination resistor.

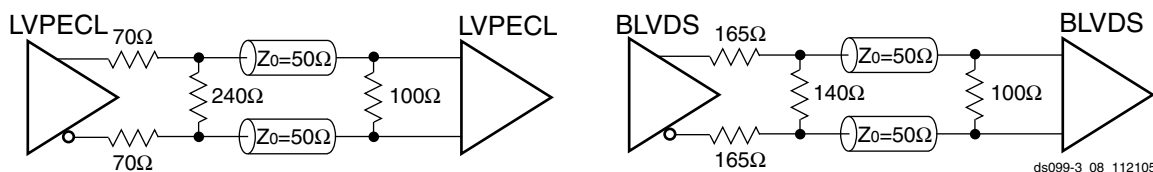


Figure 34: External Termination Required for LVPECL and BLVDS Output and Input

## Switching Characteristics

All Spartan-3 devices are available in two speed grades: -4 and the higher performance -5. Switching characteristics in this document may be designated as Advance, Preliminary, or Production. 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-reported delays may 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.

Production-quality systems must use FPGA designs compiled using a Production status speed file. FPGAs designs using a less mature speed file designation may only be used during system prototyping or preproduction qualification. FPGA designs using Advance or Preliminary status speed files should never be used in a production-quality system.

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

Xilinx ISE Software Updates: <http://www.xilinx.com/support/download/index.htm>

All specified limits are representative of worst-case supply voltage and junction temperature conditions. Unless otherwise noted, the following applies: Parameter values apply to all Spartan-3 devices. All parameters representing voltages are measured with respect to GND.

Selected timing parameters and their representative values are included below either because they are important as general design requirements or they indicate fundamental device performance characteristics. The Spartan-3 FPGA v1.38 speed files are the original source for many but not all of the values. The v1.38 speed files are available in Xilinx Integrated Software Environment (ISE) software version 8.2i.

The speed grade designations for these files are shown in [Table 39](#). 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 39: Spartan-3 FPGA Speed Grade Designations (ISE v8.2i or Later)**

| Device   | Advance | Preliminary | Production               |
|----------|---------|-------------|--------------------------|
| XC3S50   |         |             | -4, -5 (v1.37 and later) |
| XC3S200  |         |             |                          |
| XC3S400  |         |             |                          |
| XC3S1000 |         |             |                          |
| XC3S1500 |         |             |                          |
| XC3S2000 |         |             |                          |
| XC3S4000 |         |             | -4, -5 (v1.38 and later) |
| XC3S5000 |         |             |                          |



## I/O Timing

Table 40: Pin-to-Pin Clock-to-Output Times for the IOB Output Path

| Symbol                       | Description   | Conditions  | Device   | Speed Grade        |                    | Units |
|------------------------------|---|---|----------|--------------------|--------------------|-------|
|                              |   |   |          | -5                 | -4                 |       |
|                              |   |   |          | Max <sup>(2)</sup> | Max <sup>(2)</sup> |       |
| <b>Clock-to-Output Times</b> |   |   |          |                    |                    |       |
| T <sub>ICKOFDCM</sub>        | 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 <sup>(3)</sup> , 12 mA output drive, Fast slew rate, with DCM <sup>(4)</sup> | XC3S50   | 2.04               | 2.35               | ns    |
|                              |   |   | XC3S200  | 1.45               | 1.75               | ns    |
|                              |   |   | XC3S400  | 1.45               | 1.75               | ns    |
|                              |   |   | XC3S1000 | 2.07               | 2.39               | ns    |
|                              |   |   | XC3S1500 | 2.05               | 2.36               | ns    |
|                              |   |   | XC3S2000 | 2.03               | 2.34               | ns    |
|                              |   |   | XC3S4000 | 1.94               | 2.24               | ns    |
|                              |   |   | XC3S5000 | 2.00               | 2.30               | ns    |
| T <sub>ICKOF</sub>           | 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 <sup>(3)</sup> , 12 mA output drive, Fast slew rate, without DCM             | XC3S50   | 3.70               | 4.24               | ns    |
|                              |   |   | XC3S200  | 3.89               | 4.46               | ns    |
|                              |   |   | XC3S400  | 3.91               | 4.48               | ns    |
|                              |   |   | XC3S1000 | 4.00               | 4.59               | ns    |
|                              |   |   | XC3S1500 | 4.07               | 4.66               | ns    |
|                              |   |   | XC3S2000 | 4.19               | 4.80               | ns    |
|                              |   |   | XC3S4000 | 4.44               | 5.09               | ns    |
|                              |   |   | XC3S5000 | 4.38               | 5.02               | ns    |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32 and Table 35.
2. For minimums, use the values reported by the Xilinx timing analyzer.
3. 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 44. If the latter is true, add the appropriate Output adjustment from Table 47.
4. DCM output jitter is included in all measurements.

Table 41: System-Synchronous Pin-to-Pin Setup and Hold Times for the IOB Input Path

| Symbol             | Description  | Conditions   | Device   | Speed Grade |       | Units |
|--------------------|--|--|----------|-------------|-------|-------|
|                    |  |  |          | -5          | -4    |       |
|                    |  |  |          | Min         | Min   |       |
| <b>Setup Times</b> |  |  |          |             |       |       |
| $T_{PSDCM}$        | 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 <sup>(2)</sup> , IOBDELAY = NONE, with DCM <sup>(4)</sup> | XC3S50   | 2.37        | 2.71  | ns    |
|                    |  |  | XC3S200  | 2.13        | 2.35  | ns    |
|                    |  |  | XC3S400  | 2.15        | 2.36  | ns    |
|                    |  |  | XC3S1000 | 2.58        | 2.95  | ns    |
|                    |  |  | XC3S1500 | 2.55        | 2.91  | ns    |
|                    |  |  | XC3S2000 | 2.59        | 2.96  | ns    |
|                    |  |  | XC3S4000 | 2.76        | 3.15  | ns    |
|                    |  |  | XC3S5000 | 2.69        | 3.08  | 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 <sup>(2)</sup> , IOBDELAY = IFD, without DCM              | XC3S50   | 3.00        | 3.46  | ns    |
|                    |  |  | XC3S200  | 2.63        | 3.02  | ns    |
|                    |  |  | XC3S400  | 2.50        | 2.87  | ns    |
|                    |  |  | XC3S1000 | 3.50        | 4.03  | ns    |
|                    |  |  | XC3S1500 | 3.78        | 4.35  | ns    |
|                    |  |  | XC3S2000 | 4.98        | 5.73  | ns    |
|                    |  |  | XC3S4000 | 5.25        | 6.05  | ns    |
|                    |  |  | XC3S5000 | 5.37        | 6.18  | ns    |
| <b>Hold Times</b>  |  |  |          |             |       |       |
| $T_{PHDCM}$        | 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 <sup>(3)</sup> , IOBDELAY = NONE, with DCM <sup>(4)</sup> | XC3S50   | -0.45       | -0.40 | ns    |
|                    |  |  | XC3S200  | -0.12       | -0.05 | ns    |
|                    |  |  | XC3S400  | -0.12       | -0.05 | ns    |
|                    |  |  | XC3S1000 | -0.43       | -0.38 | ns    |
|                    |  |  | XC3S1500 | -0.45       | -0.40 | ns    |
|                    |  |  | XC3S2000 | -0.47       | -0.42 | ns    |
|                    |  |  | XC3S4000 | -0.61       | -0.56 | ns    |
|                    |  |  | XC3S5000 | -0.62       | -0.57 | ns    |

Table 41: System-Synchronous Pin-to-Pin Setup and Hold Times for the IOB Input Path (Cont'd)

| Symbol            | Description  | Conditions  | Device   | Speed Grade |       | Units |
|-------------------|--|---|----------|-------------|-------|-------|
|                   |  |   |          | -5          | -4    |       |
|                   |  |   |          | Min         | Min   |       |
| T <sub>PHFD</sub> | 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 <sup>(3)</sup> , IOBDELAY = IFD, without DCM | XC3S50   | -0.98       | -0.93 | ns    |
|                   |  |   | XC3S200  | -0.40       | -0.35 | ns    |
|                   |  |   | XC3S400  | -0.27       | -0.22 | ns    |
|                   |  |   | XC3S1000 | -1.19       | -1.14 | ns    |
|                   |  |   | XC3S1500 | -1.43       | -1.38 | ns    |
|                   |  |   | XC3S2000 | -2.33       | -2.28 | ns    |
|                   |  |   | XC3S4000 | -2.47       | -2.42 | ns    |
|                   |  |   | XC3S5000 | -2.66       | -2.61 | ns    |

Notes:

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32 and Table 35.
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 44. 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 44. 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.

Table 42: Setup and Hold Times for the IOB Input Path

| Symbol               | Description   | Conditions                                | Device   | Speed Grade |      | Units |
|----------------------|---|---|----------|-------------|------|-------|
|                      |   |   |          | -5          | -4   |       |
|                      |   |   |          | Min         | Min  |       |
| <b>Setup Times</b>   |   |   |          |             |      |       |
| T <sub>IOPICK</sub>  | 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 <sup>(2)</sup> , IOBDELAY = NONE | XC3S50   | 1.65        | 1.89 | ns    |
|                      |   |   | XC3S200  | 1.37        | 1.57 | ns    |
|                      |   |   | XC3S400  | 1.37        | 1.57 | ns    |
|                      |   |   | XC3S1000 | 1.65        | 1.89 | ns    |
|                      |   |   | XC3S1500 | 1.65        | 1.89 | ns    |
|                      |   |   | XC3S2000 | 1.65        | 1.89 | ns    |
|                      |   |   | XC3S4000 | 1.73        | 1.99 | ns    |
|                      |   |   | XC3S5000 | 1.82        | 2.09 | ns    |
| T <sub>IOPICKD</sub> | Time from the setup of data at the Input pin to the active transition at the IFF's ICLK input. The Input Delay is programmed.                       | LVCMOS25 <sup>(2)</sup> , IOBDELAY = IFD  | XC3S50   | 4.39        | 5.04 | ns    |
|                      |   |   | XC3S200  | 4.76        | 5.47 | ns    |
|                      |   |   | XC3S400  | 4.63        | 5.32 | ns    |
|                      |   |   | XC3S1000 | 5.02        | 5.76 | ns    |
|                      |   |   | XC3S1500 | 5.40        | 6.20 | ns    |
|                      |   |   | XC3S2000 | 6.68        | 7.68 | ns    |
|                      |   |   | XC3S4000 | 7.16        | 8.24 | ns    |
|                      |   |   | XC3S5000 | 7.33        | 8.42 | ns    |

Table 42: Setup and Hold Times for the IOB Input Path (Cont'd)

| Symbol                       | Description   | Conditions                                | Device   | Speed Grade |       | Units |
|------------------------------|---|---|----------|-------------|-------|-------|
|                              |   |   |          | -5          | -4    |       |
|                              |   |   |          | Min         | Min   |       |
| <b>Hold Times</b>            |   |   |          |             |       |       |
| T <sub>IOICKP</sub>          | Time from the active transition at the IFF's ICLK input to the point where data must be held at the Input pin. No Input Delay is programmed.  | LVCMOS25 <sup>(3)</sup> , IOBDELAY = NONE | XC3S50   | -0.55       | -0.55 | ns    |
|                              |   |   | XC3S200  | -0.29       | -0.29 | ns    |
|                              |   |   | XC3S400  | -0.29       | -0.29 | ns    |
|                              |   |   | XC3S1000 | -0.55       | -0.55 | ns    |
|                              |   |   | XC3S1500 | -0.55       | -0.55 | ns    |
|                              |   |   | XC3S2000 | -0.55       | -0.55 | ns    |
|                              |   |   | XC3S4000 | -0.61       | -0.61 | ns    |
|                              |   |   | XC3S5000 | -0.68       | -0.68 | ns    |
| T <sub>IOICKPD</sub>         | Time from the active transition at the IFF's ICLK input to the point where data must be held at the Input pin. The Input Delay is programmed. | LVCMOS25 <sup>(3)</sup> , IOBDELAY = IFD  | XC3S50   | -2.74       | -2.74 | ns    |
|                              |   |   | XC3S200  | -3.00       | -3.00 | ns    |
|                              |   |   | XC3S400  | -2.90       | -2.90 | ns    |
|                              |   |   | XC3S1000 | -3.24       | -3.24 | ns    |
|                              |   |   | XC3S1500 | -3.55       | -3.55 | ns    |
|                              |   |   | XC3S2000 | -4.57       | -4.57 | ns    |
|                              |   |   | XC3S4000 | -4.96       | -4.96 | ns    |
|                              |   |   | XC3S5000 | -5.09       | -5.09 | ns    |
| <b>Set/Reset Pulse Width</b> |   |   |          |             |       |       |
| T <sub>RPW_IOB</sub>         | Minimum pulse width to SR control input on IOB  |   | All      | 0.66        | 0.76  | ns    |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32 and Table 35.
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 44.
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 44. When the hold time is negative, it is possible to change the data before the clock's active edge.

Table 43: Propagation Times for the IOB Input Path

| Symbol                   | Description   | Conditions                                | Device   | Speed Grade |      | Units |
|--------------------------|---|---|----------|-------------|------|-------|
|                          |   |   |          | -5          | -4   |       |
|                          |   |   |          | Max         | Max  |       |
| <b>Propagation Times</b> |   |   |          |             |      |       |
| T <sub>IOPLI</sub>       | 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 <sup>(2)</sup> , IOBDELAY = NONE | XC3S50   | 2.01        | 2.31 | ns    |
|                          |   |   | XC3S200  | 1.50        | 1.72 | ns    |
|                          |   |   | XC3S400  | 1.50        | 1.72 | ns    |
|                          |   |   | XC3S1000 | 2.01        | 2.31 | ns    |
|                          |   |   | XC3S1500 | 2.01        | 2.31 | ns    |
|                          |   |   | XC3S2000 | 2.01        | 2.31 | ns    |
|                          |   |   | XC3S4000 | 2.09        | 2.41 | ns    |
|                          |   |   | XC3S5000 | 2.18        | 2.51 | ns    |
| T <sub>IOPLID</sub>      | 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 <sup>(2)</sup> , IOBDELAY = IFD  | XC3S50   | 4.75        | 5.46 | ns    |
|                          |   |   | XC3S200  | 4.89        | 5.62 | ns    |
|                          |   |   | XC3S400  | 4.76        | 5.48 | ns    |
|                          |   |   | XC3S1000 | 5.38        | 6.18 | ns    |
|                          |   |   | XC3S1500 | 5.76        | 6.62 | ns    |
|                          |   |   | XC3S2000 | 7.04        | 8.09 | ns    |
|                          |   |   | XC3S4000 | 7.52        | 8.65 | ns    |
|                          |   |   | XC3S5000 | 7.69        | 8.84 | ns    |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32 and Table 35.
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 44.

Table 44: Input Timing Adjustments for IOB

| Convert Input Time from LVCMOS25 to the Following Signal Standard (IOSTANDARD) | Add the Adjustment Below |      | Units |
|--|--------------------------|------|-------|
|  | Speed Grade              |      |       |
|  | -5                       | -4   |       |
| <b>Single-Ended Standards</b>  |                          |      |       |
| GTL, GTL_DCI   | 0.44                     | 0.50 | ns    |
| GTLP, GTLP_DCI   | 0.36                     | 0.42 | ns    |
| HSLVDCI_15   | 0.51                     | 0.59 | ns    |
| HSLVDCI_18   | 0.29                     | 0.33 | ns    |
| HSLVDCI_25   | 0.51                     | 0.59 | ns    |
| HSLVDCI_33   | 0.51                     | 0.59 | ns    |
| HSTL_I, HSTL_I_DCI   | 0.51                     | 0.59 | ns    |
| HSTL_III, HSTL_III_DCI   | 0.37                     | 0.42 | ns    |
| HSTL_I_18, HSTL_I_DCI_18   | 0.36                     | 0.41 | ns    |
| HSTL_II_18, HSTL_II_DCI_18   | 0.39                     | 0.45 | ns    |
| HSTL_III_18, HSTL_III_DCI_18   | 0.45                     | 0.52 | ns    |
| LVCMOS12   | 0.63                     | 0.72 | ns    |

Table 44: Input Timing Adjustments for IOB (Cont'd)

| Convert Input Time from LVCMOS25 to the Following Signal Standard (IOSTANDARD) | Add the Adjustment Below |       | Units |
|--|--------------------------|-------|-------|
|  | Speed Grade              |       |       |
|  | -5                       | -4    |       |
| LVC MOS15  | 0.42                     | 0.49  | ns    |
| LVDCI_15   | 0.38                     | 0.43  | ns    |
| LVDCI_DV2_15   | 0.38                     | 0.44  | ns    |
| LVC MOS18  | 0.24                     | 0.28  | ns    |
| LVDCI_18   | 0.29                     | 0.33  | ns    |
| LVDCI_DV2_18   | 0.28                     | 0.33  | ns    |
| LVC MOS25  | 0                        | 0     | ns    |
| LVDCI_25   | 0.05                     | 0.05  | ns    |
| LVDCI_DV2_25   | 0.04                     | 0.04  | ns    |
| LVC MOS33, LVDCI_33, LVDCI_DV2_33  | -0.05                    | -0.02 | ns    |
| LVTTTL   | 0.18                     | 0.21  | ns    |
| PCI33_3  | 0.20                     | 0.22  | ns    |
| SSTL18_I, SSTL18_I_DCI   | 0.39                     | 0.45  | ns    |
| SSTL18_II  | 0.39                     | 0.45  | ns    |
| SSTL2_I, SSTL2_I_DCI   | 0.40                     | 0.46  | ns    |
| SSTL2_II, SSTL2_II_DCI   | 0.36                     | 0.41  | ns    |
| <b>Differential Standards</b>  |                          |       |       |
| LDT_25 (ULVDS_25)  | 0.76                     | 0.88  | ns    |
| LVDS_25, LVDS_25_DCI   | 0.65                     | 0.75  | ns    |
| BLVDS_25   | 0.34                     | 0.39  | ns    |
| LVDS_25, LVDS_25_DCI   | 0.80                     | 0.92  | ns    |
| LVPECL_25  | 0.18                     | 0.21  | ns    |
| RS DS_25   | 0.43                     | 0.50  | ns    |
| DIFF_HSTL_II_18, DIFF_HSTL_II_18_DCI   | 0.34                     | 0.39  | ns    |
| DIFF_SSTL2_II, DIFF_SSTL2_II_DCI   | 0.65                     | 0.75  | ns    |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32, Table 35, and Table 37.
2. These adjustments are used to convert input path times originally specified for the LVCMOS25 standard to times that correspond to other signal standards.

Table 45: Timing for the IOB Output Path

| Symbol                       | Description  | Conditions   | Device   | Speed Grade        |                    | Units |
|------------------------------|--|--|--|--------------------|--------------------|-------|
|                              |  |  |  | -5                 | -4                 |       |
|                              |  |  |  | Max <sup>(3)</sup> | Max <sup>(3)</sup> |       |
| <b>Clock-to-Output Times</b> |  |  |  |                    |                    |       |
| T <sub>IOCKP</sub>           | When reading from the Output Flip-Flop (OFF), the time from the active transition at the OTCLK input to data appearing at the Output pin | LVCMOS25 <sup>(2)</sup> , 12 mA output drive, Fast slew rate | XC3S200<br>XC3S400   | 1.28               | 1.47               | ns    |
|                              |  |  | XC3S50<br>XC3S1000<br>XC3S1500<br>XC3S2000<br>XC3S4000<br>XC3S5000 | 1.95               | 2.24               | ns    |
| <b>Propagation Times</b>     |  |  |  |                    |                    |       |
| T <sub>IOOP</sub>            | The time it takes for data to travel from the IOB's O input to the Output pin  | LVCMOS25 <sup>(2)</sup> , 12 mA output drive, Fast slew rate | XC3S200<br>XC3S400   | 1.28               | 1.46               | ns    |
|                              |  |  | XC3S50<br>XC3S1000<br>XC3S1500<br>XC3S2000<br>XC3S4000<br>XC3S5000 | 1.94               | 2.23               | ns    |
| T <sub>IOOLP</sub>           | The time it takes for data to travel from the O input through the OFF latch to the Output pin  |  | XC3S200<br>XC3S400   | 1.28               | 1.47               | ns    |
|                              |  |  | XC3S50<br>XC3S1000<br>XC3S1500<br>XC3S2000<br>XC3S4000<br>XC3S5000 | 1.95               | 2.24               | ns    |
| <b>Set/Reset Times</b>       |  |  |  |                    |                    |       |
| T <sub>IOSRP</sub>           | Time from asserting the OFF's SR input to setting/resetting data at the Output pin   | LVCMOS25 <sup>(2)</sup> , 12 mA output drive, Fast slew rate | XC3S200<br>XC3S400   | 2.10               | 2.41               | ns    |
|                              |  |  | XC3S50<br>XC3S1000<br>XC3S1500<br>XC3S2000<br>XC3S4000<br>XC3S5000 | 2.77               | 3.18               | ns    |
| T <sub>IOGSRQ</sub>          | Time from asserting the Global Set Reset (GSR) net to setting/resetting data at the Output pin   |  | All  | 8.07               | 9.28               | ns    |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32 and Table 35.
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 47.
3. For minimums, use the values reported by the Xilinx timing analyzer.

Table 46: Timing for the IOB Three-State Path

| Symbol  | Description  | Conditions                                    | Device   | Speed Grade        |                    | Units |
|---|--|---|--|--------------------|--------------------|-------|
|   |  |   |  | -5                 | -4                 |       |
|   |  |   |  | Max <sup>(3)</sup> | Max <sup>(3)</sup> |       |
| <b>Synchronous Output Enable/Disable Times</b>  |  |   |  |                    |                    |       |
| T <sub>IOCKHZ</sub>                             | 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 | LVC MOS25, 12 mA output drive, Fast slew rate | All  | 0.74               | 0.85               | ns    |
| T <sub>IOCKON</sub> <sup>(2)</sup>              | Time from the active transition at TFF's OTCLK input to when the Output pin drives valid data  |   | All  | 0.72               | 0.82               | ns    |
| <b>Asynchronous Output Enable/Disable Times</b> |  |   |  |                    |                    |       |
| T <sub>GTS</sub>                                | Time from asserting the Global Three State (GTS) net to when the Output pin enters the high-impedance state                                  | LVC MOS25, 12 mA output drive, Fast slew rate | XC3S200<br>XC3S400   | 7.71               | 8.87               | ns    |
|   |  |   | XC3S50<br>XC3S1000<br>XC3S1500<br>XC3S2000<br>XC3S4000<br>XC3S5000 | 8.38               | 9.63               | ns    |
| <b>Set/Reset Times</b>                          |  |   |  |                    |                    |       |
| T <sub>IOSRHZ</sub>                             | Time from asserting TFF's SR input to when the Output pin enters a high-impedance state  | LVC MOS25, 12 mA output drive, Fast slew rate | All  | 1.55               | 1.78               | ns    |
| T <sub>IOSRON</sub> <sup>(2)</sup>              | Time from asserting TFF's SR input at TFF to when the Output pin drives valid data   |   | XC3S200<br>XC3S400   | 2.24               | 2.57               | ns    |
|   |  |   | XC3S50<br>XC3S1000<br>XC3S1500<br>XC3S2000<br>XC3S4000<br>XC3S5000 | 2.91               | 3.34               | ns    |

**Notes:**

1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32 and Table 35.
2. This time requires adjustment whenever a signal standard other than LVC MOS25 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 47.
3. For minimums, use the values reported by the Xilinx timing analyzer.

Table 47: Output Timing Adjustments for IOB

| Convert Output Time from LVC MOS25 with 12mA Drive and Fast Slew Rate to the Following Signal Standard (IOSTANDARD) | Add the Adjustment Below |      | Units |
|---|--------------------------|------|-------|
|   | Speed Grade              |      |       |
|   | -5                       | -4   |       |
| <b>Single-Ended Standards</b>   |                          |      |       |
| GTL   | 0                        | 0.02 | ns    |
| GTL_DCI   | 0.13                     | 0.15 | ns    |
| GTL P   | 0.03                     | 0.04 | ns    |
| GTL P_DCI   | 0.23                     | 0.27 | ns    |
| HSLVDCI_15  | 1.51                     | 1.74 | ns    |
| HSLVDCI_18  | 0.81                     | 0.94 | ns    |



Table 47: 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    |       |
| HSLVDCI_25   |      |       | 0.27                     | 0.31  | ns    |
| HSLVDCI_33   |      |       | 0.28                     | 0.32  | ns    |
| HSTL_I   |      |       | 0.60                     | 0.69  | ns    |
| HSTL_I_DCI   |      |       | 0.59                     | 0.68  | ns    |
| HSTL_III   |      |       | 0.19                     | 0.22  | ns    |
| HSTL_III_DCI   |      |       | 0.20                     | 0.23  | ns    |
| HSTL_I_18  |      |       | 0.18                     | 0.21  | ns    |
| HSTL_I_DCI_18  |      |       | 0.17                     | 0.19  | ns    |
| HSTL_II_18   |      |       | -0.02                    | -0.01 | ns    |
| HSTL_II_DCI_18   |      |       | 0.75                     | 0.86  | ns    |
| HSTL_III_18  |      |       | 0.28                     | 0.32  | ns    |
| HSTL_III_DCI_18  |      |       | 0.28                     | 0.32  | ns    |
| LVCMOS12   | Slow | 2 mA  | 7.60                     | 8.73  | ns    |
|  |      | 4 mA  | 7.42                     | 8.53  | ns    |
|  |      | 6 mA  | 6.67                     | 7.67  | ns    |
|  | Fast | 2 mA  | 3.16                     | 3.63  | ns    |
|  |      | 4 mA  | 2.70                     | 3.10  | ns    |
|  |      | 6 mA  | 2.41                     | 2.77  | ns    |
| LVCMOS15   | Slow | 2 mA  | 4.55                     | 5.23  | ns    |
|  |      | 4 mA  | 3.76                     | 4.32  | ns    |
|  |      | 6 mA  | 3.57                     | 4.11  | ns    |
|  |      | 8 mA  | 3.55                     | 4.09  | ns    |
|  |      | 12 mA | 3.00                     | 3.45  | ns    |
|  | Fast | 2 mA  | 3.11                     | 3.57  | ns    |
|  |      | 4 mA  | 1.71                     | 1.96  | ns    |
|  |      | 6 mA  | 1.44                     | 1.66  | ns    |
|  |      | 8 mA  | 1.26                     | 1.44  | ns    |
|  |      | 12 mA | 1.11                     | 1.27  | ns    |
| LVDCI_15   |      |       | 1.51                     | 1.74  | ns    |
| LVDCI_DV2_15   |      |       | 1.32                     | 1.52  | ns    |

Table 47: 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         | 5.49                     | 6.31  | ns    |      |    |
|  |      | 4 mA         | 3.45                     | 3.97  | ns    |      |    |
|  |      | 6 mA         | 2.84                     | 3.26  | ns    |      |    |
|  |      | 8 mA         | 2.62                     | 3.01  | ns    |      |    |
|  |      | 12 mA        | 2.11                     | 2.43  | ns    |      |    |
|  |      | 16 mA        | 2.07                     | 2.38  | ns    |      |    |
|  | Fast | 2 mA         | 2.50                     | 2.88  | ns    |      |    |
|  |      | 4 mA         | 1.15                     | 1.32  | ns    |      |    |
|  |      | 6 mA         | 0.96                     | 1.10  | ns    |      |    |
|  |      | 8 mA         | 0.87                     | 1.01  | ns    |      |    |
|  |      | 12 mA        | 0.79                     | 0.91  | ns    |      |    |
|  |      | 16 mA        | 0.76                     | 0.87  | ns    |      |    |
|  |      | LVDCI_18     |                          |       | 0.81  | 0.94 | ns |
|  |      | LVDCI_DV2_18 |                          |       | 0.67  | 0.77 | ns |
| LVCMOS25   | Slow | 2 mA         | 6.43                     | 7.39  | ns    |      |    |
|  |      | 4 mA         | 4.15                     | 4.77  | ns    |      |    |
|  |      | 6 mA         | 3.38                     | 3.89  | ns    |      |    |
|  |      | 8 mA         | 2.99                     | 3.44  | ns    |      |    |
|  |      | 12 mA        | 2.53                     | 2.91  | ns    |      |    |
|  |      | 16 mA        | 2.50                     | 2.87  | ns    |      |    |
|  |      | 24 mA        | 2.22                     | 2.55  | ns    |      |    |
|  | Fast | 2 mA         | 3.27                     | 3.76  | ns    |      |    |
|  |      | 4 mA         | 1.87                     | 2.15  | ns    |      |    |
|  |      | 6 mA         | 0.32                     | 0.37  | ns    |      |    |
|  |      | 8 mA         | 0.19                     | 0.22  | ns    |      |    |
|  |      | 12 mA        | 0                        | 0     | ns    |      |    |
|  |      | 16 mA        | -0.02                    | -0.01 | ns    |      |    |
|  |      | 24 mA        | -0.04                    | -0.02 | ns    |      |    |
| LVDCI_25   |      |              | 0.27                     | 0.31  | ns    |      |    |
| LVDCI_DV2_25   |      |              | 0.16                     | 0.19  | ns    |      |    |

Table 47: 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  | 6.38                     | 7.34 | ns    |
|  |      | 4 mA  | 4.83                     | 5.55 | ns    |
|  |      | 6 mA  | 4.01                     | 4.61 | ns    |
|  |      | 8 mA  | 3.92                     | 4.51 | ns    |
|  |      | 12 mA | 2.91                     | 3.35 | ns    |
|  |      | 16 mA | 2.81                     | 3.23 | ns    |
|  |      | 24 mA | 2.49                     | 2.86 | ns    |
|  | Fast | 2 mA  | 3.86                     | 4.44 | ns    |
|  |      | 4 mA  | 1.87                     | 2.15 | ns    |
|  |      | 6 mA  | 0.62                     | 0.71 | ns    |
|  |      | 8 mA  | 0.61                     | 0.70 | ns    |
|  |      | 12 mA | 0.16                     | 0.19 | ns    |
|  |      | 16 mA | 0.14                     | 0.16 | ns    |
|  |      | 24 mA | 0.06                     | 0.07 | ns    |
| LVDCI_33   |      |       | 0.28                     | 0.32 | ns    |
| LVDCI_DV2_33   |      |       | 0.26                     | 0.30 | ns    |
| LVTTL  | Slow | 2 mA  | 7.27                     | 8.36 | ns    |
|  |      | 4 mA  | 4.94                     | 5.69 | ns    |
|  |      | 6 mA  | 3.98                     | 4.58 | ns    |
|  |      | 8 mA  | 3.98                     | 4.58 | ns    |
|  |      | 12 mA | 2.97                     | 3.42 | ns    |
|  |      | 16 mA | 2.84                     | 3.26 | ns    |
|  |      | 24 mA | 2.65                     | 3.04 | ns    |
|  | Fast | 2 mA  | 4.32                     | 4.97 | ns    |
|  |      | 4 mA  | 1.87                     | 2.15 | ns    |
|  |      | 6 mA  | 1.27                     | 1.47 | ns    |
|  |      | 8 mA  | 1.19                     | 1.37 | ns    |
|  |      | 12 mA | 0.42                     | 0.48 | ns    |
|  |      | 16 mA | 0.27                     | 0.32 | ns    |
|  |      | 24 mA | 0.16                     | 0.18 | ns    |

Table 47: 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    |       |
| PCI33_3  | 0.74                     | 0.85  | ns    |
| SSTL18_I   | 0.07                     | 0.07  | ns    |
| SSTL18_I_DCI   | 0.22                     | 0.25  | ns    |
| SSTL18_II  | 0.30                     | 0.34  | ns    |
| SSTL2_I  | 0.23                     | 0.26  | ns    |
| SSTL2_I_DCI  | 0.19                     | 0.22  | ns    |
| SSTL2_II   | 0.13                     | 0.15  | ns    |
| SSTL2_II_DCI   | 0.10                     | 0.11  | ns    |
| <b>Differential Standards</b>  |                          |       |       |
| LDT_25 (ULVDS_25)  | -0.06                    | -0.05 | ns    |
| LVDS_25  | -0.09                    | -0.07 | ns    |
| BLVDS_25   | 0.02                     | 0.04  | ns    |
| LVDS_25  | -0.15                    | -0.13 | ns    |
| LVPECL_25  | 0.16                     | 0.18  | ns    |
| RSDS_25  | 0.05                     | 0.06  | ns    |
| DIFF_HSTL_II_18  | -0.02                    | -0.01 | ns    |
| DIFF_HSTL_II_18_DCI  | 0.75                     | 0.86  | ns    |
| DIFF_SSTL2_II  | 0.13                     | 0.15  | ns    |
| DIFF_SSTL2_II_DCI  | 0.10                     | 0.11  | ns    |

**Notes:**

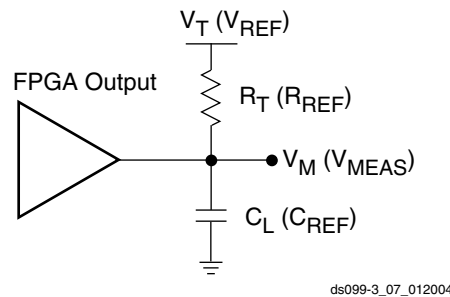
1. The numbers in this table are tested using the methodology presented in Table 48 and are based on the operating conditions set forth in Table 32, Table 35, and Table 37.
2. These adjustments are used to convert output- and three-state-path times originally specified for the LVCMOS25 standard with 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. For minimums, use the values reported by the Xilinx timing analyzer.

## Timing Measurement Methodology

When measuring timing parameters at the programmable I/Os, different signal standards call for different test conditions. Table 48 presents 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 35. 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 (e.g., LVCMOS, LVTTTL), then  $R_T$  is set to  $1M\Omega$  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 35: Output Test Setup

Table 48: Test Methods for Timing Measurement at I/Os

| Signal Standard (IOSTANDARD) | Inputs        |                 |                 | Outputs            |           | Inputs and Outputs |
|------------------------------|---------------|-----------------|-----------------|--------------------|-----------|--------------------|
|                              | $V_{REF}$ (V) | $V_L$ (V)       | $V_H$ (V)       | $R_T$ ( $\Omega$ ) | $V_T$ (V) | $V_M$ (V)          |
| <b>Single-Ended</b>          |               |                 |                 |                    |           |                    |
| GTL                          | 0.8           | $V_{REF} - 0.2$ | $V_{REF} + 0.2$ | 25                 | 1.2       | $V_{REF}$          |
| GTL_DCI                      |               |                 |                 | 50                 |           |                    |
| GTLP                         | 1.0           | $V_{REF} - 0.2$ | $V_{REF} + 0.2$ | 25                 | 1.5       | $V_{REF}$          |
| GTLP_DCI                     |               |                 |                 | 50                 |           |                    |
| HSLVDCI_15                   | 0.9           | $V_{REF} - 0.5$ | $V_{REF} + 0.5$ | 1M                 | 0         | 0.75               |
| HSLVDCI_18                   |               |                 |                 |                    |           | 0.90               |
| HSLVDCI_25                   |               |                 |                 |                    |           | 1.25               |
| HSLVDCI_33                   |               |                 |                 |                    |           | 1.65               |
| HSTL_I                       | 0.75          | $V_{REF} - 0.5$ | $V_{REF} + 0.5$ | 50                 | 0.75      | $V_{REF}$          |
| HSTL_I_DCI                   |               |                 |                 |                    |           |                    |
| HSTL_III                     | 0.90          | $V_{REF} - 0.5$ | $V_{REF} + 0.5$ | 50                 | 1.5       | $V_{REF}$          |
| HSTL_III_DCI                 |               |                 |                 |                    |           |                    |
| HSTL_I_18                    | 0.90          | $V_{REF} - 0.5$ | $V_{REF} + 0.5$ | 50                 | 0.9       | $V_{REF}$          |
| HSTL_I_DCI_18                |               |                 |                 |                    |           |                    |
| HSTL_II_18                   | 0.90          | $V_{REF} - 0.5$ | $V_{REF} + 0.5$ | 50                 | 0.9       | $V_{REF}$          |
| HSTL_II_DCI_18               |               |                 |                 |                    |           |                    |

Table 48: Test Methods for Timing Measurement at I/Os (Cont'd)

| Signal Standard (IOSTANDARD) |         | Inputs               |                          |                          | Outputs            |                    | Inputs and Outputs |
|------------------------------|---------|----------------------|--------------------------|--------------------------|--------------------|--------------------|--------------------|
|                              |         | V <sub>REF</sub> (V) | V <sub>L</sub> (V)       | V <sub>H</sub> (V)       | R <sub>T</sub> (Ω) | V <sub>T</sub> (V) | V <sub>M</sub> (V) |
| HSTL_III_18                  |         | 1.1                  | V <sub>REF</sub> - 0.5   | V <sub>REF</sub> + 0.5   | 50                 | 1.8                | V <sub>REF</sub>   |
| HSTL_III_DCI_18              |         |                      |                          |                          |                    |                    |                    |
| LVCMOS12                     |         | -                    | 0                        | 1.2                      | 1M                 | 0                  | 0.6                |
| LVCMOS15                     |         | -                    | 0                        | 1.5                      | 1M                 | 0                  | 0.75               |
| LVDCI_15                     |         |                      |                          |                          |                    |                    |                    |
| LVDCI_DV2_15                 |         |                      |                          |                          |                    |                    |                    |
| HSLVDCI_15                   |         |                      |                          |                          |                    |                    |                    |
| LVCMOS18                     |         | -                    | 0                        | 1.8                      | 1M                 | 0                  | 0.9                |
| LVDCI_18                     |         |                      |                          |                          |                    |                    |                    |
| LVDCI_DV2_18                 |         |                      |                          |                          |                    |                    |                    |
| HSLVDCI_18                   |         |                      |                          |                          |                    |                    |                    |
| LVCMOS25                     |         | -                    | 0                        | 2.5                      | 1M                 | 0                  | 1.25               |
| LVDCI_25                     |         |                      |                          |                          |                    |                    |                    |
| LVDCI_DV2_25                 |         |                      |                          |                          |                    |                    |                    |
| HSLVDCI_25                   |         |                      |                          |                          |                    |                    |                    |
| LVCMOS33                     |         | -                    | 0                        | 3.3                      | 1M                 | 0                  | 1.65               |
| LVDCI_33                     |         |                      |                          |                          |                    |                    |                    |
| LVDCI_DV2_33                 |         |                      |                          |                          |                    |                    |                    |
| HSLVDCI_33                   |         |                      |                          |                          |                    |                    |                    |
| LVTTTL                       |         | -                    | 0                        | 3.3                      | 1M                 | 0                  | 1.4                |
| PCI33_3                      | Rising  | -                    | Note 3                   | Note 3                   | 25                 | 0                  | 0.94               |
|                              | Falling |                      |                          |                          | 25                 | 3.3                | 2.03               |
| SSTL18_I                     |         | 0.9                  | V <sub>REF</sub> - 0.5   | V <sub>REF</sub> + 0.5   | 50                 | 0.9                | V <sub>REF</sub>   |
| SSTL18_I_DCI                 |         |                      |                          |                          |                    |                    |                    |
| SSTL18_II                    |         | 0.9                  | V <sub>REF</sub> - 0.5   | V <sub>REF</sub> + 0.5   | 50                 | 0.9                | V <sub>REF</sub>   |
| SSTL2_I                      |         | 1.25                 | V <sub>REF</sub> - 0.75  | V <sub>REF</sub> + 0.75  | 50                 | 1.25               | V <sub>REF</sub>   |
| SSTL2_I_DCI                  |         |                      |                          |                          |                    |                    |                    |
| SSTL2_II                     |         | 1.25                 | V <sub>REF</sub> - 0.75  | V <sub>REF</sub> + 0.75  | 25                 | 1.25               | V <sub>REF</sub>   |
| SSTL2_II_DCI                 |         |                      |                          |                          | 50                 | 1.25               |                    |
| <b>Differential</b>          |         |                      |                          |                          |                    |                    |                    |
| LDT_25 (ULVDS_25)            |         | -                    | V <sub>ICM</sub> - 0.125 | V <sub>ICM</sub> + 0.125 | 60                 | 0.6                | V <sub>ICM</sub>   |
| LVDS_25                      |         | -                    | V <sub>ICM</sub> - 0.125 | V <sub>ICM</sub> + 0.125 | 50                 | 1.2                | V <sub>ICM</sub>   |
| LVDS_25_DCI                  |         |                      |                          |                          | N/A                | N/A                |                    |
| BLVDS_25                     |         | -                    | V <sub>ICM</sub> - 0.125 | V <sub>ICM</sub> + 0.125 | 1M                 | 0                  | V <sub>ICM</sub>   |
| LVDSEXT_25                   |         | -                    | V <sub>ICM</sub> - 0.125 | V <sub>ICM</sub> + 0.125 | 50                 | 1.2                | V <sub>ICM</sub>   |
| LVDSEXT_25_DCI               |         |                      |                          |                          | N/A                | N/A                |                    |
| LVPECL_25                    |         | -                    | V <sub>ICM</sub> - 0.3   | V <sub>ICM</sub> + 0.3   | 1M                 | 0                  | V <sub>ICM</sub>   |
| RSDS_25                      |         | -                    | V <sub>ICM</sub> - 0.1   | V <sub>ICM</sub> + 0.1   | 50                 | 1.2                | V <sub>ICM</sub>   |
| DIFF_HSTL_II_18              |         | -                    | V <sub>ICM</sub> - 0.5   | V <sub>ICM</sub> + 0.5   | 50                 | 1.8                | V <sub>ICM</sub>   |
| DIFF_HSTL_II_18_DCI          |         |                      |                          |                          |                    |                    |                    |

Table 48: Test Methods for Timing Measurement at I/Os (Cont'd)

| Signal Standard (IOSTANDARD) | Inputs               |                         |                         | Outputs            |                    | Inputs and Outputs |
|------------------------------|----------------------|-------------------------|-------------------------|--------------------|--------------------|--------------------|
|                              | V <sub>REF</sub> (V) | V <sub>L</sub> (V)      | V <sub>H</sub> (V)      | R <sub>T</sub> (Ω) | V <sub>T</sub> (V) | V <sub>M</sub> (V) |
| DIFF_SSTL2_II                | -                    | V <sub>ICM</sub> - 0.75 | V <sub>ICM</sub> + 0.75 | 50                 | 1.25               | V <sub>ICM</sub>   |
| DIFF_SSTL2_II_DCI            |                      |                         |                         |                    |                    |                    |

**Notes:**

- Descriptions of the relevant symbols are as follows:  
 V<sub>REF</sub> – The reference voltage for setting the input switching threshold  
 V<sub>ICM</sub> – The common mode input voltage  
 V<sub>M</sub> – Voltage of measurement point on signal transition  
 V<sub>L</sub> – Low-level test voltage at Input pin  
 V<sub>H</sub> – High-level test voltage at Input pin  
 R<sub>T</sub> – Effective termination resistance, which takes on a value of 1MW when no parallel termination is required  
 V<sub>T</sub> – Termination voltage
- The load capacitance (CL) at the Output pin is 0 pF for all signal standards.
- According to the PCI specification.

The capacitive load (C<sub>L</sub>) 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<sub>L</sub> 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<sub>REF</sub>, R<sub>REF</sub>, and V<sub>MEAS</sub>) correspond directly with the parameters used in Table 48, V<sub>T</sub>, R<sub>T</sub>, and V<sub>M</sub>. Do not confuse V<sub>REF</sub> (the termination voltage) from the IBIS model with V<sub>REF</sub> (the input-switching threshold) from the table. A fourth parameter, C<sub>REF</sub> 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.

<http://www.xilinx.com/support/download/index.htm>

Simulate delays for a given application according to its specific load conditions as follows:

- Simulate the desired signal standard with the output driver connected to the test setup shown in Figure 35. Use parameter values V<sub>T</sub>, R<sub>T</sub>, and V<sub>M</sub> from Table 48. C<sub>REF</sub> is zero.
- Record the time to V<sub>M</sub>.
- Simulate the same signal standard with the output driver connected to the PCB trace with load. Use the appropriate IBIS model (including V<sub>REF</sub>, R<sub>REF</sub>, C<sub>REF</sub>, and V<sub>MEAS</sub> values) or capacitive value to represent the load.
- Record the time to V<sub>MEAS</sub>.
- Compare the results of steps 2 and 4. The increase (or decrease) in delay should be added to (or subtracted from) the appropriate Output standard adjustment (Table 47) to yield the worst-case delay of the PCB trace.

## Simultaneously Switching Output Guidelines

This section provides guidelines for the 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 49 and Table 50 provide the essential SSO guidelines. For each device/package combination, Table 49 provides the number of equivalent  $V_{CCO}$ /GND pairs. The equivalent number of pairs is based on characterization and will possibly not match the physical number of pairs. For each output signal standard and drive strength, Table 50 recommends the maximum number of SSOs, switching in the same direction, allowed per  $V_{CCO}$ /GND pair within an I/O bank. The Table 50 guidelines are categorized by package style. Multiply the appropriate numbers from Table 49 and Table 50 to calculate the maximum number of SSOs allowed within an I/O bank. Exceeding these SSO guidelines may result in increased power or ground bounce, degraded signal integrity, or increased system jitter.

$$SSO_{MAX}/IO \text{ Bank} = \text{Table 49} \times \text{Table 50}$$

The recommended maximum SSO values assume 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 number of SSOs allowed for quad-flat packages (VQ, TQ, PQ) is lower than for ball grid array packages (FG) due to the larger lead inductance of the quad-flat packages. Ball grid array packages are recommended for applications with a large number of simultaneously switching outputs.

Table 49: Equivalent  $V_{CCO}$ /GND Pairs per Bank

| Device   | VQ100 | CP132 (1)(2) | TQ144(1) | PQ208 | FT256 | FG320 | FG456 | FG676 | FG900 | FG1156 (2) |
|----------|-------|--------------|----------|-------|-------|-------|-------|-------|-------|------------|
| XC3S50   | 1     | 1.5          | 1.5      | 2     | –     | –     | –     | –     | –     | –          |
| XC3S200  | 1     | –            | 1.5      | 2     | 3     | –     | –     | –     | –     | –          |
| XC3S400  | –     | –            | 1.5      | 2     | 3     | 3     | 5     | –     | –     | –          |
| XC3S1000 | –     | –            | –        | –     | 3     | 3     | 5     | 5     | –     | –          |
| XC3S1500 | –     | –            | –        | –     | –     | 3     | 5     | 6     | –     | –          |
| XC3S2000 | –     | –            | –        | –     | –     | –     | 5     | 6     | 9     | –          |
| XC3S4000 | –     | –            | –        | –     | –     | –     | –     | 6     | 10    | 12         |
| XC3S5000 | –     | –            | –        | –     | –     | –     | –     | 6     | 10    | 12         |

**Notes:**

1. The  $V_{CCO}$  lines for the pair of banks on each side of the CP132 and TQ144 packages are internally tied together. Each pair of interconnected banks shares three  $V_{CCO}$ /GND pairs. Consequently, the per bank number is 1.5.
2. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).
3. The information in this table also applies to Pb-free packages.



Table 50: Recommended Number of Simultaneously Switching Outputs per V<sub>CCO</sub>/GND Pair

| Signal Standard<br>(IOSTANDARD) |      | Package |       |       |       |  |    |
|---------------------------------|------|---------|-------|-------|-------|--|----|
|                                 |      | VQ100   | TQ144 | PQ208 | CP132 | FT256, FG320, FG456,<br>FG676, FG900, FG1156 |    |
| <b>Single-Ended Standards</b>   |      |         |       |       |       |  |    |
| GTL                             |      | 0       | 0     | 0     | 1     | 14   |    |
| GTL_DCI                         |      | 0       | 0     | 0     | 1     | 14   |    |
| GTLP                            |      | 0       | 0     | 0     | 1     | 19   |    |
| GTLP_DCI                        |      | 0       | 0     | 0     | 1     | 19   |    |
| HSLVDCI_15                      |      | 6       | 6     | 6     | 6     | 14   |    |
| HSLVDCI_18                      |      | 7       | 7     | 7     | 7     | 10   |    |
| HSLVDCI_25                      |      | 7       | 7     | 7     | 7     | 11   |    |
| HSLVDCI_33                      |      | 10      | 10    | 10    | 10    | 10   |    |
| HSTL_I                          |      | 11      | 11    | 11    | 11    | 17   |    |
| HSTL_I_DCI                      |      | 11      | 11    | 11    | 11    | 17   |    |
| HSTL_III                        |      | 7       | 7     | 7     | 7     | 7  |    |
| HSTL_III_DCI                    |      | 7       | 7     | 7     | 7     | 7  |    |
| HSTL_I_18                       |      | 13      | 13    | 13    | 13    | 17   |    |
| HSTL_I_DCI_18                   |      | 13      | 13    | 13    | 13    | 17   |    |
| HSTL_II_18                      |      | 9       | 9     | 9     | 9     | 9  |    |
| HSTL_II_DCI_18                  |      | 9       | 9     | 9     | 9     | 9  |    |
| HSTL_III_18                     |      | 8       | 8     | 8     | 8     | 8  |    |
| HSTL_III_DCI_18                 |      | 8       | 8     | 8     | 8     | 8  |    |
| LVCMOS12                        | Slow | 2       | 17    | 17    | 17    | 17   | 55 |
|                                 |      | 4       | 13    | 13    | 13    | 13   | 32 |
|                                 |      | 6       | 10    | 10    | 10    | 10   | 18 |
|                                 | Fast | 2       | 12    | 12    | 12    | 12   | 31 |
|                                 |      | 4       | 11    | 11    | 11    | 11   | 13 |
|                                 |      | 6       | 9     | 9     | 9     | 9  | 9  |
| LVCMOS15                        | Slow | 2       | 16    | 12    | 12    | 19   | 55 |
|                                 |      | 4       | 8     | 7     | 7     | 9  | 31 |
|                                 |      | 6       | 7     | 7     | 7     | 9  | 18 |
|                                 |      | 8       | 6     | 6     | 6     | 6  | 15 |
|                                 |      | 12      | 5     | 5     | 5     | 5  | 10 |
|                                 | Fast | 2       | 10    | 10    | 10    | 13   | 25 |
|                                 |      | 4       | 6     | 7     | 7     | 7  | 16 |
|                                 |      | 6       | 7     | 7     | 7     | 7  | 13 |
|                                 |      | 8       | 6     | 6     | 6     | 6  | 11 |
|                                 |      | 12      | 6     | 6     | 6     | 6  | 7  |

Table 50: Recommended Number of Simultaneously Switching Outputs per V<sub>CC0</sub>/GND Pair (Cont'd)

| Signal Standard (IOSTANDARD) |      |    | Package |       |       |       |   |
|------------------------------|------|----|---------|-------|-------|-------|---|
|                              |      |    | VQ100   | TQ144 | PQ208 | CP132 | FT256, FG320, FG456, FG676, FG900, FG1156 |
| LVDCI_15                     |      |    | 6       | 6     | 6     | 6     | 14  |
| LVDCI_DV2_15                 |      |    | 6       | 6     | 6     | 6     | 14  |
| HSLVDCI_15                   |      |    | 6       | 6     | 6     | 6     | 14  |
| LVCMOS18                     | Slow | 2  | 19      | 13    | 13    | 29    | 64  |
|                              |      | 4  | 13      | 8     | 8     | 19    | 34  |
|                              |      | 6  | 8       | 8     | 8     | 9     | 22  |
|                              |      | 8  | 7       | 7     | 7     | 9     | 18  |
|                              |      | 12 | 5       | 5     | 5     | 5     | 13  |
|                              |      | 16 | 5       | 5     | 5     | 5     | 10  |
|                              | Fast | 2  | 13      | 13    | 13    | 19    | 36  |
|                              |      | 4  | 8       | 8     | 8     | 13    | 21  |
|                              |      | 6  | 8       | 8     | 8     | 8     | 13  |
|                              |      | 8  | 7       | 7     | 7     | 7     | 10  |
|                              |      | 12 | 5       | 5     | 5     | 5     | 9   |
|                              |      | 16 | 5       | 5     | 5     | 5     | 6   |
| LVDCI_18                     |      |    | 7       | 7     | 7     | 7     | 10  |
| LVDCI_DV2_18                 |      |    | 7       | 7     | 7     | 7     | 10  |
| HSLVDCI_18                   |      |    | 7       | 7     | 7     | 7     | 10  |
| LVCMOS25                     | Slow | 2  | 28      | 16    | 12    | 42    | 76  |
|                              |      | 4  | 13      | 10    | 10    | 19    | 46  |
|                              |      | 6  | 13      | 8     | 8     | 19    | 33  |
|                              |      | 8  | 7       | 7     | 7     | 9     | 24  |
|                              |      | 12 | 6       | 6     | 6     | 9     | 18  |
|                              |      | 16 | 6       | 6     | 6     | 6     | 11  |
|                              |      | 24 | 5       | 5     | 5     | 5     | 7   |
|                              | Fast | 2  | 17      | 12    | 12    | 26    | 42  |
|                              |      | 4  | 10      | 10    | 10    | 13    | 20  |
|                              |      | 6  | 8       | 8     | 8     | 13    | 15  |
|                              |      | 8  | 7       | 7     | 7     | 7     | 13  |
|                              |      | 12 | 6       | 6     | 6     | 6     | 11  |
|                              |      | 16 | 6       | 6     | 6     | 6     | 8   |
|                              |      | 24 | 5       | 5     | 5     | 5     | 5   |
| LVDCI_25                     |      |    | 7       | 7     | 7     | 7     | 11  |
| LVDCI_DV2_25                 |      |    | 7       | 7     | 7     | 7     | 11  |
| HSLVDCI_25                   |      |    | 7       | 7     | 7     | 7     | 11  |

Table 50: Recommended Number of Simultaneously Switching Outputs per V<sub>CC0</sub>/GND Pair (Cont'd)

| Signal Standard (IOSTANDARD) |      |    | Package |       |       |       |   |
|------------------------------|------|----|---------|-------|-------|-------|---|
|                              |      |    | VQ100   | TQ144 | PQ208 | CP132 | FT256, FG320, FG456, FG676, FG900, FG1156 |
| LVCMOS33                     | Slow | 2  | 34      | 24    | 24    | 52    | 76  |
|                              |      | 4  | 17      | 14    | 14    | 26    | 46  |
|                              |      | 6  | 17      | 11    | 11    | 26    | 27  |
|                              |      | 8  | 10      | 10    | 10    | 13    | 20  |
|                              |      | 12 | 9       | 9     | 9     | 13    | 13  |
|                              |      | 16 | 8       | 8     | 8     | 8     | 10  |
|                              |      | 24 | 8       | 8     | 8     | 8     | 9   |
|                              | Fast | 2  | 20      | 20    | 20    | 26    | 44  |
|                              |      | 4  | 15      | 15    | 15    | 15    | 26  |
|                              |      | 6  | 11      | 11    | 11    | 13    | 16  |
|                              |      | 8  | 10      | 10    | 10    | 10    | 12  |
|                              |      | 12 | 8       | 8     | 8     | 8     | 10  |
|                              |      | 16 | 8       | 8     | 8     | 8     | 8   |
|                              |      | 24 | 7       | 7     | 7     | 7     | 7   |
| LVDCI_33                     |      |    | 10      | 10    | 10    | 10    | 10  |
| LVDCI_DV2_33                 |      |    | 10      | 10    | 10    | 10    | 10  |
| HSLVDCI_33                   |      |    | 10      | 10    | 10    | 10    | 10  |
| LVTTTL                       | Slow | 2  | 34      | 25    | 25    | 52    | 60  |
|                              |      | 4  | 17      | 16    | 16    | 26    | 41  |
|                              |      | 6  | 17      | 15    | 15    | 26    | 29  |
|                              |      | 8  | 12      | 12    | 12    | 13    | 22  |
|                              |      | 12 | 10      | 10    | 10    | 13    | 13  |
|                              |      | 16 | 10      | 10    | 10    | 10    | 11  |
|                              |      | 24 | 8       | 8     | 8     | 8     | 9   |
|                              | Fast | 2  | 20      | 20    | 20    | 26    | 34  |
|                              |      | 4  | 13      | 13    | 13    | 13    | 20  |
|                              |      | 6  | 11      | 11    | 11    | 13    | 15  |
|                              |      | 8  | 10      | 10    | 10    | 10    | 12  |
|                              |      | 12 | 9       | 9     | 9     | 9     | 10  |
|                              |      | 16 | 8       | 8     | 8     | 8     | 9   |
|                              |      | 24 | 7       | 7     | 7     | 7     | 7   |

Table 50: Recommended Number of Simultaneously Switching Outputs per  $V_{CCO}/GND$  Pair (Cont'd)

| Signal Standard<br>(IOSTANDARD)                                 | Package |       |       |       |  |
|---|---------|-------|-------|-------|--|
|   | VQ100   | TQ144 | PQ208 | CP132 | FT256, FG320, FG456,<br>FG676, FG900, FG1156 |
| PCI33_3   | 9       | 9     | 9     | 9     | 9  |
| SSTL18_I  | 13      | 13    | 13    | 13    | 17   |
| SSTL18_I_DCI  | 13      | 13    | 13    | 13    | 17   |
| SSTL18_II   | 8       | 8     | 8     | 8     | 9  |
| SSTL2_I   | 10      | 10    | 10    | 10    | 13   |
| SSTL2_I_DCI   | 10      | 10    | 10    | 10    | 13   |
| SSTL2_II  | 6       | 6     | 6     | 6     | 9  |
| SSTL2_II_DCI  | 6       | 6     | 6     | 6     | 9  |
| <b>Differential Standards (Number of I/O Pairs or Channels)</b> |         |       |       |       |  |
| LDT_25 (ULVDS_25)   | 5       | 5     | 5     | 5     | 5  |
| LVDS_25   | 7       | 5     | 5     | 12    | 20   |
| BLVDS_25  | 2       | 1     | 1     |       | 4  |
| LVDS_25   | 5       | 5     | 5     | 5     | 5  |
| LVPECL_25   | 2       | 1     | 1     |       | 4  |
| RSDS_25   | 7       | 5     | 5     | 12    | 20   |
| DIFF_HSTL_II_18   | 4       | 4     | 4     | 4     | 4  |
| DIFF_HSTL_II_18_DCI   | 4       | 4     | 4     | 4     | 4  |
| DIFF_SSTL2_II   | 3       | 3     | 3     | 3     | 4  |
| DIFF_SSTL2_II_DCI   | 3       | 3     | 3     | 3     | 4  |

**Notes:**

1. The numbers in this table are recommendations that assume the FPGA is soldered on a printed circuit board using sound practices. 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.
2. Regarding the SSO numbers for all DCI standards, the  $R_{REF}$  resistors connected to the VRN and VRP pins of the FPGA are 50W.
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.
4. Results are based on actual silicon testing using an FPGA soldered on a typical printed-circuit board.

## Internal Logic Timing

Table 51: CLB Timing

| Symbol                       | Description   | Speed Grade |          |      |          | Units |
|------------------------------|---|-------------|----------|------|----------|-------|
|                              |   | -5          |          | -4   |          |       |
|                              |   | Min         | Max      | Min  | Max      |       |
| <b>Clock-to-Output Times</b> |   |             |          |      |          |       |
| $T_{CKO}$                    | 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 | –           | 0.63     | –    | 0.72     | ns    |
| <b>Setup Times</b>           |   |             |          |      |          |       |
| $T_{AS}$                     | Time from the setup of data at the F or G input to the active transition at the CLK input of the CLB                                    | 0.46        | –        | 0.53 | –        | 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                                  | 1.27        | –        | 1.57 | –        | ns    |
| <b>Hold Times</b>            |   |             |          |      |          |       |
| $T_{AH}$                     | Time from the active transition at the CLK input to the point where data is last held at the F or G input                               | 0           | –        | 0    | –        | 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                             | 0.25        | –        | 0.29 | –        | ns    |
| <b>Clock Timing</b>          |   |             |          |      |          |       |
| $T_{CH}$                     | CLB CLK signal High pulse width   | 0.69        | $\infty$ | 0.79 | $\infty$ | ns    |
| $T_{CL}$                     | CLB CLK signal Low pulse width  | 0.69        | $\infty$ | 0.79 | $\infty$ | ns    |
| $F_{TOG}$                    | Maximum toggle frequency (for export control)   | –           | 725      | –    | 630      | MHz   |
| <b>Propagation Times</b>     |   |             |          |      |          |       |
| $T_{ILO}$                    | The time it takes for data to travel from the CLB's F (G) input to the X (Y) output   | –           | 0.53     | –    | 0.61     | ns    |
| <b>Set/Reset Pulse Width</b> |   |             |          |      |          |       |
| $T_{RPW\_CLB}$               | The minimum allowable pulse width, High or Low, to the CLB's SR input   | 0.76        | –        | 0.87 | –        | ns    |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in [Table 32](#).
2. The timing shown is for SLICEM.
3. For minimums, use the values reported by the Xilinx timing analyzer.

Table 52: CLB Distributed RAM Switching Characteristics

| Symbol                       | Description  | -5   |      | -4   |      | Units |
|------------------------------|--|------|------|------|------|-------|
|                              |  | Min  | Max  | Min  | Max  |       |
| <b>Clock-to-Output Times</b> |  |      |      |      |      |       |
| $T_{SHCKO}$                  | Time from the active edge at the CLK input to data appearing on the distributed RAM output   | –    | 1.87 | –    | 2.15 | ns    |
| <b>Setup Times</b>           |  |      |      |      |      |       |
| $T_{DS}$                     | Setup time of data at the BX or BY input before the active transition at the CLK input of the distributed RAM  | 0.46 | –    | 0.52 | –    | ns    |
| $T_{AS}$                     | Setup time of the F/G address inputs before the active transition at the CLK input of the distributed RAM  | 0.46 | –    | 0.53 | –    | ns    |
| $T_{WS}$                     | Setup time of the write enable input before the active transition at the CLK input of the distributed RAM  | 0.33 | –    | 0.37 | –    | ns    |
| <b>Hold Times</b>            |  |      |      |      |      |       |
| $T_{DH}, T_{AH}, T_{WH}$     | Hold time of the BX, BY data inputs, the F/G address inputs, or the write enable input after the active transition at the CLK input of the distributed RAM | 0    | –    | 0    | –    | ns    |
| <b>Clock Pulse Width</b>     |  |      |      |      |      |       |
| $T_{WPH}, T_{WPL}$           | Minimum High or Low pulse width at CLK input   | 0.85 | –    | 0.97 | –    | ns    |

Table 53: CLB Shift Register Switching Characteristics

| Symbol                       | Description  | -5   |      | -4   |      | Units |
|------------------------------|--|------|------|------|------|-------|
|                              |  | Min  | Max  | Min  | Max  |       |
| <b>Clock-to-Output Times</b> |  |      |      |      |      |       |
| $T_{REG}$                    | Time from the active edge at the CLK input to data appearing on the shift register output                    | –    | 3.30 | –    | 3.79 | ns    |
| <b>Setup Times</b>           |  |      |      |      |      |       |
| $T_{SRLDS}$                  | Setup time of data at the BX or BY input before the active transition at the CLK input of the shift register | 0.46 | –    | 0.52 | –    | ns    |
| <b>Hold Times</b>            |  |      |      |      |      |       |
| $T_{SRLDH}$                  | Hold time of the BX or BY data input after the active transition at the CLK input of the shift register      | 0    | –    | 0    | –    | ns    |
| <b>Clock Pulse Width</b>     |  |      |      |      |      |       |
| $T_{WPH}, T_{WPL}$           | Minimum High or Low pulse width at CLK input   | 0.85 | –    | 0.97 | –    | ns    |

Table 54: Synchronous 18 x 18 Multiplier Timing

| Symbol                       | Description   | P Outputs | Speed Grade |      |      |      | Units |
|------------------------------|---|-----------|-------------|------|------|------|-------|
|                              |   |           | -5          |      | -4   |      |       |
|                              |   |           | Min         | Max  | Min  | Max  |       |
| <b>Clock-to-Output Times</b> |   |           |             |      |      |      |       |
| T <sub>MULTCK</sub>          | When reading from the Multiplier, the time from the active transition at the C clock input to data appearing at the P outputs | P[0]      | –           | 1.00 | –    | 1.15 | ns    |
|                              |   | P[15]     | –           | 1.15 | –    | 1.32 | ns    |
|                              |   | P[17]     | –           | 1.30 | –    | 1.50 | ns    |
|                              |   | P[19]     | –           | 1.45 | –    | 1.67 | ns    |
|                              |   | P[23]     | –           | 1.76 | –    | 2.02 | ns    |
|                              |   | P[31]     | –           | 2.37 | –    | 2.72 | ns    |
|                              |   | P[35]     | –           | 2.67 | –    | 3.07 | ns    |
| <b>Setup Times</b>           |   |           |             |      |      |      |       |
| T <sub>MULIDCK</sub>         | Time from the setup of data at the A and B inputs to the active transition at the C input of the Multiplier                   | -         | 1.84        | –    | 2.11 | –    | ns    |
| <b>Hold Times</b>            |   |           |             |      |      |      |       |
| T <sub>MULCKID</sub>         | Time from the active transition at the Multiplier's C input to the point where data is last held at the A and B inputs        | -         | 0           | –    | 0    | –    | ns    |

**Notes:**

- The numbers in this table are based on the operating conditions set forth in Table 32.

Table 55: Asynchronous 18 x 18 Multiplier Timing

| Symbol                   | Description   | P Outputs | Speed Grade |      | Units |
|--------------------------|---|-----------|-------------|------|-------|
|                          |   |           | -5          | -4   |       |
|                          |   |           | Max         | Max  |       |
| <b>Propagation Times</b> |   |           |             |      |       |
| T <sub>MULT</sub>        | The time it takes for data to travel from the A and B inputs to the P outputs | P[0]      | 1.55        | 1.78 | ns    |
|                          |   | P[15]     | 3.15        | 3.62 | ns    |
|                          |   | P[17]     | 3.36        | 3.86 | ns    |
|                          |   | P[19]     | 3.49        | 4.01 | ns    |
|                          |   | P[23]     | 3.73        | 4.29 | ns    |
|                          |   | P[31]     | 4.23        | 4.86 | ns    |
|                          |   | P[35]     | 4.47        | 5.14 | ns    |

**Notes:**

- The numbers in this table are based on the operating conditions set forth in Table 32.

Table 56: Block RAM Timing

| Symbol                       | Description  | Speed Grade |          |      |          | Units |
|------------------------------|--|-------------|----------|------|----------|-------|
|                              |  | -5          |          | -4   |          |       |
|                              |  | Min         | Max      | Min  | Max      |       |
| <b>Clock-to-Output Times</b> |  |             |          |      |          |       |
| $T_{BCKO}$                   | When reading from the Block RAM, the time from the active transition at the CLK input to data appearing at the DOUT output | –           | 2.09     | –    | 2.40     | ns    |
| <b>Setup Times</b>           |  |             |          |      |          |       |
| $T_{BDCK}$                   | Time from the setup of data at the DIN inputs to the active transition at the CLK input of the Block RAM                   | 0.43        | –        | 0.49 | –        | ns    |
| <b>Hold Times</b>            |  |             |          |      |          |       |
| $T_{BCKD}$                   | Time from the active transition at the Block RAM's CLK input to the point where data is last held at the DIN inputs        | 0           | –        | 0    | –        | ns    |
| <b>Clock Timing</b>          |  |             |          |      |          |       |
| $T_{BPWH}$                   | Block RAM CLK signal High pulse width  | 1.19        | $\infty$ | 1.37 | $\infty$ | ns    |
| $T_{BPWL}$                   | Block RAM CLK signal Low pulse width   | 1.19        | $\infty$ | 1.37 | $\infty$ | ns    |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 32.
2. For minimums, use the values reported by the Xilinx timing analyzer.

**Clock Distribution Switching Characteristics**

Table 57: Clock Distribution Switching Characteristics

| Description  | Symbol    | Maximum     |      | Units |
|--|-----------|-------------|------|-------|
|  |           | Speed Grade |      |       |
|  |           | -5          | -4   |       |
| Global clock buffer (BUFG, BUFGMUX, BUFGCE) I-input to O-output delay  | $T_{GIO}$ | 0.36        | 0.41 | ns    |
| Global clock multiplexer (BUFGMUX) select S-input setup to I0- and I1-inputs. Same as BUFGCE enable CE-input | $T_{GSI}$ | 0.53        | 0.60 | ns    |

**Notes:**

1. For minimums, use the values reported by the Xilinx timing analyzer.



## 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 58](#) and [Table 59](#)) 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 60](#) through [Table 63](#)) 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 58](#) and [Table 59](#).

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

Period jitter is the worst-case deviation from the average clock period of all clock cycles in the collection of clock periods sampled (usually from 100,000 to more than a million samples for specification purposes). 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.

### Delay-Locked Loop (DLL)

Table 58: Recommended Operating Conditions for the DLL

| Symbol   |                   | Description   | Frequency Mode/<br>F <sub>CLKIN</sub> Range | Speed Grade       |                    |                   |                       | Units |
|--|-------------------|---|---|-------------------|--------------------|-------------------|-----------------------|-------|
|  |                   |   |   | -5                |                    | -4                |                       |       |
|  |                   |   |   | Min               | Max                | Min               | Max                   |       |
| <b>Input Frequency Ranges</b>  |                   |   |   |                   |                    |                   |                       |       |
| F <sub>CLKIN</sub>   | CLKIN_FREQ_DLL_LF | Frequency for the CLKIN input   | Low   | 18 <sup>(2)</sup> | 167 <sup>(3)</sup> | 18 <sup>(2)</sup> | 167 <sup>(3)</sup>    | MHz   |
|  | CLKIN_FREQ_DLL_HF |   | High  | 48                | 280 <sup>(3)</sup> | 48                | 280 <sup>(3)(4)</sup> | MHz   |
| <b>Input Pulse Requirements</b>  |                   |   |   |                   |                    |                   |                       |       |
| CLKIN_PULSE  |                   | CLKIN pulse width as a percentage of the CLKIN period                                 | F <sub>CLKIN</sub> ≤ 100 MHz                | 40%               | 60%                | 40%               | 60%                   | -     |
|  |                   |   | F <sub>CLKIN</sub> > 100 MHz                | 45%               | 55%                | 45%               | 55%                   | -     |
| <b>Input Clock Jitter Tolerance and Delay Path Variation<sup>(5)</sup></b> |                   |   |   |                   |                    |                   |                       |       |
| CLKIN_CYC_JITT_DLL_LF  |                   | Cycle-to-cycle jitter at the CLKIN input  | Low   | -                 | ±300               | -                 | ±300                  | ps    |
| CLKIN_CYC_JITT_DLL_HF  |                   |   | High  | -                 | ±150               | -                 | ±150                  | ps    |
| CLKIN_PER_JITT_DLL_LF  |                   | Period jitter at the CLKIN input  | All   | -                 | ±1                 | -                 | ±1                    | ns    |
| CLKIN_PER_JITT_DLL_HF  |                   |   | -   | -                 | -                  | -                 | -                     | -     |
| CLKFB_DELAY_VAR_EXT  |                   | Allowable variation of off-chip feedback delay from the DCM output to the CLKFB input | All   | -                 | ±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 F<sub>CLKIN</sub> frequencies. See [Table 60](#).
3. The CLKIN\_DIVIDE\_BY\_2 attribute can be used to increase the effective input frequency range up to F<sub>BUFG</sub>. When set to TRUE, CLKIN\_DIVIDE\_BY\_2 divides the incoming clock frequency by two as it enters the DCM.
4. Industrial temperature range devices have additional requirements for continuous clocking, as specified in [Table 64](#).
5. CLKIN input jitter beyond these limits may cause the DCM to lose lock. See [UG331](#) for more details.

Table 59: Switching Characteristics for the DLL

| Symbol                                   | Description  | Frequency Mode / FCLKIN Range | Device   | Speed Grade |      |       |      | Units |
|--|--|-------------------------------|----------|-------------|------|-------|------|-------|
|  |  |                               |          | -5          |      | -4    |      |       |
|  |  |                               |          | Min         | Max  | Min   | Max  |       |
| <b>Output Frequency Ranges</b>           |  |                               |          |             |      |       |      |       |
| CLKOUT_FREQ_1X_LF                        | Frequency for the CLK0, CLK90, CLK180, and CLK270 outputs                                    | Low                           | All      | 18          | 167  | 18    | 167  | MHz   |
| CLKOUT_FREQ_1X_HF                        | Frequency for the CLK0 and CLK180 outputs  | High                          |          | 48          | 280  | 48    | 280  | MHz   |
| CLKOUT_FREQ_2X_LF <sup>(3)</sup>         | Frequency for the CLK2X and CLK2X180 outputs   | Low                           |          | 36          | 334  | 36    | 334  | MHz   |
| CLKOUT_FREQ_DV_LF                        | Frequency for the CLKDV output   | Low                           |          | 1.125       | 110  | 1.125 | 110  | MHz   |
| CLKOUT_FREQ_DV_HF                        |  | High                          |          | 3           | 185  | 3     | 185  | MHz   |
| <b>Output Clock Jitter<sup>(4)</sup></b> |  |                               |          |             |      |       |      |       |
| CLKOUT_PER_JITT_0                        | Period jitter at the CLK0 output   | All                           | 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  |                               |          | –           | ±200 | –     | ±200 | 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                       |                               |          | –           | ±300 | –     | ±300 | ps    |
| <b>Duty Cycle</b>                        |  |                               |          |             |      |       |      |       |
| CLKOUT_DUTY_CYCLE_DLL <sup>(5)</sup>     | Duty cycle variation for the CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, and CLKDV outputs | All                           | XC3S50   | –           | ±150 | –     | ±150 | ps    |
|  |  |                               | XC3S200  | –           | ±150 | –     | ±150 | ps    |
|  |  |                               | XC3S400  | –           | ±250 | –     | ±250 | ps    |
|  |  |                               | XC3S1000 | –           | ±400 | –     | ±400 | ps    |
|  |  |                               | XC3S1500 | –           | ±400 | –     | ±400 | ps    |
|  |  |                               | XC3S2000 | –           | ±400 | –     | ±400 | ps    |
|  |  |                               | XC3S4000 | –           | ±400 | –     | ±400 | ps    |
|  |  |                               | XC3S5000 | –           | ±400 | –     | ±400 | ps    |
| <b>Phase Alignment</b>                   |  |                               |          |             |      |       |      |       |
| CLKIN_CLKFB_PHASE                        | Phase offset between the CLKIN and CLKFB inputs  | All                           | All      | –           | ±150 | –     | ±150 | ps    |
| CLKOUT_PHASE                             | Phase offset between any two DLL outputs (except CLK2X and CLK0)                             |                               |          | –           | ±140 | –     | ±140 | ps    |
|  | Phase offset between the CLK2X and CLK0 outputs  |                               |          | –           | ±250 | –     | ±250 | ps    |

Table 59: Switching Characteristics for the DLL (Cont'd)

| Symbol             | Description  | Frequency Mode / FCLKIN Range                            | Device | Speed Grade |      |      |      | Units |
|--------------------|--|--|--------|-------------|------|------|------|-------|
|                    |  |  |        | -5          |      | -4   |      |       |
|                    |  |  |        | Min         | Max  | Min  | Max  |       |
| <b>Lock Time</b>   |  |  |        |             |      |      |      |       |
| LOCK_DLL           | 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 | $18\text{ MHz} \leq F_{\text{CLKIN}} \leq 30\text{ MHz}$ | All    | –           | 2.88 | –    | 2.88 | ms    |
|                    |  | $30\text{ MHz} < F_{\text{CLKIN}} \leq 40\text{ MHz}$    |        | –           | 2.16 | –    | 2.16 | ms    |
|                    |  | $40\text{ MHz} < F_{\text{CLKIN}} \leq 50\text{ MHz}$    |        | –           | 1.20 | –    | 1.20 | ms    |
|                    |  | $50\text{ MHz} < F_{\text{CLKIN}} \leq 60\text{ MHz}$    |        | –           | 0.60 | –    | 0.60 | ms    |
|                    |  | $F_{\text{CLKIN}} > 60\text{ MHz}$                       |        | –           | 0.48 | –    | 0.48 | ms    |
| <b>Delay Lines</b> |  |  |        |             |      |      |      |       |
| DCM_TAP            | Delay tap resolution   | All  | All    | 30.0        | 60.0 | 30.0 | 60.0 | ps    |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 32 and Table 58.
2. DLL specifications apply when any of the DLL outputs (CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, or CLKDV) are in use.
3. Only mask revision 'E' and later devices (see Mask and Fab Revisions, page 58) and all revisions of the XC3S50 and the XC3S1000 support DLL feedback using the CLK2X output. For all other Spartan-3 devices, use feedback from the CLK0 output (instead of the CLK2X output) and set the CLK\_FEEDBACK attribute to 1X.
4. Indicates the maximum amount of output jitter that the DCM adds to the jitter on the CLKIN input.
5. This specification only applies if the attribute DUTY\_CYCLE\_CORRECTION = TRUE.

**Digital Frequency Synthesizer (DFS)**

Table 60: Recommended Operating Conditions for the DFS

| Symbol  |               | Description                              | Frequency Mode | Speed Grade |      |     |      | Units |
|---|---------------|--|----------------|-------------|------|-----|------|-------|
|   |               |  |                | -5          |      | -4  |      |       |
|   |               |  |                | Min         | Max  | Min | Max  |       |
| <b>Input Frequency Ranges<sup>(2)</sup></b>       |               |  |                |             |      |     |      |       |
| $F_{\text{CLKIN}}$                                | CLKIN_FREQ_FX | Frequency for the CLKIN input            | All            | 1           | 280  | 1   | 280  | MHz   |
| <b>Input Clock Jitter Tolerance<sup>(3)</sup></b> |               |  |                |             |      |     |      |       |
| CLKIN_CYC_JITT_FX_LF                              |               | Cycle-to-cycle jitter at the CLKIN input | Low            | –           | ±300 | –   | ±300 | ps    |
| CLKIN_CYC_JITT_FX_HF                              |               |  | High           | –           | ±150 | –   | ±150 | ps    |
| CLKIN_PER_JITT_FX                                 |               | Period jitter at the CLKIN input         | All            | –           | ±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 58.
3. CLKIN input jitter beyond these limits may cause the DCM to lose lock.

Table 61: Switching Characteristics for the DFS

| Symbol                          | Description   | Frequency Mode | Device   | Speed Grade |                    |        |                    | Units |
|---------------------------------|---|----------------|----------|-------------|--------------------|--------|--------------------|-------|
|                                 |   |                |          | -5          |                    | -4     |                    |       |
|                                 |   |                |          | Min         | Max                | Min    | Max                |       |
| <b>Output Frequency Ranges</b>  |   |                |          |             |                    |        |                    |       |
| CLKOUT_FREQ_FX_LF               | Frequency for the CLKFX and CLKFX180 outputs  | Low            | All      | 18          | 210                | 18     | 210                | MHz   |
| CLKOUT_FREQ_FX_HF               |   | High           | All      | 210         | 326 <sup>(2)</sup> | 210    | 307 <sup>(2)</sup> | MHz   |
| <b>Output Clock Jitter</b>      |   |                |          |             |                    |        |                    |       |
| CLKOUT_PER_JITT_FX              | Period jitter at the CLKFX and CLKFX180 outputs   | All            | All      | Note 3      | Note 3             | Note 3 | Note 3             | ps    |
| <b>Duty Cycle<sup>(4)</sup></b> |   |                |          |             |                    |        |                    |       |
| CLKOUT_DUTY_CYCLE_FX            | Duty cycle precision for the CLKFX and CLKFX180 outputs   | All            | XC3S50   | –           | ±100               | –      | ±100               | ps    |
|                                 |   |                | XC3S200  | –           | ±100               | –      | ±100               | ps    |
|                                 |   |                | XC3S400  | –           | ±250               | –      | ±250               | ps    |
|                                 |   |                | XC3S1000 | –           | ±400               | –      | ±400               | ps    |
|                                 |   |                | XC3S1500 | –           | ±400               | –      | ±400               | ps    |
|                                 |   |                | XC3S2000 | –           | ±400               | –      | ±400               | ps    |
|                                 |   |                | XC3S4000 | –           | ±400               | –      | ±400               | ps    |
|                                 |   |                | XC3S5000 | –           | ±400               | –      | ±400               | ps    |
| <b>Phase Alignment</b>          |   |                |          |             |                    |        |                    |       |
| CLKOUT_PHASE                    | Phase offset between the DFS output and the CLK0 output   | All            | All      | –           | ±300               | –      | ±300               | ps    |
| <b>Lock Time</b>                |   |                |          |             |                    |        |                    |       |
| LOCK_DLL_FX                     | When using the DFS in conjunction with the DLL: 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.       | All            | All      | –           | 10.0               | –      | 10.0               | ms    |
| LOCK_FX                         | When using the DFS without the DLL: The time from deassertion at the DCM's Reset input to the rising transition at its LOCKED output. By asserting the LOCKED signal, the DFS indicates valid CLKFX and CLKFX180 signals. | All            | All      | –           | 10.0               | –      | 10.0               | ms    |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in [Table 32](#) and [Table 60](#).
2. Mask revisions prior to the E mask revision have a CLKOUT\_FREQ\_FX\_HF max of 280 MHz. See [Mask and Fab Revisions, page 58](#).
3. Use the DCM Clocking Wizard in the ISE software for a Spartan-3 device specific number. Jitter number assumes 150 ps of input clock jitter.
4. The CLKFX and CLKFX180 outputs always approximate 50% duty cycles.
5. DFS specifications apply when either of the DFS outputs (CLKFX or CLKFX180) is in use.

### Phase Shifter (PS)

Phase shifter operation is only supported if the DLL is in low-frequency mode, see [Table 58](#). Fixed phase shift requires ISE software version 10.1.03 (or later).

Table 62: Recommended Operating Conditions for the PS in Variable Phase Mode

| Symbol                              | Description   | Frequency Mode/<br>F <sub>CLKIN</sub> Range |                              | Speed Grade |     |     |     | Units |
|-------------------------------------|---|---|------------------------------|-------------|-----|-----|-----|-------|
|                                     |   |   |                              | -5          |     | -4  |     |       |
|                                     |   |   |                              | Min         | Max | Min | Max |       |
| <b>Operating Frequency Ranges</b>   |   |   |                              |             |     |     |     |       |
| PSCLK_FREQ<br>(F <sub>PSCLK</sub> ) | Frequency for the PSCLK input                         | Low   |                              | 1           | 167 | 1   | 167 | MHz   |
| <b>Input Pulse Requirements</b>     |   |   |                              |             |     |     |     |       |
| PSCLK_PULSE                         | PSCLK pulse width as a percentage of the PSCLK period | Low   | F <sub>CLKIN</sub> ≤ 100 MHz | 40%         | 60% | 40% | 60% | -     |
|                                     |   |   | F <sub>CLKIN</sub> > 100 MHz | 45%         | 55% | 45% | 55% | -     |

Table 63: Switching Characteristics for the PS in Variable or Fixed Phase Shift Mode

| Symbol                      | Description  | Frequency Mode/<br>F <sub>CLKIN</sub> Range |  | Speed Grade |       |     |       | Units |
|-----------------------------|--|---|--|-------------|-------|-----|-------|-------|
|                             |  |   |  | -5          |       | -4  |       |       |
|                             |  |   |  | Min         | Max   | Min | Max   |       |
| <b>Phase Shifting Range</b> |  |   |  |             |       |     |       |       |
| FINE_SHIFT_RANGE            | Phase shift range  | Low   |  | -           | 10.0  | -   | 10.0  | ns    |
| <b>Lock Time</b>            |  |   |  |             |       |     |       |       |
| LOCK_DLL_PS                 | When using the PS in conjunction with the DLL: 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.         | 18 MHz ≤ F <sub>CLKIN</sub> ≤ 30 MHz        |  | -           | 3.28  | -   | 3.28  | ms    |
|                             |  | 30 MHz < F <sub>CLKIN</sub> ≤ 40 MHz        |  | -           | 2.56  | -   | 2.56  | ms    |
|                             |  | 40 MHz < F <sub>CLKIN</sub> ≤ 50 MHz        |  | -           | 1.60  | -   | 1.60  | ms    |
|                             |  | 50 MHz < F <sub>CLKIN</sub> ≤ 60 MHz        |  | -           | 1.00  | -   | 1.00  | ms    |
|                             |  | 60 MHz < F <sub>CLKIN</sub> ≤ 165 MHz       |  | -           | 0.88  | -   | 0.88  | ms    |
| LOCK_DLL_PS_FX              | When using the PS in conjunction with the DLL and DFS: 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. | Low   |  | -           | 10.40 | -   | 10.40 | ms    |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in [Table 32](#) and [Table 62](#).
2. The PS specifications in this table apply when the PS attribute CLKOUT\_PHASE\_SHIFT= VARIABLE or FIXED.

## Miscellaneous DCM Timing

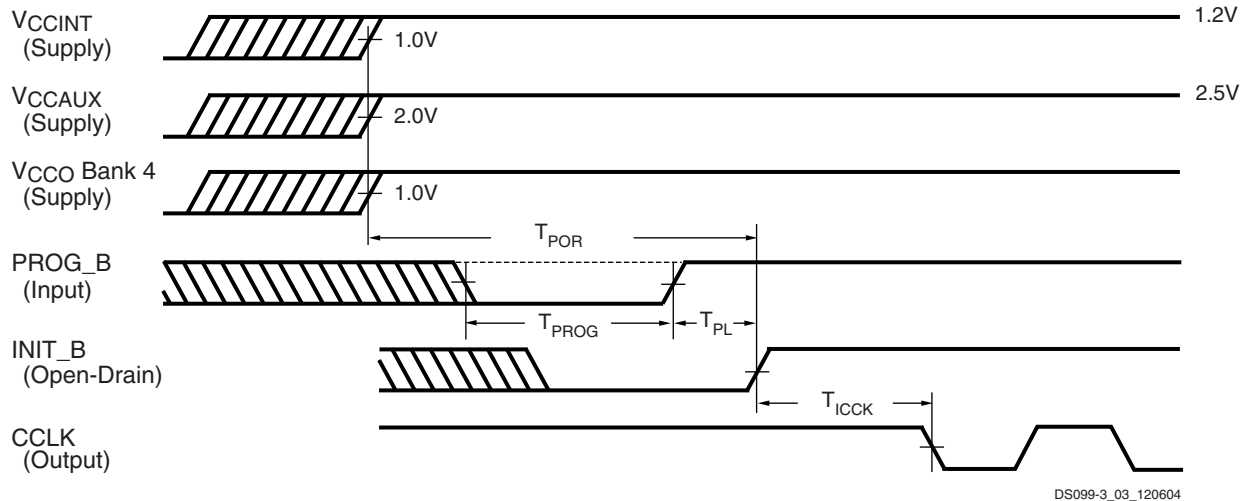
Table 64: Miscellaneous DCM Timing

| Symbol                             | Description  | DLL Frequency Mode | Temperature Range |            | Units        |
|------------------------------------|--|--------------------|-------------------|------------|--------------|
|                                    |  |                    | Commercial        | Industrial |              |
| DCM_INPUT_CLOCK_STOP               | Maximum duration that the CLKIN and CLKFB signals can be stopped <sup>(1,2)</sup>  | Any                | 100               | 100        | ms           |
| DCM_RST_PW_MIN                     | Minimum duration of a RST pulse width  | Any                | 3                 | 3          | CLKIN cycles |
| DCM_RST_PW_MAX <sup>(3)</sup>      | Maximum duration of a RST pulse width <sup>(1,2)</sup>   | Low                | N/A               | N/A        | seconds      |
|                                    |  | High               | N/A               | 10         | seconds      |
| DCM_CONFIG_LAG_TIME <sup>(4)</sup> | Maximum duration from $V_{CCINT}$ applied to FPGA configuration successfully completed (DONE pin goes High) and clocks applied to DCM DLL <sup>(1,2)</sup> | Low                | N/A               | N/A        | minutes      |
|                                    |  | High               | N/A               | 10         | minutes      |

### Notes:

1. These limits only apply to applications that use the DCM DLL outputs (CLK0, CLK90, CLK180, CLK270, CLK2X, CLK2X180, and CLKDV). The DCM DFS outputs (CLKFX, CLKFX180) are unaffected. Required due to effects of device cooling: see "Momentarily Stopping CLKIN" in Chapter 3 of [UG331](#).
2. Industrial-temperature applications that use the DLL in High-Frequency mode must use a continuous or increasing operating frequency. The DLL under these conditions does not support reducing the operating frequency once establishing an initial operating frequency.
3. This specification is equivalent to the Virtex-4 FPGA DCM\_RESET specification.
4. This specification is equivalent to the Virtex-4 FPGA TCONFIG specification.

### Configuration and JTAG Timing



**Notes:**

1. The  $V_{CCINT}$ ,  $V_{CCAUX}$ , and  $V_{CCO}$  supplies may 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).

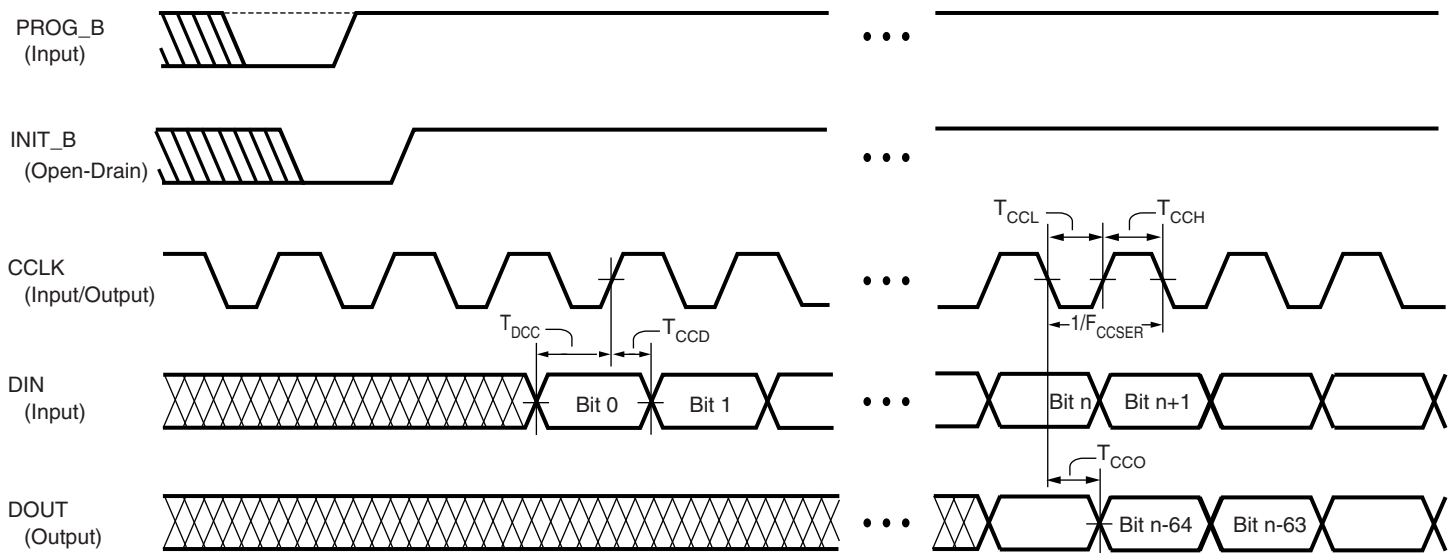
Figure 36: Waveforms for Power-On and the Beginning of Configuration

Table 65: 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 4 supply voltage ramps (whichever occurs last) to the rising transition of the INIT_B pin | XC3S50   | –                | 5   | ms      |
|                  |   | XC3S200  | –                | 5   | ms      |
|                  |   | XC3S400  | –                | 5   | ms      |
|                  |   | XC3S1000 | –                | 5   | ms      |
|                  |   | XC3S1500 | –                | 7   | ms      |
|                  |   | XC3S2000 | –                | 7   | ms      |
|                  |   | XC3S4000 | –                | 7   | ms      |
|                  |   | XC3S5000 | –                | 7   | ms      |
| $T_{PROG}$       | The width of the low-going pulse on the PROG_B pin  | All      | 0.3              | –   | $\mu$ s |
| $T_{PL}^{(2)}$   | The time from the rising edge of the PROG_B pin to the rising transition on the INIT_B pin  | XC3S50   | –                | 2   | ms      |
|                  |   | XC3S200  | –                | 2   | ms      |
|                  |   | XC3S400  | –                | 2   | ms      |
|                  |   | XC3S1000 | –                | 2   | ms      |
|                  |   | XC3S1500 | –                | 3   | ms      |
|                  |   | XC3S2000 | –                | 3   | ms      |
|                  |   | XC3S4000 | –                | 3   | ms      |
|                  |   | XC3S5000 | –                | 3   | ms      |
| $T_{INIT}$       | Minimum Low pulse width on INIT_B output  | All      | 250              | –   | 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      | 0.25             | 4.0 | $\mu$ s |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 32. 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 for the Master Serial and Master Parallel modes.



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Figure 37: Waveforms for Master and Slave Serial Configuration

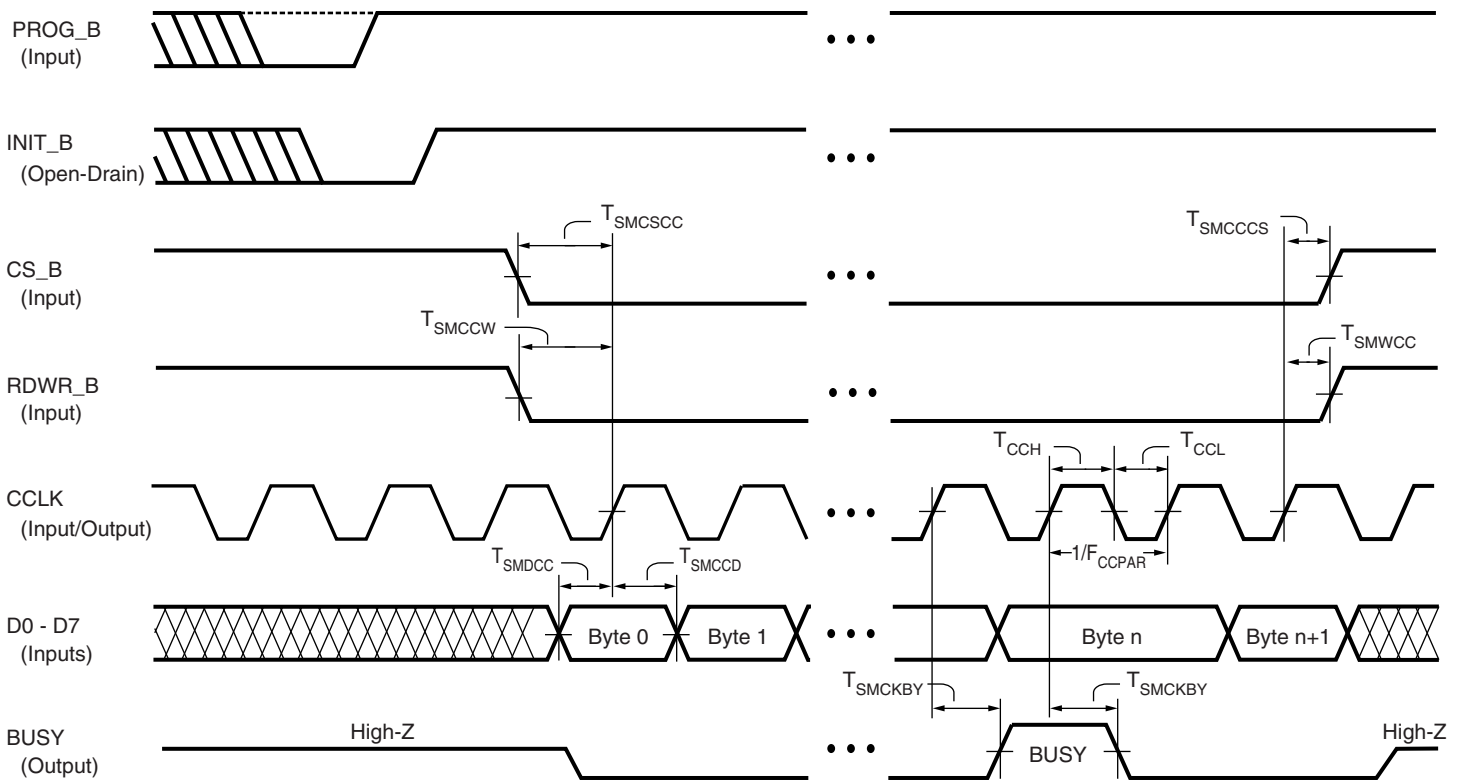
Table 66: Timing for the Master and Slave Serial Configuration Modes

| Symbol                       | Description  | Slave/<br>Master           | All Speed Grades         |          | Units             |
|------------------------------|--|----------------------------|--------------------------|----------|-------------------|
|                              |  |                            | Min                      | Max      |                   |
| <b>Clock-to-Output Times</b> |  |                            |                          |          |                   |
| $T_{CCO}$                    | The time from the falling transition on the CCLK pin to data appearing at the DOUT pin                 | Both                       | 1.5                      | 12.0     | ns                |
| <b>Setup Times</b>           |  |                            |                          |          |                   |
| $T_{DCC}$                    | The time from the setup of data at the DIN pin to the rising transition at the CCLK pin                | Both                       | 10.0                     | –        | ns                |
| <b>Hold Times</b>            |  |                            |                          |          |                   |
| $T_{CCD}$                    | The time from the rising transition at the CCLK pin to the point when data is last held at the DIN pin | Both                       | 0                        | –        | ns                |
| <b>Clock Timing</b>          |  |                            |                          |          |                   |
| $T_{CCH}$                    | CCLK input pin High pulse width  | Slave                      | 5.0                      | $\infty$ | ns                |
| $T_{CCL}$                    | CCLK input pin Low pulse width   |                            | 5.0                      | $\infty$ | ns                |
| $F_{CCSER}$                  | Frequency of the clock signal at the CCLK input pin  |                            | No bitstream compression | 0        | 66 <sup>(2)</sup> |
|                              |  | With bitstream compression | 0                        | 20       | MHz               |
|                              |  | During STARTUP phase       | 0                        | 50       | MHz               |
| $\Delta F_{CCSER}$           | Variation from the CCLK output frequency set using the ConfigRate BitGen option                        | Master                     | –50%                     | +50%     | –                 |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 32.
2. For serial configuration with a daisy-chain of multiple FPGAs, the maximum limit is 25 MHz.





DS099-3\_05\_041103

Figure 38: Waveforms for Master and Slave Parallel Configuration

Table 67: Timing for the Master and Slave Parallel Configuration Modes

| Symbol                       | Description  | Slave/<br>Master | All Speed Grades |      | Units |
|------------------------------|--|------------------|------------------|------|-------|
|                              |  |                  | Min              | Max  |       |
| <b>Clock-to-Output Times</b> |  |                  |                  |      |       |
| $T_{SMCKBY}$                 | The time from the rising transition on the CCLK pin to a signal transition at the BUSY pin                         | Slave            | –                | 12.0 | ns    |
| <b>Setup Times</b>           |  |                  |                  |      |       |
| $T_{SMDCC}$                  | The time from the setup of data at the D0-D7 pins to the rising transition at the CCLK pin                         | Both             | 10.0             | –    | ns    |
| $T_{SMCSCC}$                 | The time from the setup of a logic level at the CS_B pin to the rising transition at the CCLK pin                  |                  | 10.0             | –    | ns    |
| $T_{SMCCW}^{(3)}$            | The time from the setup of a logic level at the RDWR_B pin to the rising transition at the CCLK pin                |                  | 10.0             | –    | ns    |
| <b>Hold Times</b>            |  |                  |                  |      |       |
| $T_{SMCCD}$                  | The time from the rising transition at the CCLK pin to the point when data is last held at the D0-D7 pins          | Both             | 0                | –    | 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 CS_B pin   |                  | 0                | –    | ns    |
| $T_{SMWCC}^{(3)}$            | 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    |

Table 67: Timing for the Master and Slave Parallel Configuration Modes (Cont'd)

| Symbol              | Description   |                            | Slave/<br>Master | All Speed Grades                      |          | Units |    |     |
|---------------------|---|----------------------------|------------------|---------------------------------------|----------|-------|----|-----|
|                     |   |                            |                  | Min                                   | Max      |       |    |     |
| <b>Clock Timing</b> |   |                            |                  |                                       |          |       |    |     |
| $T_{CCH}$           | CCLK input pin High pulse width   |                            | Slave            | 5                                     | $\infty$ | ns    |    |     |
| $T_{CCL}$           | CCLK input pin Low pulse width  |                            |                  | 5                                     | $\infty$ | ns    |    |     |
| $F_{CCPAR}$         | Frequency of the clock signal at the CCLK input pin                             | No bitstream compression   | Slave            | Not using the BUSY pin <sup>(4)</sup> |          | 0     | 50 | MHz |
|                     |   |                            |                  | Using the BUSY pin                    |          | 0     | 66 | MHz |
|                     |   | With bitstream compression |                  | 0                                     | 20       | MHz   |    |     |
|                     |   | During STARTUP phase       |                  | 0                                     | 50       | MHz   |    |     |
| $\Delta F_{CCPAR}$  | Variation from the CCLK output frequency set using the BitGen option ConfigRate |                            | Master           | -50%                                  | +50%     | -     |    |     |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in [Table 32](#).
2. Some Xilinx documents may refer to Parallel modes as "SelectMAP" modes.
3. RDWR\_B is synchronized to CCLK for the purpose of performing the Abort operation. The same pin asynchronously controls the driver impedance of the D0 - D7 pins. To avoid contention when writing configuration data to the D0 - D7 bus, do not bring RDWR\_B High when CS\_B is Low.
4. In the Slave Parallel mode, it is necessary to use the BUSY pin when the CCLK frequency exceeds this maximum specification.

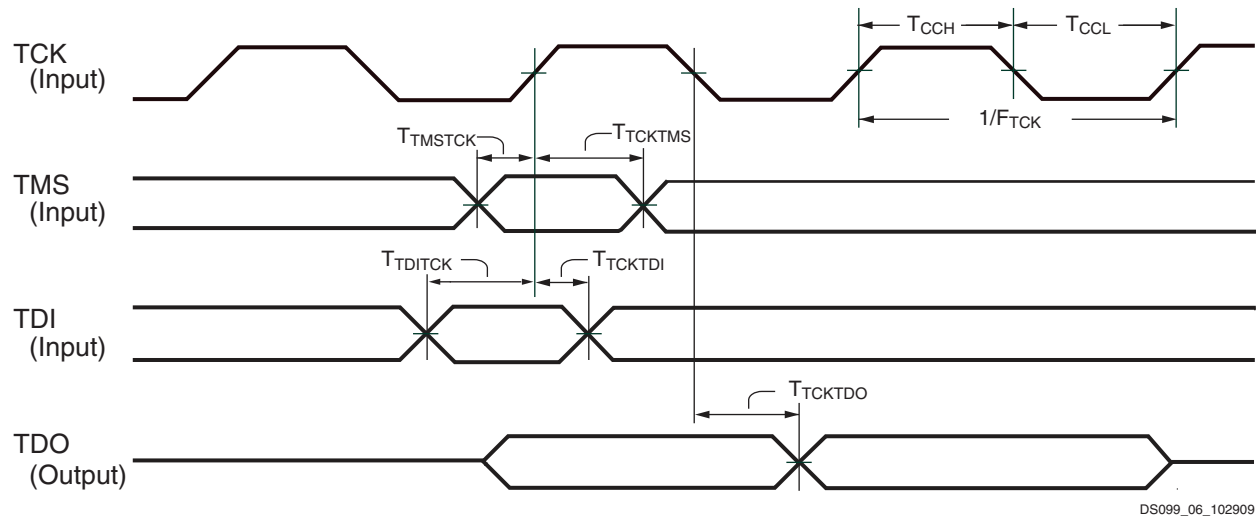


Figure 39: JTAG Waveforms

Table 68: Timing for the JTAG Test Access Port

| Symbol                       | Description  | All Speed Grades   |          | Units |     |
|------------------------------|--|--------------------|----------|-------|-----|
|                              |  | Min                | Max      |       |     |
| <b>Clock-to-Output Times</b> |  |                    |          |       |     |
| $T_{TCKTDO}$                 | The time from the falling transition on the TCK pin to data appearing at the TDO pin                           | 1.0                | 11.0     | ns    |     |
| <b>Setup Times</b>           |  |                    |          |       |     |
| $T_{TDITCK}$                 | The time from the setup of data at the TDI pin to the rising transition at the TCK pin                         | 7.0                | –        | ns    |     |
| $T_{TMSTCK}$                 | The time from the setup of a logic level at the TMS pin to the rising transition at the TCK pin                | 7.0                | –        | ns    |     |
| <b>Hold Times</b>            |  |                    |          |       |     |
| $T_{TCKTDI}$                 | The time from the rising transition at the TCK pin to the point when data is last held at the TDI pin          | 0                  | –        | ns    |     |
| $T_{TCKTMS}$                 | 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    |     |
| <b>Clock Timing</b>          |  |                    |          |       |     |
| $T_{TCKH}$                   | TCK pin High pulse width   | 5                  | $\infty$ | ns    |     |
| $T_{TCKL}$                   | TCK pin Low pulse width  | 5                  | $\infty$ | ns    |     |
| $F_{TCK}$                    | Frequency of the TCK signal  | JTAG Configuration | 0        | 33    | MHz |
|                              |  | Boundary-Scan      | 0        | 25    | MHz |

**Notes:**

1. The numbers in this table are based on the operating conditions set forth in Table 32.

## Revision History

| Date       | Version | Description  |
|------------|---------|--|
| 04/11/2003 | 1.0     | Initial Xilinx release.  |
| 07/11/2003 | 1.1     | Extended Absolute Maximum Rating for junction temperature in <a href="#">Table 28</a> . Added numbers for typical quiescent supply current ( <a href="#">Table 34</a> ) and DLL timing.  |
| 02/06/2004 | 1.2     | Revised $V_{IN}$ maximum rating ( <a href="#">Table 28</a> ). Added power-on requirements ( <a href="#">Table 30</a> ), leakage current number ( <a href="#">Table 33</a> ), and differential output voltage levels ( <a href="#">Table 38</a> ) for Rev. 0. Published new quiescent current numbers ( <a href="#">Table 34</a> ). Updated pull-up and pull-down resistor strengths ( <a href="#">Table 33</a> ). Added LVDCI_DV2 and LVPECL standards ( <a href="#">Table 37</a> and <a href="#">Table 38</a> ). Changed CCLK setup time ( <a href="#">Table 66</a> and <a href="#">Table 67</a> ).   |
| 03/04/2004 | 1.3     | Added timing numbers from v1.29 speed files as well as DCM timing ( <a href="#">Table 58</a> through <a href="#">Table 63</a> ).   |
| 08/24/2004 | 1.4     | Added reference to errata documents on <a href="#">page 49</a> . Clarified Absolute Maximum Ratings and added ESD information ( <a href="#">Table 28</a> ). Explained $V_{CCO}$ ramp time measurement ( <a href="#">Table 30</a> ). Clarified $I_L$ specification ( <a href="#">Table 33</a> ). Updated quiescent current numbers and added information on power-on and surplus current ( <a href="#">Table 34</a> ). Adjusted $V_{REF}$ range for HSTL_III and HSTL_I_18 and changed $V_{IH}$ min for LVCMOS12 ( <a href="#">Table 35</a> ). Added note limiting $V_{TT}$ range for SSTL2-II signal standards ( <a href="#">Table 36</a> ). Calculated $V_{OH}$ and $V_{OL}$ levels for differential standards ( <a href="#">Table 38</a> ). Updated Switching Characteristics with speed file v1.32 ( <a href="#">Table 40</a> through <a href="#">Table 48</a> and <a href="#">Table 51</a> through <a href="#">Table 56</a> ). Corrected IOB test conditions ( <a href="#">Table 41</a> ). Updated DCM timing with latest characterization data ( <a href="#">Table 58</a> through <a href="#">Table 62</a> ). Improved DCM CLKIN pulse width specification ( <a href="#">Table 58</a> ). Recommended use of Virtex-II FPGA Jitter calculator ( <a href="#">Table 61</a> ). Improved DCM PSCLK pulse width specification ( <a href="#">Table 62</a> ). Changed Phase Shifter lock time parameter ( <a href="#">Table 63</a> ). Because the BitGen option Centered_x#_y# is not necessary for Variable Phase Shift mode, removed BitGen command table and referring text. Adjusted maximum CCLK frequency for the slave serial and parallel configuration modes ( <a href="#">Table 66</a> ). Inverted CCLK waveform ( <a href="#">Figure 37</a> ). Adjusted JTAG setup times ( <a href="#">Table 68</a> ). |
| 12/17/2004 | 1.5     | Updated timing parameters to match v1.35 speed file. Improved $V_{CCO}$ ramp time specification ( <a href="#">Table 30</a> ). Added a note limiting the rate of change of $V_{CCAUX}$ ( <a href="#">Table 32</a> ). Added typical quiescent current values for the XC3S2000, XC3S4000, and XC3S5000 ( <a href="#">Table 34</a> ). Increased $I_{OH}$ and $I_{OL}$ for SSTL2-I and SSTL2-II standards ( <a href="#">Table 36</a> ). Added SSO guidelines for the VQ, TQ, and PQ packages as well as edited SSO guidelines for the FT and FG packages ( <a href="#">Table 50</a> ). Added maximum CCLK frequencies for configuration using compressed bitstreams ( <a href="#">Table 66</a> and <a href="#">Table 67</a> ). Added specifications for the HSLVDCI standards ( <a href="#">Table 35</a> , <a href="#">Table 36</a> , <a href="#">Table 44</a> , <a href="#">Table 47</a> , <a href="#">Table 48</a> , and <a href="#">Table 50</a> ).  |
| 08/19/2005 | 1.6     | Updated timing parameters to match v1.37 speed file. All Spartan-3 FPGA part types, except XC3S5000, promoted to Production status. Removed $V_{CCO}$ ramp rate restriction from all mask revision 'E' and later devices ( <a href="#">Table 30</a> ). Added equivalent resistance values for internal pull-up and pull-down resistors ( <a href="#">Table 33</a> ). Added worst-case quiescent current values for XC3S2000, XC3S4000, XC3S5000 ( <a href="#">Table 34</a> ). Added industrial temperature range specification and improved typical quiescent current values ( <a href="#">Table 34</a> ). Improved the DLL minimum clock input frequency specification from 24 MHz down to 18 MHz ( <a href="#">Table 58</a> ). Improved the DFS minimum and maximum clock output frequency specifications ( <a href="#">Table 60</a> , <a href="#">Table 61</a> ). Added new miscellaneous DCM specifications ( <a href="#">Table 64</a> ), primarily affecting Industrial temperature range applications. Updated <a href="#">Simultaneously Switching Output Guidelines</a> and <a href="#">Table 50</a> for QFP packages. Added information on SSTL18_II I/O standard and timing to support DDR2 SDRAM interfaces. Added differential (or complementary single-ended) DIFF_HSTL_II_18 and DIFF_SSTL2_II I/O standards, including DCI terminated versions. Added electro-static discharge (ESD) data for the XC3S2000 and larger FPGAs ( <a href="#">Table 28</a> ). Added link to Spartan-3 FPGA errata notices and how to receive automatic notifications of data sheet or errata changes.   |
| 04/03/2006 | 2.0     | Upgraded Module 3, removing Preliminary status. Moved XC3S5000 to Production status in <a href="#">Table 39</a> . Finalized I/O timing on XC3S5000 for v1.38 speed files. Added minimum timing values for various logic and I/O paths. Corrected labels for $R_{PU}$ and $R_{PD}$ and updated $R_{PD}$ conditions for in <a href="#">Table 33</a> . Added final mask revision 'E' specifications for LVDS_25, RSDS_25, LVDSEXT_25 differential outputs to <a href="#">Table 38</a> . Added BLVDS termination requirements to <a href="#">Figure 34</a> . Improved recommended Simultaneous Switching Outputs (SSOs) limits in <a href="#">Table 50</a> for quad-flat packaged based on silicon testing using devices soldered on a printed circuit board. Updated Note 2 in <a href="#">Table 63</a> . Updated Note 6 in <a href="#">Table 30</a> . Added INIT_B minimum pulse width specification, $T_{INIT}$ , to <a href="#">Table 65</a> .   |
| 04/26/2006 | 2.1     | Updated document links.  |

| Date       | Version | Description  |
|------------|---------|--|
| 05/25/2007 | 2.2     | Improved absolute maximum voltage specifications in <a href="#">Table 28</a> , providing additional overshoot allowance. Improved XC3S50 HBM ESD to 2000V in <a href="#">Table 28</a> . Based on extensive 90 nm production data, improved (reduced) the maximum quiescent current limits for the $I_{CCINTQ}$ and $I_{CCOQ}$ specifications in <a href="#">Table 34</a> . Widened the recommended voltage range for the PCI standard and clarified the hysteresis footnote in <a href="#">Table 35</a> . Noted restriction on combining differential outputs in <a href="#">Table 38</a> . Updated footnote 1 in <a href="#">Table 64</a> .   |
| 11/30/2007 | 2.3     | Updated 3.3V VCCO max from 3.45V to 3.465V in <a href="#">Table 32</a> and elsewhere. Reduced $t_{ICCK}$ minimum from 0.50 $\mu$ s to 0.25 $\mu$ s in <a href="#">Table 65</a> . Updated links to technical documentation.   |
| 06/25/2008 | 2.4     | Clarified dual marking. Added <a href="#">Mask and Fab Revisions</a> . Added references to <a href="#">XAPP459</a> in <a href="#">Table 28</a> and <a href="#">Table 32</a> . Removed absolute minimum and added footnote referring to timing analyzer for minimum delay values. Added HSLVDCI to <a href="#">Table 48</a> and <a href="#">Table 50</a> . Updated $t_{DICK}$ in <a href="#">Table 51</a> to match largest possible value in speed file. Updated formatting and links.  |
| 12/04/2009 | 2.5     | Updated notes 2 and 3 in <a href="#">Table 28</a> . Removed silicon process specific information and revised notes in <a href="#">Table 30</a> . Updated note 3 in <a href="#">Table 32</a> . Updated note 3 in <a href="#">Table 34</a> . Updated note 5 in <a href="#">Table 35</a> . Updated $V_{OL}$ max and $V_{OH}$ min for SSTL2_II in <a href="#">Table 36</a> . Updated note 5 in <a href="#">Table 36</a> . Updated JTAG Waveforms in <a href="#">Figure 39</a> . Updated $V_{ICM}$ max for LVPECL_25 in <a href="#">Table 37</a> . Updated RT and VT for LVDS_25_DCI in <a href="#">Table 48</a> . Updated <a href="#">Simultaneously Switching Output Guidelines</a> . Noted that the CP132 package is being discontinued in <a href="#">Table 49</a> . Removed minimum values for $T_{MULTCK}$ clock-to-output times in <a href="#">Table 54</a> . Updated footnote 3 in <a href="#">Table 58</a> . Removed minimum values for $T_{MULT}$ propagation times in <a href="#">Table 55</a> . Removed silicon process specific information and revised notes in <a href="#">Table 61</a> . Updated <a href="#">Phase Shifter (PS)</a> . |
| 10/29/2012 | 3.0     | Added <a href="#">Notice of Disclaimer</a> . Per <a href="#">XCN07022</a> , updated the discontinued FG1156 and FGG1156 package discussion throughout document. Per <a href="#">XCN08011</a> , updated the discontinued CP132 and CPG132 package discussion throughout document. Revised description of $V_{IN}$ in <a href="#">Table 32</a> and added note 7. Added note 4 to <a href="#">Table 33</a> . This product is not recommended for new designs.   |
| 06/27/2013 | 3.1     | Removed banner. This product IS recommended for new designs.   |

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## Introduction

This data sheet module describes the various pins on a Spartan®-3 FPGA and how they connect to the supported component packages.

- The [Pin Types](#) section categorizes all of the FPGA pins by their function type.
- The [Pin Definitions](#) section provides a top-level description for each pin on the device.
- The [Detailed, Functional Pin Descriptions](#) section offers significantly more detail about each pin, especially for the dual- or special-function pins used during device configuration.
- Some pins have associated behavior that is controlled by settings in the configuration bitstream. These options are described in the [Bitstream Options](#) section.
- The [Package Overview](#) section describes the various packaging options available for Spartan-3 FPGAs. Detailed pin list tables and footprint diagrams are provided for each package solution.

## Pin Descriptions

### Pin Types

A majority of the pins on a Spartan-3 FPGA are general-purpose, user-defined I/O pins. There are, however, up to 12 different functional types of pins on Spartan-3 device packages, as outlined in [Table 69](#). In the package footprint drawings that follow, the individual pins are color-coded according to pin type as in the table.

*Table 69: Types of Pins on Spartan-3 FPGAs*

| Pin Type/<br>Color Code | Description  | Pin Name   |
|-------------------------|--|--|
| I/O                     | Unrestricted, general-purpose user-I/O pin. Most pins can be paired together to form differential I/Os.  | IO,<br>IO_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. There are 12 dual-purpose configuration pins on every package. The INIT_B pin has an internal pull-up resistor to VCCO_4 or VCCO_BOTTOM during configuration. | IO_Lxxy_#/DIN/D0, IO_Lxxy_#/D1,<br>IO_Lxxy_#/D2, IO_Lxxy_#/D3,<br>IO_Lxxy_#/D4, IO_Lxxy_#/D5,<br>IO_Lxxy_#/D6, IO_Lxxy_#/D7,<br>IO_Lxxy_#/CS_B,<br>IO_Lxxy_#/RDWR_B,<br>IO_Lxxy_#/BUSY/DOUT,<br>IO_Lxxy_#/INIT_B |
| CONFIG                  | Dedicated configuration pin. Not available as a user-I/O pin. Every package has seven dedicated configuration pins. These pins are powered by VCCAUX and have a dedicated internal pull-up resistor to VCCAUX during configuration.  | CCLK, DONE, M2, M1, M0,<br>PROG_B, HSWAP_EN  |
| JTAG                    | Dedicated JTAG pin. Not available as a user-I/O pin. Every package has four dedicated JTAG pins. These pins are powered by VCCAUX and have a dedicated internal pull-up resistor to VCCAUX during configuration.   | TDI, TMS, TCK, TDO   |
| DCI                     | Dual-purpose pin that is either a user-I/O pin or used to calibrate output buffer impedance for a specific bank using Digital Controlled Impedance (DCI). There are two DCI pins per I/O bank.   | IO/VRN_#<br>IO_Lxxy_#/VRN_#<br>IO/VRP_#<br>IO_Lxxy_#/VRP_#   |

Table 69: Types of Pins on Spartan-3 FPGAs (Cont'd)

| Pin Type/<br>Color Code | Description   | Pin Name  |
|-------------------------|---|---|
| VREF                    | Dual-purpose pin that is either a user-I/O 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. | IO/VREF_#<br>IO_Lxy_#/VREF_#  |
| 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 to +2.5V.  | 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                    | Dedicated I/O bank, output buffer power supply pin. Along with 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.                                   | VCCO_#<br><b>CP132 and TQ144 Packages Only:</b><br>VCCO_LEFT, VCCO_TOP,<br>VCCO_RIGHT, VCCO_BOTTOM  |
| GCLK                    | Dual-purpose pin that is either a user-I/O pin or an input to a specific global buffer input. Every package has eight dedicated GCLK pins.  | IO_Lxy_#/GCLK0,<br>IO_Lxy_#/GCLK1,<br>IO_Lxy_#/GCLK2,<br>IO_Lxy_#/GCLK3,<br>IO_Lxy_#/GCLK4,<br>IO_Lxy_#/GCLK5,<br>IO_Lxy_#/GCLK6,<br>IO_Lxy_#/GCLK7 |
| 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:**

- # = I/O bank number, an integer between 0 and 7.

I/Os with Lxy\_# are part of a differential output pair. 'L' indicates differential output capability. The "xx" field is a two-digit integer, unique to each bank that identifies a differential pin-pair. The 'y' field is either 'P' for the true signal or 'N' for the inverted signal in the differential pair. The '#' field is the I/O bank number.

**Pin Definitions**

Table 70 provides a brief description of each pin listed in the Spartan-3 FPGA pinout tables and package footprint diagrams. Pins are categorized by their pin type, as listed in Table 69. See Detailed, Functional Pin Descriptions for more information.



Table 70: Spartan-3 FPGA Pin Definitions

| Pin Name  | Direction   | Description   |
|---|---|---|
| <b>I/O: General-purpose I/O pins</b>  |   |   |
| I/O   | User-defined as input, output, bidirectional, three-state output, open-drain output, open-source output   | <b>User I/O:</b><br>Unrestricted single-ended user-I/O pin. Supports all I/O standards except the differential standards.   |
| I/O_Lxxy_#  | User-defined as input, output, bidirectional, three-state output, open-drain output, open-source output   | <b>User I/O, Half of Differential Pair:</b><br>Unrestricted single-ended user-I/O pin or half of a differential pair. Supports all I/O standards including the differential standards.  |
| <b>DUAL: Dual-purpose configuration pins</b>  |   |   |
| IO_Lxxy_#/DIN/D0,<br>IO_Lxxy_#/D1,<br>IO_Lxxy_#/D2,<br>IO_Lxxy_#/D3,<br>IO_Lxxy_#/D4,<br>IO_Lxxy_#/D5,<br>IO_Lxxy_#/D6,<br>IO_Lxxy_#/D7 | Input during configuration<br>Possible bidirectional I/O after configuration if SelectMap port is retained<br>Otherwise, user I/O after configuration   | <b>Configuration Data Port:</b><br>In Parallel (SelectMAP) modes, D0-D7 are byte-wide configuration data pins. These pins become user I/Os after configuration unless the SelectMAP port is retained via the Persist bitstream option.<br>In Serial modes, DIN (D0) serves as the single configuration data input. This pin becomes a user I/O after configuration unless retained by the Persist bitstream option.   |
| IO_Lxxy_#/CS_B  | Input during Parallel mode configuration<br>Possible input after configuration if SelectMap port is retained<br>Otherwise, user I/O after configuration | <b>Chip Select for Parallel Mode Configuration:</b><br>In Parallel (SelectMAP) modes, this is the active-Low Chip Select signal. This pin becomes a user I/O after configuration unless the SelectMAP port is retained via the Persist bitstream option.  |
| IO_Lxxy_#/RDWR_B  | Input during Parallel mode configuration<br>Possible input after configuration if SelectMap port is retained<br>Otherwise, user I/O after configuration | <b>Read/Write Control for Parallel Mode Configuration:</b><br>In Parallel (SelectMAP) modes, this is the active-Low Write Enable, active-High Read Enable signal. This pin becomes a user I/O after configuration unless the SelectMAP port is retained via the Persist bitstream option.   |
| IO_Lxxy_#/<br>BUSY/DOUT   | Output during configuration<br>Possible output after configuration if SelectMap port is retained<br>Otherwise, user I/O after configuration             | <b>Configuration Data Rate Control for Parallel Mode, Serial Data Output for Serial Mode:</b><br>In Parallel (SelectMAP) modes, BUSY throttles the rate at which configuration data is loaded. This pin becomes a user I/O after configuration unless the SelectMAP port is retained via the Persist bitstream option.<br>In Serial modes, DOUT provides preamble and configuration data to downstream devices in a multi-FPGA daisy-chain. This pin becomes a user I/O after configuration.  |
| IO_Lxxy_#/INIT_B  | Bidirectional (open-drain) during configuration<br>User I/O after configuration   | <b>Initializing Configuration Memory/Detected Configuration Error:</b><br>When Low, this pin indicates that configuration memory is being cleared. When held Low, this pin delays the start of configuration. After this pin is released or configuration memory is cleared, the pin goes High. During configuration, a Low on this output indicates that a configuration data error occurred. This pin always has an internal pull-up resistor to VCCO_4 or VCCO_BOTTOM during configuration, regardless of the HSWAP_EN pin. This pin becomes a user I/O after configuration. |
| <b>DCI: Digitally Controlled Impedance reference resistor input pins</b>  |   |   |
| IO_Lxxy_#/VRN_# or<br>IO/VRN_#  | Input when using DCI<br>Otherwise, same as I/O  | <b>DCI Reference Resistor for NMOS I/O Transistor (per bank):</b><br>If using DCI, a 1% precision impedance-matching resistor is connected between this pin and the VCCO supply for this bank. Otherwise, this pin is a user I/O.   |
| IO_Lxxy_#/VRP_# or<br>IO/VRP_#  | Input when using DCI<br>Otherwise, same as I/O  | <b>DCI Reference Resistor for PMOS I/O Transistor (per bank):</b><br>If using DCI, a 1% precision impedance-matching resistor is connected between this pin and the ground supply. Otherwise, this pin is a user I/O.   |

Table 70: Spartan-3 FPGA Pin Definitions (Cont'd)

| Pin Name  | Direction   | Description   |
|---|---|---|
| <b>GCLK: Global clock buffer inputs</b>   |   |   |
| IO_Lxy_#/GCLK0,<br>IO_Lxy_#/GCLK1,<br>IO_Lxy_#/GCLK2,<br>IO_Lxy_#/GCLK3,<br>IO_Lxy_#/GCLK4,<br>IO_Lxy_#/GCLK5,<br>IO_Lxy_#/GCLK6,<br>IO_Lxy_#/GCLK7 | Input if connected to global clock buffers<br>Otherwise, same as I/O                  | <b>Global Buffer Input:</b><br>Direct input to a low-skew global clock buffer. If not connected to a global clock buffer, this pin is a user I/O.   |
| <b>VREF: I/O bank input reference voltage pins</b>  |   |   |
| IO_Lxy_#/VREF_# or<br>IO/VREF_#   | Voltage supply input when VREF pins are used within a bank.<br>Otherwise, same as I/O | <b>Input Buffer Reference Voltage for Special I/O Standards (per bank):</b><br>If required to support special I/O standards, all the VREF pins within a bank connect to an input threshold voltage source.<br>If not used as input reference voltage pins, these pins are available as individual user-I/O pins.  |
| <b>CONFIG: Dedicated configuration pins (pull-up resistor to VCCAUX always active during configuration, regardless of HSWAP_EN pin)</b>             |   |   |
| CCLK  | Input in Slave configuration modes<br>Output in Master configuration modes            | <b>Configuration Clock:</b><br>The configuration clock signal synchronizes configuration data. This pin has an internal pull-up resistor to VCCAUX during configuration.  |
| PROG_B  | Input   | <b>Program/Configure Device:</b><br>Active Low asynchronous reset to configuration logic. Asserting PROG_B Low for an extended period delays the configuration process. This pin has an internal pull-up resistor to VCCAUX during configuration.   |
| DONE  | Bidirectional with open-drain or totem-pole Output                                    | <b>Configuration Done, Delay Start-up Sequence:</b><br>A Low-to-High output transition on this bidirectional pin signals the end of the configuration process.<br>The FPGA produces a Low-to-High transition on this pin to indicate that the configuration process is complete. The DriveDone bitstream generation option defines whether this pin functions as a totem-pole output that actively drives High or as an open-drain output. An open-drain output requires a pull-up resistor to produce a High logic level. The open-drain option permits the DONE lines of multiple FPGAs to be tied together, so that the common node transitions High only after all of the FPGAs have completed configuration. Externally holding the open-drain output Low delays the start-up sequence, which marks the transition to user mode. |
| M0, M1, M2  | Input   | <b>Configuration Mode Selection:</b><br>These inputs select the configuration mode. The logic levels applied to the mode pins are sampled on the rising edge of INIT_B. See Table 75. These pins have an internal pull-up resistor to VCCAUX during configuration, making Slave Serial the default configuration mode.  |
| HSWAP_EN  | Input   | <b>Disable Pull-up Resistors During Configuration:</b><br>A Low on this pin enables pull-up resistors on all pins that are not actively involved in the configuration process. A High value disables all pull-ups, allowing the non-configuration pins to float.  |
| <b>JTAG: JTAG interface pins (pull-up resistor to VCCAUX always active during configuration, regardless of HSWAP_EN pin)</b>                        |   |   |
| TCK   | Input   | <b>JTAG Test Clock:</b><br>The TCK clock signal synchronizes all JTAG port operations. This pin has an internal pull-up resistor to VCCAUX during configuration.  |

Table 70: Spartan-3 FPGA Pin Definitions (Cont'd)

| Pin Name   | Direction | Description   |
|--|-----------|---|
| TDI  | Input     | <b>JTAG Test Data Input:</b><br>TDI is the serial data input for all JTAG instruction and data registers. This pin has an internal pull-up resistor to VCCAUX during configuration.   |
| TMS  | Input     | <b>JTAG Test Mode Select:</b><br>The serial TMS input controls the operation of the JTAG port. This pin has an internal pull-up resistor to VCCAUX during configuration.  |
| TDO  | Output    | <b>JTAG Test Data Output:</b><br>TDO is the serial data output for all JTAG instruction and data registers. This pin has an internal pull-up resistor to VCCAUX during configuration.   |
| <b>VCCO: I/O bank output voltage supply pins</b> |           |   |
| VCCO_#   | Supply    | <b>Power Supply for Output Buffer Drivers (per bank):</b><br>These pins power the output drivers within a specific I/O bank.  |
| <b>VCCAUX: Auxiliary voltage supply pins</b>     |           |   |
| VCCAUX   | Supply    | <b>Power Supply for Auxiliary Circuits:</b><br>+2.5V power pins for auxiliary circuits, including the Digital Clock Managers (DCMs), the dedicated configuration pins (CONFIG), and the dedicated JTAG pins. All VCCAUX pins must be connected. |
| <b>VCCINT: Internal core voltage supply pins</b> |           |   |
| VCCINT   | Supply    | <b>Power Supply for Internal Core Logic:</b><br>+1.2V power pins for the internal logic. All pins must be connected.  |
| <b>GND: Ground supply pins</b>                   |           |   |
| GND  | Supply    | <b>Ground:</b><br>Ground pins, which are connected to the power supply's return path. All pins must be connected.   |
| <b>N.C.: Unconnected package pins</b>            |           |   |
| N.C.   |           | <b>Unconnected Package Pin:</b><br>These package pins are unconnected.  |

**Notes:**

- All unused inputs and bidirectional pins must be tied either High or Low. For unused enable inputs, apply the level that disables the associated function. One common approach is to activate internal pull-up or pull-down resistors. An alternative approach is to externally connect the pin to either VCCO or GND.
- All outputs are of the totem-pole type — i.e., they can drive High as well as Low logic levels — except for the cases where “Open Drain” is indicated. The latter can only drive a Low logic level and require a pull-up resistor to produce a High logic level.

## Detailed, Functional Pin Descriptions

### I/O Type: Unrestricted, General-purpose I/O Pins

After configuration, I/O-type pins are inputs, outputs, bidirectional I/O, three-state outputs, open-drain outputs, or open-source outputs, as defined in the application

Pins labeled "IO" support all SelectIO™ interface signal standards except differential standards. A given device at most only has a few of these pins.

A majority of the general-purpose I/O pins are labeled in the format “IO\_Lxxy\_#”. These pins support all SelectIO signal standards, including the differential standards such as LVDS, ULVDS, BLVDS, RSDS, or LDT.

For additional information, see [IOBs, page 10](#)

## Differential Pair Labeling

A pin supports differential standards if the pin is labeled in the format “L<sub>xy</sub>\_#”. The pin name suffix has the following significance. [Figure 40](#) provides a specific example showing a differential input to and a differential output from Bank 2.

- ‘L’ indicates differential capability.
- “xx” is a two-digit integer, unique for each bank, that identifies a differential pin-pair.
- ‘y’ is replaced by ‘P’ for the true signal or ‘N’ for the inverted. These two pins form one differential pin-pair.
- ‘#’ is an integer, 0 through 7, indicating the associated I/O bank.

If unused, these pins are in a high impedance state. The Bitstream generator option UnusedPin enables a pull-up or pull-down resistor on all unused I/O pins.

## Behavior from Power-On through End of Configuration

During the configuration process, all pins that are not actively involved in the configuration process are in a high-impedance state. The CONFIG- and JTAG-type pins have an internal pull-up resistor to VCCAUX during configuration. For all other I/O pins, the HSWAP\_EN input determines whether or not pull-up resistors are activated during configuration. HSWAP\_EN = 0 enables the pull-up resistors. HSWAP\_EN = 1 disables the pull-up resistors allowing the pins to float, which is the desired state for hot-swap applications.

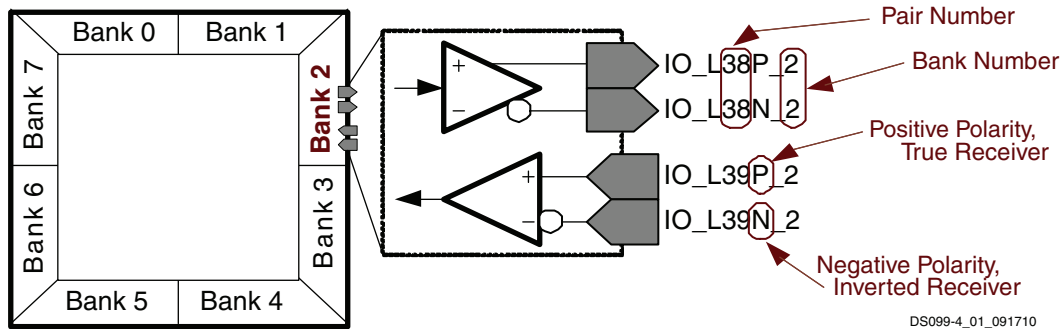


Figure 40: Differential Pair Labelling

## DUAL Type: Dual-Purpose Configuration and I/O Pins

These pins serve dual purposes. The user-I/O pins are temporarily borrowed during the configuration process to load configuration data into the FPGA. After configuration, these pins are then usually available as a user I/O in the application. If a pin is not applicable to the specific configuration mode—controlled by the mode select pins M2, M1, and M0—then the pin behaves as an I/O-type pin.

There are 12 dual-purpose configuration pins on every package, six of which are part of I/O Bank 4, the other six part of I/O Bank 5. Only a few of the pins in Bank 4 are used in the Serial configuration modes.

See [Pin Behavior During Configuration, page 122](#).

## Serial Configuration Modes

This section describes the dual-purpose pins used during either Master or Slave Serial mode. See [Table 75](#) for Mode Select pin settings required for Serial modes. All such pins are in Bank 4 and powered by VCCO\_4.

In both the Master and Slave Serial modes, DIN is the serial configuration data input. The D1-D7 inputs are unused in serial mode and behave like general-purpose I/O pins.

In all the cases, the configuration data is synchronized to the rising edge of the CCLK clock signal.

The DIN, DOUT, and INIT\_B pins can be retained in the application to support reconfiguration by setting the Persist bitstream generation option. However, the serial modes do not support device readback.

Table 71: Dual-Purpose Pins Used in Master or Slave Serial Mode

| Pin Name | Direction                  | Description  |
|----------|----------------------------|--|
| DIN      | Input                      | <b>Serial Data Input:</b><br>During the Master or Slave Serial configuration modes, DIN is the serial configuration data input, and all data is synchronized to the rising CCLK edge. After configuration, this pin is available as a user I/O. This signal is located in Bank 4 and its output voltage determined by VCCO_4.<br>The BitGen option <i>Persist</i> permits this pin to retain its configuration function in the User mode.  |
| DOUT     | Output                     | <b>Serial Data Output:</b><br>In a multi-FPGA design where all the FPGAs use serial mode, connect the DOUT output of one FPGA—in either Master or Slave Serial mode—to the DIN input of the next FPGA—in Slave Serial mode—so that configuration data passes from one to the next, in daisy-chain fashion. This “daisy chain” permits sequential configuration of multiple FPGAs.<br>This signal is located in Bank 4 and its output voltage determined by VCCO_4.<br>The BitGen option <i>Persist</i> permits this pin to retain its configuration function in the User mode.   |
| INIT_B   | Bidirectional (open-drain) | <b>Initializing Configuration Memory/Configuration Error:</b><br>Just after power is applied, the FPGA produces a Low-to-High transition on this pin indicating that initialization ( <i>i.e.</i> , clearing) of the configuration memory has finished. Before entering the User mode, this pin functions as an open-drain output, which requires a pull-up resistor in order to produce a High logic level. In a multi-FPGA design, tie (wire AND) the INIT_B pins from all FPGAs together so that the common node transitions High only after all of the FPGAs have been successfully initialized.<br>Externally holding this pin Low beyond the initialization phase delays the start of configuration. This action stalls the FPGA at the configuration step just before the mode select pins are sampled.<br>During configuration, the FPGA indicates the occurrence of a data ( <i>i.e.</i> , CRC) error by asserting INIT_B Low.<br>This signal is located in Bank 4 and its output voltage determined by VCCO_4.<br>The BitGen option <i>Persist</i> permits this pin to retain its configuration function in the User mode. |

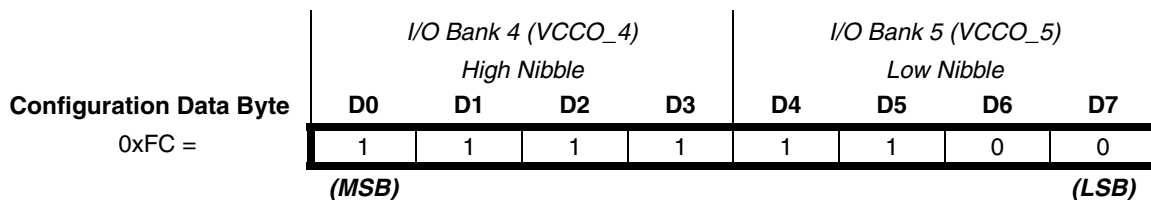


Figure 41: Configuration Data Byte Mapping to D0-D7 Bits

### Parallel Configuration Modes (SelectMAP)

This section describes the dual-purpose configuration pins used during the Master and Slave Parallel configuration modes, sometimes also called the SelectMAP modes. In both Master and Slave Parallel configuration modes, D0-D7 form the byte-wide configuration data input. See Table 75 for Mode Select pin settings required for Parallel modes.

As shown in Figure 41, D0 is the most-significant bit while D7 is the least-significant bit. Bits D0-D3 form the high nibble of the byte and bits D4-D7 form the low nibble.

In the Parallel configuration modes, both the VCCO\_4 and VCCO\_5 voltage supplies are required and must both equal the voltage of the attached configuration device, typically either 2.5V or 3.3V.

Assert Low both the chip-select pin, CS\_B, and the read/write control pin, RDWR\_B, to write the configuration data byte presented on the D0-D7 pins to the FPGA on a rising-edge of the configuration clock, CCLK. The order of CS\_B and RDWR\_B does not matter, although RDWR\_B must be asserted throughout the configuration process. If RDWR\_B is de-asserted during configuration, the FPGA aborts the configuration operation.

After configuration, these pins are available as general-purpose user I/O. However, the SelectMAP configuration interface is optionally available for debugging and dynamic reconfiguration. To use these SelectMAP pins after configuration, set the Persist bitstream generation option.

The Readback debugging option, for example, requires the Persist bitstream generation option. During Readback mode, assert CS\_B Low, along with RDWR\_B High, to read a configuration data byte from the FPGA to the D0-D7 bus on a rising CCLK edge. During Readback mode, D0-D7 are output pins.

In all the cases, the configuration data and control signals are synchronized to the rising edge of the CCLK clock signal.

Table 72: Dual-Purpose Configuration Pins for Parallel (SelectMAP) Configuration Modes

| Pin Name       | Direction  | Description  |        |          |   |  |   |  |
|----------------|--|--|--------|----------|---|--|---|--|
| D0, D1, D2, D3 | <ul style="list-style-type: none"> <li>Input during configuration</li> <li>Output during readback</li> </ul>                         | <p><b>Configuration Data Port (high nibble):</b><br/>Collectively, the D0-D7 pins are the byte-wide configuration data port for the Parallel (SelectMAP) configuration modes. Configuration data is synchronized to the rising edge of CCLK clock signal. The D0-D3 pins are the high nibble of the configuration data byte and located in Bank 4 and powered by VCCO_4. The BitGen option Persist permits this pin to retain its configuration function in the User mode.</p>   |        |          |   |  |   |  |
| D4, D5, D6, D7 | <ul style="list-style-type: none"> <li>Input during configuration</li> <li>Output during readback</li> </ul>                         | <p><b>Configuration Data Port (low nibble):</b><br/>The D4-D7 pins are the low nibble of the configuration data byte. However, these signals are located in Bank 5 and powered by VCCO_5. The BitGen option Persist permits this pin to retain its configuration function in the User mode.</p>  |        |          |   |  |   |  |
| CS_B           | Input  | <p><b>Chip Select for Parallel Mode Configuration:</b><br/>Assert this pin Low, together with RDWR_B to write a configuration data byte from the D0-D7 bus to the FPGA on a rising CCLK edge.<br/>During Readback, assert this pin Low, along with RDWR_B High, to read a configuration data byte from the FPGA to the D0-D7 bus on a rising CCLK edge.<br/>This signal is located in Bank 5 and powered by VCCO_5.<br/>The BitGen option Persist permits this pin to retain its configuration function in the User mode.</p> <table border="1"> <thead> <tr> <th>CS_B</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>FPGA selected. SelectMAP inputs are valid on the next rising edge of CCLK.</td> </tr> <tr> <td>1</td> <td>FPGA deselected. All SelectMAP inputs are ignored.</td> </tr> </tbody> </table>   | CS_B   | Function | 0 | FPGA selected. SelectMAP inputs are valid on the next rising edge of CCLK. | 1 | FPGA deselected. All SelectMAP inputs are ignored.   |
| CS_B           | Function   |  |        |          |   |  |   |  |
| 0              | FPGA selected. SelectMAP inputs are valid on the next rising edge of CCLK.   |  |        |          |   |  |   |  |
| 1              | FPGA deselected. All SelectMAP inputs are ignored.   |  |        |          |   |  |   |  |
| RDWR_B         | Input  | <p><b>Read/Write Control for Parallel Mode Configuration:</b><br/>In Master and Slave Parallel modes, assert this pin Low together with CS_B to write a configuration data byte from the D0-D7 bus to the FPGA on a rising CCLK edge. Once asserted during configuration, RDWR_B must remain asserted until configuration is complete.<br/>During Readback, assert this pin High with CS_B Low to read a configuration data byte from the FPGA to the D0-D7 bus on a rising CCLK edge.<br/>This signal is located in Bank 5 and powered by VCCO_5.<br/>The BitGen option Persist permits this pin to retain its configuration function in the User mode.</p> <table border="1"> <thead> <tr> <th>RDWR_B</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>If CS_B is Low, then load (write) configuration data to the FPGA.</td> </tr> <tr> <td>1</td> <td>This option is valid only if the Persist bitstream option is set to Yes. If CS_B is Low, then read configuration data from the FPGA.</td> </tr> </tbody> </table> | RDWR_B | Function | 0 | If CS_B is Low, then load (write) configuration data to the FPGA.          | 1 | This option is valid only if the Persist bitstream option is set to Yes. If CS_B is Low, then read configuration data from the FPGA. |
| RDWR_B         | Function   |  |        |          |   |  |   |  |
| 0              | If CS_B is Low, then load (write) configuration data to the FPGA.  |  |        |          |   |  |   |  |
| 1              | This option is valid only if the Persist bitstream option is set to Yes. If CS_B is Low, then read configuration data from the FPGA. |  |        |          |   |  |   |  |



Table 72: Dual-Purpose Configuration Pins for Parallel (SelectMAP) Configuration Modes (Cont'd)

| Pin Name | Direction   | Description  |      |          |   |   |   |   |      |   |
|----------|---|--|------|----------|---|---|---|---|------|---|
| BUSY     | Output  | <p><b>Configuration Data Rate Control for Parallel Mode:</b><br/>           In the Slave and Master Parallel modes, BUSY throttles the rate at which configuration data is loaded. BUSY is only necessary if CCLK operates at greater than 50 MHz. Ignore BUSY for frequencies of 50 MHz and below.</p> <p>When BUSY is Low, the FPGA accepts the next configuration data byte on the next rising CCLK edge for which CS_B and RDWR_B are Low. When BUSY is High, the FPGA ignores the next configuration data byte. The next configuration data value must be held or reloaded until the next rising CCLK edge when BUSY is Low. When CS_B is High, BUSY is in a high impedance state.</p> <table border="1"> <thead> <tr> <th>BUSY</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>The FPGA is ready to accept the next configuration data byte.</td> </tr> <tr> <td>1</td> <td>The FPGA is busy processing the current configuration data byte and is not ready to accept the next byte.</td> </tr> <tr> <td>Hi-Z</td> <td>If CS_B is High, then BUSY is high impedance.</td> </tr> </tbody> </table> <p>This signal is located in Bank 4 and its output voltage is determined by VCCO_4. The BitGen option Persist permits this pin to retain its configuration function in the User mode.</p> | BUSY | Function | 0 | The FPGA is ready to accept the next configuration data byte. | 1 | The FPGA is busy processing the current configuration data byte and is not ready to accept the next byte. | Hi-Z | If CS_B is High, then BUSY is high impedance. |
| BUSY     | Function  |  |      |          |   |   |   |   |      |   |
| 0        | The FPGA is ready to accept the next configuration data byte.   |  |      |          |   |   |   |   |      |   |
| 1        | The FPGA is busy processing the current configuration data byte and is not ready to accept the next byte. |  |      |          |   |   |   |   |      |   |
| Hi-Z     | If CS_B is High, then BUSY is high impedance.   |  |      |          |   |   |   |   |      |   |
| INIT_B   | Bidirectional (open-drain)  | <p><b>Initializing Configuration Memory/Configuration Error (active-Low):</b><br/>           See description under <a href="#">Serial Configuration Modes, page 112</a>.</p>   |      |          |   |   |   |   |      |   |

## JTAG Configuration Mode

In the JTAG configuration mode all dual-purpose configuration pins are unused and behave exactly like user-I/O pins, as shown in [Table 79](#). See [Table 75](#) for Mode Select pin settings required for JTAG mode.

## Dual-Purpose Pin I/O Standard During Configuration

During configuration, the dual-purpose pins default to CMOS input and output levels for the associated VCCO voltage supply pins. For example, in the Parallel configuration modes, both VCCO\_4 and VCCO\_5 are required. If connected to +2.5V, then the associated pins conform to the LVCMOS25 I/O standard. If connected to +3.3V, then the pins drive LVCMOS output levels and accept either LVTTTL or LVCMOS input levels.

## Dual-Purpose Pin Behavior After Configuration

After the configuration process completes, these pins, if they were borrowed during configuration, become user-I/O pins available to the application. If a dual-purpose configuration pin is not used during the configuration process—*i.e.*, the parallel configuration pins when using serial mode—then the pin behaves exactly like a general-purpose I/O. See [I/O Type: Unrestricted, General-purpose I/O Pins](#) section.

## DCI: User I/O or Digitally Controlled Impedance Resistor Reference Input

These pins are individual user-I/O pins unless one of the I/O standards used in the bank requires the Digitally Controlled Impedance (DCI) feature. If DCI is used, then 1% precision resistors connected to the VRP\_# and VRN\_# pins match the impedance on the input or output buffers of the I/O standards that use DCI within the bank. The '#' character in the pin name indicates the associated I/O bank and is an integer, 0 through 7.

There are two DCI pins per I/O bank, except in the CP132 and TQ144 packages, which do not have any DCI inputs for Bank 5.

## VRP and VRN Impedance Resistor Reference Inputs

The 1% precision impedance-matching resistor attached to the VRP\_# pin controls the pull-up impedance of PMOS transistor in the input or output buffer. Consequently, the VRP\_# pin must connect to ground. The 'P' character in "VRP" indicates that this pin controls the I/O buffer's PMOS transistor impedance. The VRP\_# pin is used for both single and split termination.

The 1% precision impedance-matching resistor attached to the VRN\_# pin controls the pull-down impedance of NMOS transistor in the input or output buffer. Consequently, the VRN\_# pin must connect to VCCO. The ‘N’ character in “VRN” indicates that this pin controls the I/O buffer’s NMOS transistor impedance. The VRN\_# pin is only used for split termination.

Each VRN or VRP reference input requires its own resistor. A single resistor cannot be shared between VRN or VRP pins associated with different banks.

During configuration, these pins behave exactly like user-I/O pins. The associated DCI behavior is not active or valid until after configuration completes.

Also see [Digitally Controlled Impedance \(DCI\), page 16](#).

### DCI Termination Types

If the I/O in an I/O bank do not use the DCI feature, then no external resistors are required and both the VRP\_# and VRN\_# pins are available for user I/O, as shown in section [a] of [Figure 42](#).

If the I/O standards within the associated I/O bank require single termination—such as GTL\_DCI, GTLP\_DCI, or HSTL\_III\_DCI—then only the VRP\_# signal connects to a 1% precision impedance-matching resistor, as shown in section [b] of [Figure 42](#). A resistor is not required for the VRN\_# pin.

Finally, if the I/O standards with the associated I/O bank require split termination—such as HSTL\_I\_DCI, SSTL2\_I\_DCI, SSTL2\_II\_DCI, or LVDS\_25\_DCI and LVDSEXT\_25\_DCI receivers—then both the VRP\_# and VRN\_# pins connect to separate 1% precision impedance-matching resistors, as shown in section [c] of [Figure 42](#). Neither pin is available for user I/O.

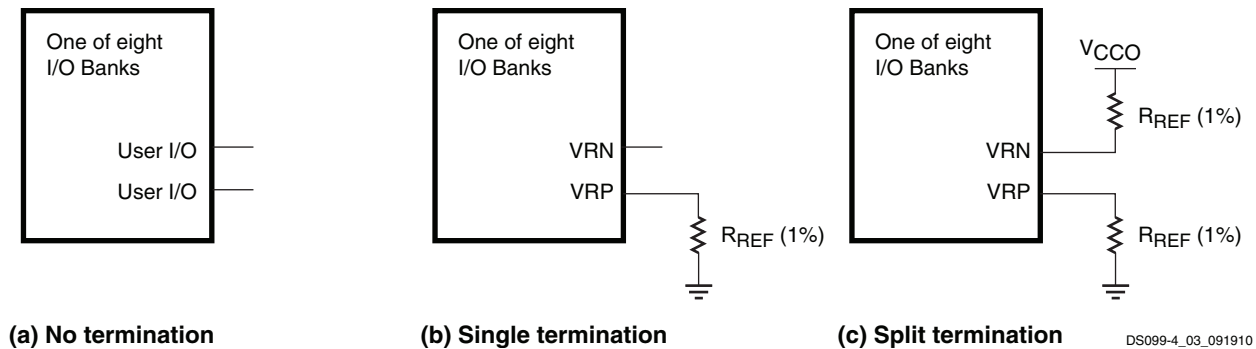


Figure 42: DCI Termination Types

### GCLK: Global Clock Buffer Inputs or General-Purpose I/O Pins

These pins are user-I/O pins unless they specifically connect to one of the eight low-skew global clock buffers on the device, specified using the IBUFG primitive.

There are eight GCLK pins per device and two each appear in the top-edge banks, Bank 0 and 1, and the bottom-edge banks, Banks 4 and 5. See [Figure 40](#) for a picture of bank labeling.

During configuration, these pins behave exactly like user-I/O pins.

Also see [Global Clock Network, page 42](#).

### CONFIG: Dedicated Configuration Pins

The dedicated configuration pins control the configuration process and are not available as user-I/O pins. Every package has seven dedicated configuration pins. All CONFIG-type pins are powered by the +2.5V VCCAUX supply.

Also see [Configuration, page 46](#).



## CCLK: Configuration Clock

The configuration clock signal on this pin synchronizes the reading or writing of configuration data. The CCLK pin is an input-only pin for the Slave Serial and Slave Parallel configuration modes. In the Master Serial and Master Parallel configuration modes, the FPGA drives the CCLK pin and CCLK should be treated as a full bidirectional I/O pin for signal integrity analysis.

Although the CCLK frequency is relatively low, Spartan-3 FPGA output edge rates are fast. Any potential signal integrity problems on the CCLK board trace can cause FPGA configuration to fail. Therefore, pay careful attention to the CCLK signal integrity on the printed circuit board. Signal integrity simulation with IBIS is recommended. For all configuration modes except JTAG, consider the signal integrity at every CCLK trace destination, including the FPGA's CCLK pin. For more details on CCLK design considerations, see Chapter 2 of [UG332, Spartan-3 Generation Configuration User Guide](#).

During configuration, the CCLK pin has a pull-up resistor to VCCAUX, regardless of the HSWAP\_EN pin. After configuration, the CCLK pin is pulled High to VCCAUX by default as defined by the **CclkPin** bitstream selection, although this behavior is programmable. Any clocks applied to CCLK after configuration are ignored unless the bitstream option **Persist** is set to **Yes**, which retains the configuration interface. **Persist** is set to **No** by default. However, if **Persist** is set to **Yes**, then all clock edges are potentially active events, depending on the other configuration control signals.



The bitstream generator option **ConfigRate** determines the frequency of the internally-generated CCLK oscillator required for the Master configuration modes. The actual frequency is approximate due to the characteristics of the silicon oscillator and varies by up to 50% over the temperature and voltage range. By default, CCLK operates at approximately 6 MHz. Via the **ConfigRate** option, the oscillator frequency is set at approximately 3, 6, 12, 25, or 50 MHz. At power-on, CCLK always starts operation at its lowest frequency. The device does not start operating at the higher frequency until the ConfigRate control bits are loaded during the configuration process.

## PROG\_B: Program/Configure Device

This asynchronous pin initiates the configuration or re-configuration processes. A Low-going pulse resets the configuration logic, initializing the configuration memory. This initialization process cannot finish until PROG\_B returns High. Asserting PROG\_B Low for an extended period delays the configuration process. At power-up, there is always a pull-up resistor to VCCAUX on this pin, regardless of the HSWAP\_EN input. After configuration, the bitstream generator option **ProgPin** determines whether or not the pull-up resistor is present. By default, the **ProgPin** option retains the pull-up resistor.

After configuration, hold the PROG\_B input High. Any Low-going pulse on PROG\_B lasting 300 ns or longer restarts the configuration process.

Table 73: PROG\_B Operation

| PROG_B Input   | Response   |
|--|--|
| Power-up   | Automatically initiates configuration process.   |
| Low-going pulse<br> | Initiate (re-)configuration process and continue to completion.  |
| Extended Low<br>    | Initiate (re-)configuration process and stall process at step where configuration memory is cleared. Process is stalled until PROG_B returns High. |
| 1  | If the configuration process is started, continue to completion. If configuration process is complete, stay in User mode.                          |

## DONE: Configuration Done, Delay Start-Up Sequence

The FPGA produces a Low-to-High transition on this pin indicating that the configuration process is complete. The bitstream generator option **DriveDone** determines whether this pin functions as a totem-pole output that can drive High or as an open-drain output. If configured as an open-drain output—which is the default behavior—then a pull-up resistor is required to produce a High logic level. There is a bitstream option that provides an internal pull-up resistor, otherwise an external pull-up resistor is required.

The open-drain option permits the DONE lines of multiple FPGAs to be tied together, so that the common node transitions High only after all of the FPGAs have completed configuration. Externally holding the open-drain DONE pin Low delays the start-up sequence, which marks the transition to user mode.

Once the FPGA enters User mode after completing configuration, the DONE pin no longer drives the DONE pin Low. The bitstream generator option DonePin determines whether or not a pull-up resistor is present on the DONE pin to pull the pin to VCCAUX. If the pull-up resistor is eliminated, then the DONE pin must be pulled High using an external pull-up resistor or one of the FPGAs in the design must actively drive the DONE pin High via the DriveDone bitstream generator option.

The bitstream generator option DriveDone causes the FPGA to actively drive the DONE output High after configuration. This option should only be used in single-FPGA designs or on the last FPGA in a multi-FPGA daisy-chain.

By default, the bitstream generator software retains the pull-up resistor and does not actively drive the DONE pin as highlighted in Table 74, which shows the interaction of these bitstream options in single- and multi-FPGA designs.

Table 74: DonePin and DriveDone Bitstream Option Interaction

| DonePin  | DriveDone | Single- or Multi-FPGA Design | Comments  |
|----------|-----------|------------------------------|---|
| Pullnone | No        | Single                       | External pull-up resistor, with value between 330Ω to 3.3kΩ, required on DONE.                                    |
| Pullnone | No        | Multi                        | External pull-up resistor, with value between 330Ω to 3.3kΩ, required on common node connecting to all DONE pins. |
| Pullnone | Yes       | Single                       | OK, no external requirements.   |
| Pullnone | Yes       | Multi                        | DriveDone on last device in daisy-chain only. No external requirements.   |
| Pullup   | No        | Single                       | OK, but pull-up on DONE pin has slow rise time. May require 330Ω pull-up resistor for high CCLK frequencies.      |
| Pullup   | No        | Multi                        | External pull-up resistor, with value between 330Ω to 3.3kΩ, required on common node connecting to all DONE pins. |
| Pullup   | Yes       | Single                       | OK, no external requirements.   |
| Pullup   | Yes       | Multi                        | DriveDone on last device in daisy-chain only. No external requirements.   |

### M2, M1, M0: Configuration Mode Selection

The M2, M1, and M0 inputs select the FPGA configuration mode, as described in Table 75. The logic levels applied to the mode pins are sampled on the rising edge of INIT\_B.

Table 75: Spartan-3 FPGA Mode Select Settings

| Configuration Mode  | M2 | M1 | M0 |
|---------------------|----|----|----|
| Master Serial       | 0  | 0  | 0  |
| Slave Serial        | 1  | 1  | 1  |
| Master Parallel     | 0  | 1  | 1  |
| Slave Parallel      | 1  | 1  | 0  |
| JTAG                | 1  | 0  | 1  |
| Reserved            | 0  | 0  | 1  |
| Reserved            | 0  | 1  | 0  |
| Reserved            | 1  | 0  | 0  |
| After Configuration | X  | X  | X  |

**Notes:**

1. X = don't care, either 0 or 1.

Before and during configuration, the mode pins have an internal pull-up resistor to VCCAUX, regardless of the HSWAP\_EN pin. If the mode pins are unconnected, then the FPGA defaults to the Slave Serial configuration mode. After configuration successfully completes, any levels applied to these input are ignored. Furthermore, the bitstream generator options M0Pin, M1Pin, and M2Pin determines whether a pull-up resistor, pull-down resistor, or no resistor is present on its respective mode pin, M0, M1, or M2.

## HSWAP\_EN: Disable Pull-up Resistors During Configuration

As shown in [Table 76](#), a Low on this asynchronous pin enables pull-up resistors on all user I/Os not actively involved in the configuration process, although only until device configuration completes. A High disables the pull-up resistors during configuration, which is the desired state for some applications.

The dedicated configuration CONFIG pins (CCLK, DONE, PROG\_B, HSWAP\_EN, M2, M1, M0), the JTAG pins (TDI, TMS, TCK, TDO) and the INIT\_B always have active pull-up resistors during configuration, regardless of the value on HSWAP\_EN.

After configuration, HSWAP\_EN becomes a "don't care" input and any pull-up resistors previously enabled by HSWAP\_EN are disabled. If a user I/O in the application requires a pull-up resistor after configuration, place a PULLUP primitive on the associated I/O pin or, for some pins, set the associated bitstream generator option.

Table 76: HSWAP\_EN Encoding

| HSWAP_EN                              | Function  |
|---------------------------------------|---|
| <b>During Configuration</b>           |   |
| 0                                     | Enable pull-up resistors on all pins not actively involved in the configuration process. Pull-ups are only active until configuration completes. See <a href="#">Table 79</a> . |
| 1                                     | No pull-up resistors during configuration.  |
| <b>After Configuration, User Mode</b> |   |
| X                                     | This pin has no function except during device configuration.  |

**Notes:**

1. X = don't care, either 0 or 1.

The Bitstream generator option HswapenPin determines whether a pull-up resistor to VCCAUX, a pull-down resistor, or no resistor is present on HSWAP\_EN after configuration.

## JTAG: Dedicated JTAG Port Pins

Table 77: JTAG Pin Descriptions

| Pin Name | Direction | Description   | Bitstream Generation Option  |
|----------|-----------|---|--|
| TCK      | Input     | <b>Test Clock:</b> The TCK clock signal synchronizes all boundary scan operations on its rising edge.   | The BitGen option <b>TckPin</b> determines whether a pull-up resistor, pull-down resistor or no resistor is present. |
| TDI      | Input     | <b>Test Data Input:</b> TDI is the serial data input for all JTAG instruction and data registers. This input is sampled on the rising edge of TCK.  | The BitGen option <b>TdiPin</b> determines whether a pull-up resistor, pull-down resistor or no resistor is present. |
| TMS      | Input     | <b>Test Mode Select:</b> The TMS input controls the sequence of states through which the JTAG TAP state machine passes. This input is sampled on the rising edge of TCK.  | The BitGen option <b>TmsPin</b> determines whether a pull-up resistor, pull-down resistor or no resistor is present. |
| TDO      | Output    | <b>Test Data Output:</b> The TDO pin is the data output for all JTAG instruction and data registers. This output is sampled on the rising edge of TCK. The TDO output is an active totem-pole driver and is not like the open-collector TDO output on Virtex®-II Pro FPGAs. | The BitGen option <b>TdoPin</b> determines whether a pull-up resistor, pull-down resistor or no resistor is present. |

These pins are dedicated connections to the four-wire IEEE 1532/IEEE 1149.1 JTAG port, shown in [Figure 43](#) and described in [Table 77](#). The JTAG port is used for boundary-scan testing, device configuration, application debugging, and possibly an additional serial port for the application. These pins are dedicated and are not available as user-I/O pins. Every package has four dedicated JTAG pins and these pins are powered by the +2.5V VCCAUX supply.

For additional information on JTAG configuration, see [Boundary-Scan \(JTAG\) Mode, page 50](#).

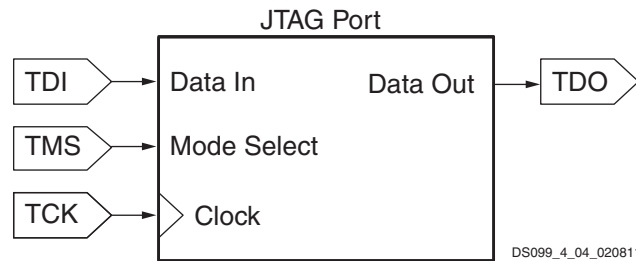


Figure 43: JTAG Port

## IDCODE Register

Spartan-3 FPGAs contain a 32-bit identification register called the IDCODE register, as defined in the IEEE 1149.1 JTAG standard. The fixed value electrically identifies the manufacture (Xilinx) and the type of device being addressed over a JTAG chain. This register allows the JTAG host to identify the device being tested or programmed via JTAG. See [Table 78](#).

## Using JTAG Port After Configuration

The JTAG port is always active and available before, during, and after FPGA configuration. Add the BSCAN\_SPARTAN3 primitive to the design to create user-defined JTAG instructions and JTAG chains to communicate with internal logic.

Furthermore, the contents of the User ID register within the JTAG port can be specified as a Bitstream Generation option. By default, the 32-bit User ID register contains `0xFFFFFFFF`.

Table 78: Spartan-3 JTAG IDCODE Register Values (hexadecimal)

| Part Number | IDCODE Register |
|-------------|-----------------|
| XC3S50      | 0x0140C093      |
| XC3S200     | 0x01414093      |
| XC3S400     | 0x0141C093      |
| XC3S1000    | 0x01428093      |
| XC3S1500    | 0x01434093      |
| XC3S2000    | 0x01440093      |
| XC3S4000    | 0x01448093      |
| XC3S5000    | 0x01450093      |

## Precautions When Using the JTAG Port in 3.3V Environments

The JTAG port is powered by the +2.5V VCCAUX power supply. When connecting to a 3.3V interface, the JTAG input pins must be current-limited using a series resistor. Similarly, the TDO pin is a CMOS output powered from +2.5V. The TDO output can directly drive a 3.3V input but with reduced noise immunity. See [3.3V-Tolerant Configuration Interface, page 47](#). See also [XAPP453: The 3.3V Configuration of Spartan-3 FPGAs](#) for additional details.

The following interface precautions are recommended when connecting the JTAG port to a 3.3V interface.

- Avoid actively driving the JTAG input signals High with 3.3V signal levels. If required in the application, use series current-limiting resistors to keep the current below 10 mA per pin.
- If possible, drive the FPGA JTAG inputs with drivers that can be placed in high-impedance (Hi-Z) after using the JTAG port. Alternatively, drive the FPGA JTAG inputs with open-drain outputs, which only drive Low. In both cases, pull-up resistors are required. The FPGA JTAG pins have pull-up resistors to VCCAUX before configuration and optional pull-up resistors after configuration, controlled by [Bitstream Options, page 125](#).

## VREF: User I/O or Input Buffer Reference Voltage for Special Interface Standards

These pins are individual user-I/O pins unless collectively they supply an input reference voltage, VREF\_#, for any SSTL, HSTL, GTL, or GTLP I/Os implemented in the associated I/O bank. The '#' character in the pin name represents an integer, 0 through 7, that indicates the associated I/O bank.

The VREF function becomes active for this pin whenever a signal standard requiring a reference voltage is used in the associated bank. If used as a user I/O, then each pin behaves as an independent I/O described in the I/O type section. If used for a reference voltage within a bank, then *all* VREF pins within the bank must be connected to the same reference voltage.

Spartan-3 devices are designed and characterized to support certain I/O standards when VREF is connected to +1.25V, +1.10V, +1.00V, +0.90V, +0.80V, and +0.75V. During configuration, the VREF pins behave exactly like user-I/O pins.

If designing for footprint compatibility across the range of devices in a specific package, and if the VREF\_# pins within a bank connect to an input reference voltage, then also connect any N.C. (not connected) pins on the smaller devices in that package to the input reference voltage. More details are provided later for each package type.

## N.C. Type: Unconnected Package Pins

Pins marked as "N.C." are unconnected for the specific device/package combination. For other devices in this same package, this pin may be used as an I/O or VREF connection. In both the pinout tables and the footprint diagrams, unconnected pins are noted with either a black diamond symbol (◆) or a black square symbol (■).

If designing for footprint compatibility across multiple device densities, check the pin types of the other Spartan-3 devices available in the same footprint. If the N.C. pin matches to VREF pins in other devices, and the VREF pins are used in the associated I/O bank, then connect the N.C. to the VREF voltage source.

## VCCO Type: Output Voltage Supply for I/O Bank

Each I/O bank has its own set of voltage supply pins that determines the output voltage for the output buffers in the I/O bank. Furthermore, for some I/O standards such as LVCMOS, LVCMOS25, LVTTTL, etc., VCCO sets the input threshold voltage on the associated input buffers.

Spartan-3 devices are designed and characterized to support various I/O standards for VCCO values of +1.2V, +1.5V, +1.8V, +2.5V, and +3.3V.

Most VCCO pins are labeled as VCCO\_# where the '#' symbol represents the associated I/O bank number, an integer ranging from 0 to 7. In the 144-pin TQFP package (TQ144) however, the VCCO pins along an edge of the device are combined into a single VCCO input. For example, the VCCO inputs for Bank 0 and Bank 1 along the top edge of the package are combined and relabeled VCCO\_TOP. The bottom, left, and right edges are similarly combined.

In Serial configuration mode, VCCO\_4 must be at a level compatible with the attached configuration memory or data source. In Parallel configuration mode, both VCCO\_4 and VCCO\_5 must be at the same compatible voltage level.

All VCCO inputs to a bank must be connected together and to the voltage supply. Furthermore, there must be sufficient supply decoupling to guarantee problem-free operation, as described in [XAPP623: Power Distribution System \(PDS\) Design: Using Bypass/Decoupling Capacitors](#).

## VCCINT Type: Voltage Supply for Internal Core Logic

Internal core logic circuits such as the configurable logic blocks (CLBs) and programmable interconnect operate from the VCCINT voltage supply inputs. VCCINT must be +1.2V.

All VCCINT inputs must be connected together and to the +1.2V voltage supply. Furthermore, there must be sufficient supply decoupling to guarantee problem-free operation, as described in [XAPP623](#).

## VCCAUX Type: Voltage Supply for Auxiliary Logic

The VCCAUX pins supply power to various auxiliary circuits, such as to the Digital Clock Managers (DCMs), the JTAG pins, and to the dedicated configuration pins (CONFIG type). VCCAUX must be +2.5V.

All VCCAUX inputs must be connected together and to the +2.5V voltage supply. Furthermore, there must be sufficient supply decoupling to guarantee problem-free operation, as described in [XAPP623](#).

Because VCCAUX connects to the DCMs and the DCMs are sensitive to voltage changes, be sure that the VCCAUX supply and the ground return paths are designed for low noise and low voltage drop, especially that caused by a large number of simultaneous switching I/Os.

### GND Type: Ground

All GND pins must be connected and have a low resistance path back to the various VCCO, VCCINT, and VCCAUX supplies.

### Pin Behavior During Configuration

[Table 79](#) shows how various pins behave during the FPGA configuration process. The actual behavior depends on the values applied to the M2, M1, and M0 mode select pins and the HSWAP\_EN pin. The mode select pins determine which of the DUAL type pins are active during configuration. In JTAG configuration mode, none of the DUAL-type pins are used for configuration and all behave as user-I/O pins.

All DUAL-type pins not actively used during configuration and all I/O-type, DCI-type, VREF-type, GCLK-type pins are high impedance (floating, three-stated, Hi-Z) during the configuration process. These pins are indicated in [Table 79](#) as shaded table entries or cells. These pins have a pull-up resistor to their associated VCCO if the HSWAP\_EN pin is Low. When HSWAP\_EN is High, these pull-up resistors are disabled during configuration.

Some pins always have an active pull-up resistor during configuration, regardless of the value applied to the HSWAP\_EN pin. After configuration, these pull-up resistors are controlled by [Bitstream Options](#).

- All the dedicated CONFIG-type configuration pins (CCLK, PROG\_B, DONE, M2, M1, M0, and HSWAP\_EN) have a pull-up resistor to VCCAUX.
- All JTAG-type pins (TCK, TDI, TMS, TDO) have a pull-up resistor to VCCAUX.
- The INIT\_B DUAL-purpose pin has a pull-up resistor to VCCO\_4 or VCCO\_BOTTOM, depending on package style.

After configuration completes, some pins have optional behavior controlled by the configuration bitstream loaded into the part. For example, via the bitstream, all unused I/O pins can be collectively configured as input pins with either a pull-up resistor, a pull-down resistor, or be left in a high-impedance state.

*Table 79: Pin Behavior After Power-Up, During Configuration*

| Pin Name                                     | Configuration Mode Settings <M2:M1:M0> |               |                          |               |                   | Bitstream Configuration Option |
|--|--|---------------|--------------------------|---------------|-------------------|--------------------------------|
|  | Serial Modes                           |               | SelectMap Parallel Modes |               | JTAG Mode <1:0:1> |                                |
|  | Master <0:0:0>                         | Slave <1:1:1> | Master <0:1:1>           | Slave <1:1:0> |                   |                                |
| <b>I/O: General-purpose I/O pins</b>         |  |               |                          |               |                   |                                |
| IO   |  |               |                          |               |                   | UnusedPin                      |
| IO_Lxxy_#                                    |  |               |                          |               |                   | UnusedPin                      |
| <b>DUAL: Dual-purpose configuration pins</b> |  |               |                          |               |                   |                                |
| IO_Lxxy_#/<br>DIN/D0                         | DIN (I)                                | DIN (I)       | D0 (I/O)                 | D0 (I/O)      |                   | Persist UnusedPin              |
| IO_Lxxy_#/<br>D1                             |  |               | D1 (I/O)                 | D1 (I/O)      |                   | Persist UnusedPin              |
| IO_Lxxy_#/<br>D2                             |  |               | D2 (I/O)                 | D2 (I/O)      |                   | Persist UnusedPin              |
| IO_Lxxy_#/<br>D3                             |  |               | D3 (I/O)                 | D3 (I/O)      |                   | Persist UnusedPin              |
| IO_Lxxy_#/<br>D4                             |  |               | D4 (I/O)                 | D4 (I/O)      |                   | Persist UnusedPin              |



Table 79: Pin Behavior After Power-Up, During Configuration (Cont'd)

| Pin Name   | Configuration Mode Settings <M2:M1:M0> |                      |                          |                      |                                     | Bitstream Configuration Option   |
|--|--|----------------------|--------------------------|----------------------|-------------------------------------|----------------------------------|
|  | Serial Modes                           |                      | SelectMap Parallel Modes |                      | JTAG Mode <1:0:1>                   |                                  |
|  | Master <0:0:0>                         | Slave <1:1:1>        | Master <0:1:1>           | Slave <1:1:0>        |                                     |                                  |
| IO_Lxxy_#/D5   |  |                      | D5 (I/O)                 | D5 (I/O)             |                                     | Persist UnusedPin                |
| IO_Lxxy_#/D6   |  |                      | D6 (I/O)                 | D6 (I/O)             |                                     | Persist UnusedPin                |
| IO_Lxxy_#/D7   |  |                      | D7 (I/O)                 | D7 (I/O)             |                                     | Persist UnusedPin                |
| IO_Lxxy_#/CS_B   |  |                      | CS_B (I)                 | CS_B (I)             |                                     | Persist UnusedPin                |
| IO_Lxxy_#/RDWR_B   |  |                      | RDWR_B (I)               | RDWR_B (I)           |                                     | Persist UnusedPin                |
| IO_Lxxy_#/BUSY/DOUT  | DOUT (O)                               | DOUT (O)             | BUSY (O)                 | BUSY (O)             |                                     | Persist UnusedPin                |
| <b>DUAL: Dual-purpose configuration pins (INIT_B has a pull-up resistor to VCCO_4 or VCCO_BOTTOM always active during configuration, regardless of HSWAP_EN pin)</b> |  |                      |                          |                      |                                     |                                  |
| IO_Lxxy_#/INIT_B   | INIT_B (I/OD)                          | INIT_B (I/OD)        | INIT_B (I/OD)            | INIT_B (I/OD)        |                                     | UnusedPin                        |
| <b>DCI: Digitally Controlled Impedance reference resistor input pins</b>   |  |                      |                          |                      |                                     |                                  |
| IO_Lxxy_#/VRN_#  |  |                      |                          |                      |                                     | UnusedPin                        |
| IO/VRN_#   |  |                      |                          |                      |                                     | UnusedPin                        |
| IO_Lxxy_#/VRP_#  |  |                      |                          |                      |                                     | UnusedPin                        |
| IO/VRP_#   |  |                      |                          |                      |                                     | UnusedPin                        |
| <b>GCLK: Global clock buffer inputs</b>  |  |                      |                          |                      |                                     |                                  |
| IO_Lxxy_#/GCLK0 through GCLK7  |  |                      |                          |                      |                                     | UnusedPin                        |
| <b>VREF: I/O bank input reference voltage pins</b>   |  |                      |                          |                      |                                     |                                  |
| IO_Lxxy_#/VREF_#   |  |                      |                          |                      |                                     | UnusedPin                        |
| IO/VREF_#  |  |                      |                          |                      |                                     | UnusedPin                        |
| <b>CONFIG: Dedicated configuration pins (pull-up resistor to VCCAUX always active during configuration, regardless of HSWAP_EN pin)</b>                              |  |                      |                          |                      |                                     |                                  |
| CCLK   | CCLK (I/O)                             | CCLK (I)             | CCLK (I/O)               | CCLK (I)             |                                     | CclkPin ConfigRate               |
| PROG_B   | PROG_B (I) (pull-up)                   | PROG_B (I) (pull-up) | PROG_B (I) (pull-up)     | PROG_B (I) (pull-up) | PROG_B (I), Via JPROG_B instruction | ProgPin                          |
| DONE   | DONE (I/OD)                            | DONE (I/OD)          | DONE (I/OD)              | DONE (I/OD)          | DONE (I/OD)                         | DriveDone<br>DonePin<br>DonePipe |
| M2   | M2=0 (I)                               | M2=1 (I)             | M2=0 (I)                 | M2=1 (I)             | M2=1 (I)                            | M2Pin                            |
| M1   | M1=0 (I)                               | M1=1 (I)             | M1=1 (I)                 | M1=1 (I)             | M1=0 (I)                            | M1Pin                            |
| M0   | M0=0 (I)                               | M0=1 (I)             | M0=1 (I)                 | M0=0 (I)             | M0=1 (I)                            | M0Pin                            |
| HSWAP_EN   | HSWAP_EN (I)                           | HSWAP_EN (I)         | HSWAP_EN (I)             | HSWAP_EN (I)         | HSWAP_EN (I)                        | HswapenPin                       |

Table 79: Pin Behavior After Power-Up, During Configuration (Cont'd)

| Pin Name   | Configuration Mode Settings <M2:M1:M0> |               |                          |               |                   | Bitstream Configuration Option |
|--|--|---------------|--------------------------|---------------|-------------------|--------------------------------|
|  | Serial Modes                           |               | SelectMap Parallel Modes |               | JTAG Mode <1:0:1> |                                |
|  | Master <0:0:0>                         | Slave <1:1:1> | Master <0:1:1>           | Slave <1:1:0> |                   |                                |
| <b>JTAG: JTAG interface pins (pull-up resistor to VCCAUX always active during configuration, regardless of HSWAP_EN pin)</b> |  |               |                          |               |                   |                                |
| TDI  | TDI (I)                                | TDI (I)       | TDI (I)                  | TDI (I)       | TDI (I)           | TdiPin                         |
| TMS  | TMS (I)                                | TMS (I)       | TMS (I)                  | TMS (I)       | TMS (I)           | TmsPin                         |
| TCK  | TCK (I)                                | TCK (I)       | TCK (I)                  | TCK (I)       | TCK (I)           | TckPin                         |
| TDO  | TDO (O)                                | TDO (O)       | TDO (O)                  | TDO (O)       | TDO (O)           | TdoPin                         |



Table 79: Pin Behavior After Power-Up, During Configuration (Cont'd)

| Pin Name   | Configuration Mode Settings <M2:M1:M0> |                                    |                                    |                                    |                   | Bitstream Configuration Option |
|--|--|------------------------------------|------------------------------------|------------------------------------|-------------------|--------------------------------|
|  | Serial Modes                           |                                    | SelectMap Parallel Modes           |                                    | JTAG Mode <1:0:1> |                                |
|  | Master <0:0:0>                         | Slave <1:1:1>                      | Master <0:1:1>                     | Slave <1:1:0>                      |                   |                                |
| <b>VCCO: I/O bank output voltage supply pins</b> |  |                                    |                                    |                                    |                   |                                |
| VCCO_4 (for DUAL pins)                           | Same voltage as external interface     | Same voltage as external interface | Same voltage as external interface | Same voltage as external interface | VCCO_4            | N/A                            |
| VCCO_5 (for DUAL pins)                           | VCCO_5                                 | VCCO_5                             | Same voltage as external interface | Same voltage as external interface | VCCO_5            | N/A                            |
| VCCO_#   | VCCO_#                                 | VCCO_#                             | VCCO_#                             | VCCO_#                             | VCCO_#            | N/A                            |
| <b>VCCAUX: Auxiliary voltage supply pins</b>     |  |                                    |                                    |                                    |                   |                                |
| VCCAUX   | +2.5V                                  | +2.5V                              | +2.5V                              | +2.5V                              | +2.5V             | N/A                            |
| <b>VCCINT: Internal core voltage supply pins</b> |  |                                    |                                    |                                    |                   |                                |
| VCCINT   | +1.2V                                  | +1.2V                              | +1.2V                              | +1.2V                              | +1.2V             | N/A                            |
| <b>GND: Ground supply pins</b>                   |  |                                    |                                    |                                    |                   |                                |
| GND  | GND                                    | GND                                | GND                                | GND                                | GND               | N/A                            |

**Notes:**

1. # = I/O bank number, an integer from 0 to 7.
2. (I) = input, (O) = output, (OD) = open-drain output, (I/O) = bidirectional, (I/OD) = bidirectional with open-drain output. Open-drain output requires pull-up to create logic High level.
3.   Shaded cell indicates that the pin is high-impedance during configuration. To enable a soft pull-up resistor during configuration, drive or tie HSWAP\_EN Low.

## Bitstream Options

Table 80 lists the various bitstream options that affect pins on a Spartan-3 FPGA. The table shows the names of the affected pins, describes the function of the bitstream option, the name of the bitstream generator option variable, and the legal values for each variable. The default option setting for each variable is indicated with bold, underlined text.

Table 80: Bitstream Options Affecting Spartan-3 Device Pins

| Affected Pin Name(s)   | Bitstream Generation Function  | Option Variable Name | Values (Default)   |
|--|--|----------------------|--|
| All unused I/O pins of type I/O, DUAL, GCLK, DCI, VREF   | For all I/O pins that are unused in the application after configuration, this option defines whether the I/Os are individually tied to VCCO via a pull-up resistor, tied ground via a pull-down resistor, or left floating. If left floating, the unused pins should be connected to a defined logic level, either from a source internal to the FPGA or external. | UnusedPin            | <ul style="list-style-type: none"> <li>• <b><u>Pulldown</u></b></li> <li>• Pullup</li> <li>• Pullnone</li> </ul> |
| IO_Lxxy_#/DIN, IO_Lxxy_#/DOUT, IO_Lxxy_#/INIT_B  | Serial configuration mode: If set to Yes, then these pins retain their functionality after configuration completes, allowing for device (re-)configuration. Readback is not supported in with serial mode.   | Persist              | <ul style="list-style-type: none"> <li>• <b>No</b></li> <li>• Yes</li> </ul>                                     |
| IO_Lxxy_#/D0, IO_Lxxy_#/D1, IO_Lxxy_#/D2, IO_Lxxy_#/D3, IO_Lxxy_#/D4, IO_Lxxy_#/D5, IO_Lxxy_#/D6, IO_Lxxy_#/D7, IO_Lxxy_#/CS_B, IO_Lxxy_#/RDWR_B, IO_Lxxy_#/BUSY, IO_Lxxy_#/INIT_B | Parallel configuration mode (also called SelectMAP): If set to Yes, then these pins retain their SelectMAP functionality after configuration completes, allowing for device readback and for partial or complete (re-)configuration.   | Persist              | <ul style="list-style-type: none"> <li>• <b>No</b></li> <li>• Yes</li> </ul>                                     |

**Table 80: Bitstream Options Affecting Spartan-3 Device Pins (Cont'd)**

| Affected Pin Name(s) | Bitstream Generation Function  | Option Variable Name | Values (Default)  |
|----------------------|--|----------------------|---|
| CCLK                 | After configuration, this bitstream option either pulls CCLK to VCCAUX via a pull-up resistor, or allows CCLK to float.  | CclkPin              | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pullnone</li> </ul>                     |
| CCLK                 | For Master configuration modes, this option sets the approximate frequency, in MHz, for the internal silicon oscillator.   | ConfigRate           | <ul style="list-style-type: none"> <li>• 3, <b>6</b>, 12, 25, 50</li> </ul>                               |
| PROG_B               | A pull-up resistor to VCCAUX exists on PROG_B during configuration. After configuration, this bitstream option either pulls PROG_B to VCCAUX via a pull-up resistor, or allows PROG_B to float.  | ProgPin              | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pullnone</li> </ul>                     |
| DONE                 | After configuration, this bitstream option either pulls DONE to VCCAUX via a pull-up resistor, or allows DONE to float. See also DriveDone option.   | DonePin              | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pullnone</li> </ul>                     |
| DONE                 | If set to Yes, this option allows the FPGA's DONE pin to drive High when configuration completes. By default, the DONE is an open-drain output and can only drive Low. Only single FPGAs and the last FPGA in a multi-FPGA daisy-chain should use this option. | DriveDone            | <ul style="list-style-type: none"> <li>• <b>No</b></li> <li>• Yes</li> </ul>                              |
| M2                   | After configuration, this bitstream option either pulls M2 to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows M2 to float.  | M2Pin                | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| M1                   | After configuration, this bitstream option either pulls M1 to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows M1 to float.  | M1Pin                | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| M0                   | After configuration, this bitstream option either pulls M0 to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows M0 to float.  | M0Pin                | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| HSWAP_EN             | After configuration, this bitstream option either pulls HSWAP_EN to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows HSWAP_EN to float.  | HswapenPin           | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| TDI                  | After configuration, this bitstream option either pulls TDI to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows TDI to float.  | TdiPin               | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| TMS                  | After configuration, this bitstream option either pulls TMS to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows TMS to float.  | TmsPin               | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| TCK                  | After configuration, this bitstream option either pulls TCK to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows TCK to float.  | TckPin               | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |
| TDO                  | After configuration, this bitstream option either pulls TDO to VCCAUX via a pull-up resistor, to ground via a pull-down resistor, or allows TDO to float.  | TdoPin               | <ul style="list-style-type: none"> <li>• <b>Pullup</b></li> <li>• Pulldown</li> <li>• Pullnone</li> </ul> |

## Setting Bitstream Generator Options

Refer to the [“BitGen” chapter](#) in the Xilinx ISE® software documentation.

## Package Overview

Table 81 shows the 10 low-cost, space-saving production package styles for the Spartan-3 family. 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 "VQ100" package becomes "VQG100" 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 83.

Not all Spartan-3 device densities are available in all packages. However, for a specific package there is a common footprint that supports the various devices available in that package. See the footprint diagrams that follow.

Table 81: Spartan-3 Family Package Options

| Package                         | Leads | Type                             | Maximum I/O | Pitch (mm) | Footprint (mm) | Height (mm) |
|---------------------------------|-------|----------------------------------|-------------|------------|----------------|-------------|
| VQ100 / VQG100                  | 100   | Very-thin Quad Flat Pack         | 63          | 0.5        | 16 x 16        | 1.20        |
| CP132 / CPG132 <sup>(1)</sup>   | 132   | Chip-Scale Package               | 89          | 0.5        | 8 x 8          | 1.10        |
| TQ144 / TQG144                  | 144   | Thin Quad Flat Pack              | 97          | 0.5        | 22 x 22        | 1.60        |
| PQ208 / PQG208                  | 208   | Quad Flat Pack                   | 141         | 0.5        | 30.6 x 30.6    | 4.10        |
| FT256 / FTG256                  | 256   | Fine-pitch, Thin Ball Grid Array | 173         | 1.0        | 17 x 17        | 1.55        |
| FG320 / FGG320                  | 320   | Fine-pitch Ball Grid Array       | 221         | 1.0        | 19 x 19        | 2.00        |
| FG456 / FGG456                  | 456   | Fine-pitch Ball Grid Array       | 333         | 1.0        | 23 x 23        | 2.60        |
| FG676 / FGG676                  | 676   | Fine-pitch Ball Grid Array       | 489         | 1.0        | 27 x 27        | 2.60        |
| FG900 / FGG900                  | 900   | Fine-pitch Ball Grid Array       | 633         | 1.0        | 31 x 31        | 2.60        |
| FG1156 / FGG1156 <sup>(1)</sup> | 1156  | Fine-pitch Ball Grid Array       | 784         | 1.0        | 35 x 35        | 2.60        |

**Notes:**

1. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

## Selecting the Right Package Option

Spartan-3 FPGAs are available in both quad-flat pack (QFP) and ball grid array (BGA) packaging options. While QFP packaging offers the lowest absolute cost, the BGA packages are superior in almost every other aspect, as summarized in Table 82. Consequently, Xilinx recommends using BGA packaging whenever possible.

Table 82: Comparing Spartan-3 Device Packaging Options

| Characteristic                              | Quad Flat-Pack (QFP) | Ball Grid Array (BGA) |
|---|----------------------|-----------------------|
| Maximum User I/O                            | 141                  | 633                   |
| Packing Density (Logic/Area)                | Good                 | Better                |
| Signal Integrity                            | Fair                 | Better                |
| Simultaneous Switching Output (SSO) Support | Limited              | Better                |
| Thermal Dissipation                         | Fair                 | Better                |
| Minimum Printed Circuit Board (PCB) Layers  | 4                    | 6                     |
| Hand Assembly/Rework                        | Possible             | Very Difficult        |

## Mechanical Drawings

Detailed mechanical drawings for each package type are available from the Xilinx website at the specified location in [Table 83](#).

Material Declaration Data Sheets (MDDS) are also available on the [Xilinx website](#) for each package.

*Table 83: Xilinx Package Mechanical Drawings*

| Package                           | Web Link (URL)  |
|-----------------------------------|---|
| VQ100 and VQG100                  | <a href="http://www.xilinx.com/support/documentation/package_specs/vq100.pdf">http://www.xilinx.com/support/documentation/package_specs/vq100.pdf</a>   |
| CP132 and CPG132 <sup>(1)</sup>   | <a href="http://www.xilinx.com/support/documentation/package_specs/cp132.pdf">http://www.xilinx.com/support/documentation/package_specs/cp132.pdf</a>   |
| TQ144 and TQG144                  | <a href="http://www.xilinx.com/support/documentation/package_specs/tq144.pdf">http://www.xilinx.com/support/documentation/package_specs/tq144.pdf</a>   |
| PQ208 and PQG208                  | <a href="http://www.xilinx.com/support/documentation/package_specs/pq208.pdf">http://www.xilinx.com/support/documentation/package_specs/pq208.pdf</a>   |
| FT256 and FTG256                  | <a href="http://www.xilinx.com/support/documentation/package_specs/ft256.pdf">http://www.xilinx.com/support/documentation/package_specs/ft256.pdf</a>   |
| FG320 and FGG320                  | <a href="http://www.xilinx.com/support/documentation/package_specs/fg320.pdf">http://www.xilinx.com/support/documentation/package_specs/fg320.pdf</a>   |
| FG456 and FGG456                  | <a href="http://www.xilinx.com/support/documentation/package_specs/fg456.pdf">http://www.xilinx.com/support/documentation/package_specs/fg456.pdf</a>   |
| FG676 and FGG676                  | <a href="http://www.xilinx.com/support/documentation/package_specs/fg676.pdf">http://www.xilinx.com/support/documentation/package_specs/fg676.pdf</a>   |
| FG900 and FGG900                  | <a href="http://www.xilinx.com/support/documentation/package_specs/fg900.pdf">http://www.xilinx.com/support/documentation/package_specs/fg900.pdf</a>   |
| FG1156 and FGG1156 <sup>(1)</sup> | <a href="http://www.xilinx.com/support/documentation/package_specs/fg1156.pdf">http://www.xilinx.com/support/documentation/package_specs/fg1156.pdf</a> |

**Notes:**

1. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

## Power, Ground, and I/O by Package

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 varies by package, as shown in [Table 84](#).

*Table 84: Power and Ground Supply Pins by Package*

| Package               | VCCINT | VCCAUX | VCCO | GND |
|-----------------------|--------|--------|------|-----|
| VQ100                 | 4      | 4      | 8    | 10  |
| CP132 <sup>(1)</sup>  | 4      | 4      | 12   | 12  |
| TQ144                 | 4      | 4      | 12   | 16  |
| PQ208                 | 4      | 8      | 12   | 28  |
| FT256                 | 8      | 8      | 24   | 32  |
| FG320                 | 12     | 8      | 28   | 40  |
| FG456                 | 12     | 8      | 40   | 52  |
| FG676                 | 20     | 16     | 64   | 76  |
| FG900                 | 32     | 24     | 80   | 120 |
| FG1156 <sup>(1)</sup> | 40     | 32     | 104  | 184 |

**Notes:**

1. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

A majority of package pins are user-defined I/O pins. However, the numbers and characteristics of these I/O depends on the device type and the package in which it is available, as shown in [Table 85](#). The table shows the maximum number of single-ended I/O pins available, assuming that all I/O-, DUAL-, DCI-, VREF-, and GCLK-type pins are used as general-purpose I/O. 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—i.e., N.C.—pins on the device.

Table 85: Maximum User I/Os by Package

| Device   | Package               | Maximum User I/Os | Maximum Differential Pairs | All Possible I/O Pins by Type |      |     |      |      | N.C. |
|----------|-----------------------|-------------------|----------------------------|-------------------------------|------|-----|------|------|------|
|          |                       |                   |                            | I/O                           | DUAL | DCI | VREF | GCLK |      |
| XC3S50   | VQ100                 | 63                | 29                         | 22                            | 12   | 14  | 7    | 8    | 0    |
| XC3S200  | VQ100                 | 63                | 29                         | 22                            | 12   | 14  | 7    | 8    | 0    |
| XC3S50   | CP132 <sup>(1)</sup>  | 89                | 44                         | 44                            | 12   | 14  | 11   | 8    | 0    |
| XC3S50   | TQ144                 | 97                | 46                         | 51                            | 12   | 14  | 12   | 8    | 0    |
| XC3S200  | TQ144                 | 97                | 46                         | 51                            | 12   | 14  | 12   | 8    | 0    |
| XC3S400  | TQ144                 | 97                | 46                         | 51                            | 12   | 14  | 12   | 8    | 0    |
| XC3S50   | PQ208                 | 124               | 56                         | 72                            | 12   | 16  | 16   | 8    | 17   |
| XC3S200  | PQ208                 | 141               | 62                         | 83                            | 12   | 16  | 22   | 8    | 0    |
| XC3S400  | PQ208                 | 141               | 62                         | 83                            | 12   | 16  | 22   | 8    | 0    |
| XC3S200  | FT256                 | 173               | 76                         | 113                           | 12   | 16  | 24   | 8    | 0    |
| XC3S400  | FT256                 | 173               | 76                         | 113                           | 12   | 16  | 24   | 8    | 0    |
| XC3S1000 | FT256                 | 173               | 76                         | 113                           | 12   | 16  | 24   | 8    | 0    |
| XC3S400  | FG320                 | 221               | 100                        | 156                           | 12   | 16  | 29   | 8    | 0    |
| XC3S1000 | FG320                 | 221               | 100                        | 156                           | 12   | 16  | 29   | 8    | 0    |
| XC3S1500 | FG320                 | 221               | 100                        | 156                           | 12   | 16  | 29   | 8    | 0    |
| XC3S400  | FG456                 | 264               | 116                        | 196                           | 12   | 16  | 32   | 8    | 69   |
| XC3S1000 | FG456                 | 333               | 149                        | 261                           | 12   | 16  | 36   | 8    | 0    |
| XC3S1500 | FG456                 | 333               | 149                        | 261                           | 12   | 16  | 36   | 8    | 0    |
| XC3S2000 | FG456                 | 333               | 149                        | 261                           | 12   | 16  | 36   | 8    | 0    |
| XC3S1000 | FG676                 | 391               | 175                        | 315                           | 12   | 16  | 40   | 8    | 98   |
| XC3S1500 | FG676                 | 487               | 221                        | 403                           | 12   | 16  | 48   | 8    | 2    |
| XC3S2000 | FG676                 | 489               | 221                        | 405                           | 12   | 16  | 48   | 8    | 0    |
| XC3S4000 | FG676                 | 489               | 221                        | 405                           | 12   | 16  | 48   | 8    | 0    |
| XC3S5000 | FG676                 | 489               | 221                        | 405                           | 12   | 16  | 48   | 8    | 0    |
| XC3S2000 | FG900                 | 565               | 270                        | 481                           | 12   | 16  | 48   | 8    | 68   |
| XC3S4000 | FG900                 | 633               | 300                        | 549                           | 12   | 16  | 48   | 8    | 0    |
| XC3S5000 | FG900                 | 633               | 300                        | 549                           | 12   | 16  | 48   | 8    | 0    |
| XC3S4000 | FG1156 <sup>(1)</sup> | 712               | 312                        | 621                           | 12   | 16  | 55   | 8    | 73   |
| XC3S5000 | FG1156 <sup>(1)</sup> | 784               | 344                        | 692                           | 12   | 16  | 56   | 8    | 1    |

**Notes:**

1. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

Electronic versions of the package pinout tables and footprints 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. Download the files from the following location:

[http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip)

## Package Thermal Characteristics

The power dissipated by an FPGA application has implications on package selection and system design. The power consumed by a Spartan-3 FPGA is reported using either the [XPower Estimator \(XPE\)](#) or the XPower Analyzer integrated in the Xilinx ISE development software. [Table 86](#) provides the thermal characteristics for the various Spartan-3 device/package offerings.

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 per watt 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 86: Spartan-3 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 |         |
| VQ(G)100                | XC3S50   | 12.0                               | –                                   | 46.2   | 38.4    | 35.8    | 34.9    | °C/Watt |
|                         | XC3S200  | 10.0                               | –                                   | 40.5   | 33.7    | 31.3    | 30.5    | °C/Watt |
| CP(G)132 <sup>(1)</sup> | XC3S50   | 14.5                               | 32.8                                | 53.0   | 46.4    | 44.0    | 42.5    | °C/Watt |
| TQ(G)144                | XC3S50   | 7.6                                | –                                   | 41.0   | 31.9    | 27.2    | 25.6    | °C/Watt |
|                         | XC3S200  | 6.6                                | –                                   | 34.5   | 26.9    | 23.0    | 21.6    | °C/Watt |
|                         | XC3S400  | 6.1                                | –                                   | 32.8   | 25.5    | 21.8    | 20.4    | °C/Watt |
| PQ(G)208                | XC3S50   | 10.6                               | –                                   | 37.4   | 27.6    | 24.4    | 22.6    | °C/Watt |
|                         | XC3S200  | 8.6                                | –                                   | 36.2   | 26.7    | 23.6    | 21.9    | °C/Watt |
|                         | XC3S400  | 7.5                                | –                                   | 35.4   | 26.1    | 23.1    | 21.4    | °C/Watt |
| FT(G)256                | XC3S200  | 9.9                                | 22.9                                | 31.7   | 25.6    | 24.5    | 24.2    | °C/Watt |
|                         | XC3S400  | 7.9                                | 19.0                                | 28.4   | 22.8    | 21.5    | 21.0    | °C/Watt |
|                         | XC3S1000 | 5.6                                | 14.7                                | 24.8   | 19.2    | 18.0    | 17.5    | °C/Watt |
| FG(G)320                | XC3S400  | 8.9                                | 13.9                                | 24.4   | 19.0    | 17.8    | 17.0    | °C/Watt |
|                         | XC3S1000 | 7.8                                | 11.8                                | 22.3   | 17.0    | 15.8    | 15.0    | °C/Watt |
|                         | XC3S1500 | 6.7                                | 9.8                                 | 20.3   | 15.18   | 13.8    | 13.1    | °C/Watt |
| FG(G)456                | XC3S400  | 8.4                                | 13.6                                | 20.8   | 15.1    | 13.9    | 13.4    | °C/Watt |
|                         | XC3S1000 | 6.4                                | 10.6                                | 19.3   | 13.4    | 12.3    | 11.7    | °C/Watt |
|                         | XC3S1500 | 4.9                                | 8.3                                 | 18.3   | 12.4    | 11.2    | 10.7    | °C/Watt |
|                         | XC3S2000 | 3.7                                | 6.5                                 | 17.7   | 11.7    | 10.5    | 10.0    | °C/Watt |
| FG(G)676                | XC3S1000 | 6.0                                | 10.4                                | 17.9   | 13.7    | 12.6    | 12.0    | °C/Watt |
|                         | XC3S1500 | 4.9                                | 8.8                                 | 16.8   | 12.4    | 11.3    | 10.7    | °C/Watt |
|                         | XC3S2000 | 4.1                                | 7.9                                 | 15.6   | 11.1    | 9.9     | 9.3     | °C/Watt |
|                         | XC3S4000 | 3.6                                | 7.0                                 | 15.0   | 10.5    | 9.3     | 8.7     | °C/Watt |
|                         | XC3S5000 | 3.4                                | 6.3                                 | 14.7   | 10.3    | 9.1     | 8.5     | °C/Watt |
| FG(G)900                | XC3S2000 | 3.7                                | 7.0                                 | 14.3   | 10.3    | 9.3     | 8.8     | °C/Watt |
|                         | XC3S4000 | 3.3                                | 6.4                                 | 13.6   | 9.7     | 8.7     | 8.2     | °C/Watt |
|                         | XC3S5000 | 2.9                                | 5.9                                 | 13.1   | 9.2     | 8.1     | 7.6     | °C/Watt |

Table 86: Spartan-3 FPGA Package Thermal Characteristics (Cont'd)

| 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 |         |
| FG(G)1156 <sup>(1)</sup> | XC3S4000 | 1.9                                | –                                   | 14.7   | 11.4    | 10.1    | 9.0     | °C/Watt |
|                          | XC3S5000 | 1.9                                | 8.9                                 | 14.5   | 11.3    | 10.0    | 8.9     | °C/Watt |

**Notes:**

1. The CP132, CPG132, FG1156, and FGG1156 packages are discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

## VQ100: 100-lead Very-Thin Quad Flat Package

The XC3S50 and the XC3S200 devices are available in the 100-lead very-thin quad flat package, VQ100. Both devices share a common footprint for this package as shown in Table 87 and Figure 44.

All the package pins appear in Table 87 and are sorted by bank number, 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 [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 87: VQ100 Package Pinout

| Bank | XC3S50<br>XC3S200<br>Pin Name | VQ100<br>Pin<br>Number | Type |
|------|-------------------------------|------------------------|------|
| 0    | IO_L01N_0/VRP_0               | P97                    | DCI  |
| 0    | IO_L01P_0/VRN_0               | P96                    | DCI  |
| 0    | IO_L31N_0                     | P92                    | I/O  |
| 0    | IO_L31P_0/VREF_0              | P91                    | VREF |
| 0    | IO_L32N_0/GCLK7               | P90                    | GCLK |
| 0    | IO_L32P_0/GCLK6               | P89                    | GCLK |
| 0    | VCCO_0                        | P94                    | VCCO |
| 1    | IO                            | P81                    | I/O  |
| 1    | IO_L01N_1/VRP_1               | P80                    | DCI  |
| 1    | IO_L01P_1/VRN_1               | P79                    | DCI  |
| 1    | IO_L31N_1/VREF_1              | P86                    | VREF |
| 1    | IO_L31P_1                     | P85                    | I/O  |
| 1    | IO_L32N_1/GCLK5               | P88                    | GCLK |
| 1    | IO_L32P_1/GCLK4               | P87                    | GCLK |
| 1    | VCCO_1                        | P83                    | VCCO |
| 2    | IO_L01N_2/VRP_2               | P75                    | DCI  |
| 2    | IO_L01P_2/VRN_2               | P74                    | DCI  |
| 2    | IO_L21N_2                     | P72                    | I/O  |
| 2    | IO_L21P_2                     | P71                    | I/O  |
| 2    | IO_L24N_2                     | P68                    | I/O  |
| 2    | IO_L24P_2                     | P67                    | I/O  |

Table 87: VQ100 Package Pinout (Cont'd)

| Bank | XC3S50<br>XC3S200<br>Pin Name | VQ100<br>Pin<br>Number | Type |
|------|-------------------------------|------------------------|------|
| 2    | IO_L40N_2                     | P65                    | I/O  |
| 2    | IO_L40P_2/VREF_2              | P64                    | VREF |
| 2    | VCCO_2                        | P70                    | VCCO |
| 3    | IO                            | P55                    | I/O  |
| 3    | IO                            | P59                    | I/O  |
| 3    | IO_L01N_3/VRP_3               | P54                    | DCI  |
| 3    | IO_L01P_3/VRN_3               | P53                    | DCI  |
| 3    | IO_L24N_3                     | P61                    | I/O  |
| 3    | IO_L24P_3                     | P60                    | I/O  |
| 3    | IO_L40N_3/VREF_3              | P63                    | VREF |
| 3    | IO_L40P_3                     | P62                    | I/O  |
| 3    | VCCO_3                        | P57                    | VCCO |
| 4    | IO_L01N_4/VRP_4               | P50                    | DCI  |
| 4    | IO_L01P_4/VRN_4               | P49                    | DCI  |
| 4    | IO_L27N_4/DIN/D0              | P48                    | DUAL |
| 4    | IO_L27P_4/D1                  | P47                    | DUAL |
| 4    | IO_L30N_4/D2                  | P44                    | DUAL |
| 4    | IO_L30P_4/D3                  | P43                    | DUAL |
| 4    | IO_L31N_4/INIT_B              | P42                    | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY           | P40                    | DUAL |
| 4    | IO_L32N_4/GCLK1               | P39                    | GCLK |
| 4    | IO_L32P_4/GCLK0               | P38                    | GCLK |
| 4    | VCCO_4                        | P46                    | VCCO |
| 5    | IO_L01N_5/RDWR_B              | P28                    | DUAL |
| 5    | IO_L01P_5/CS_B                | P27                    | DUAL |
| 5    | IO_L28N_5/D6                  | P32                    | DUAL |
| 5    | IO_L28P_5/D7                  | P30                    | DUAL |
| 5    | IO_L31N_5/D4                  | P35                    | DUAL |
| 5    | IO_L31P_5/D5                  | P34                    | DUAL |
| 5    | IO_L32N_5/GCLK3               | P37                    | GCLK |
| 5    | IO_L32P_5/GCLK2               | P36                    | GCLK |
| 5    | VCCO_5                        | P31                    | VCCO |
| 6    | IO                            | P17                    | I/O  |
| 6    | IO                            | P21                    | I/O  |
| 6    | IO_L01N_6/VRP_6               | P23                    | DCI  |
| 6    | IO_L01P_6/VRN_6               | P22                    | DCI  |
| 6    | IO_L24N_6/VREF_6              | P16                    | VREF |
| 6    | IO_L24P_6                     | P15                    | I/O  |
| 6    | IO_L40N_6                     | P14                    | I/O  |



Table 87: VQ100 Package Pinout (Cont'd)

| Bank   | XC3S50<br>XC3S200<br>Pin Name | VQ100<br>Pin<br>Number | Type   |
|--------|-------------------------------|------------------------|--------|
| 6      | IO_L40P_6/VREF_6              | P13                    | VREF   |
| 6      | VCCO_6                        | P19                    | VCCO   |
| 7      | IO_L01N_7/VRP_7               | P2                     | DCI    |
| 7      | IO_L01P_7/VRN_7               | P1                     | DCI    |
| 7      | IO_L21N_7                     | P5                     | I/O    |
| 7      | IO_L21P_7                     | P4                     | I/O    |
| 7      | IO_L23N_7                     | P9                     | I/O    |
| 7      | IO_L23P_7                     | P8                     | I/O    |
| 7      | IO_L40N_7/VREF_7              | P12                    | VREF   |
| 7      | IO_L40P_7                     | P11                    | I/O    |
| 7      | VCCO_7                        | P6                     | VCCO   |
| N/A    | GND                           | P3                     | GND    |
| N/A    | GND                           | P10                    | GND    |
| N/A    | GND                           | P20                    | GND    |
| N/A    | GND                           | P29                    | GND    |
| N/A    | GND                           | P41                    | GND    |
| N/A    | GND                           | P56                    | GND    |
| N/A    | GND                           | P66                    | GND    |
| N/A    | GND                           | P73                    | GND    |
| N/A    | GND                           | P82                    | GND    |
| N/A    | GND                           | P95                    | GND    |
| N/A    | VCCAUX                        | P7                     | VCCAUX |
| N/A    | VCCAUX                        | P33                    | VCCAUX |
| N/A    | VCCAUX                        | P58                    | VCCAUX |
| N/A    | VCCAUX                        | P84                    | VCCAUX |
| N/A    | VCCINT                        | P18                    | VCCINT |
| N/A    | VCCINT                        | P45                    | VCCINT |
| N/A    | VCCINT                        | P69                    | VCCINT |
| N/A    | VCCINT                        | P93                    | VCCINT |
| VCCAUX | CCLK                          | P52                    | CONFIG |
| VCCAUX | DONE                          | P51                    | CONFIG |
| VCCAUX | HSWAP_EN                      | P98                    | CONFIG |
| VCCAUX | M0                            | P25                    | CONFIG |
| VCCAUX | M1                            | P24                    | CONFIG |
| VCCAUX | M2                            | P26                    | CONFIG |
| VCCAUX | PROG_B                        | P99                    | CONFIG |
| VCCAUX | TCK                           | P77                    | JTAG   |
| VCCAUX | TDI                           | P100                   | JTAG   |

Table 87: VQ100 Package Pinout (Cont'd)

| Bank   | XC3S50<br>XC3S200<br>Pin Name | VQ100<br>Pin<br>Number | Type |
|--------|-------------------------------|------------------------|------|
| VCCAUX | TDO                           | P76                    | JTAG |
| VCCAUX | TMS                           | P78                    | JTAG |

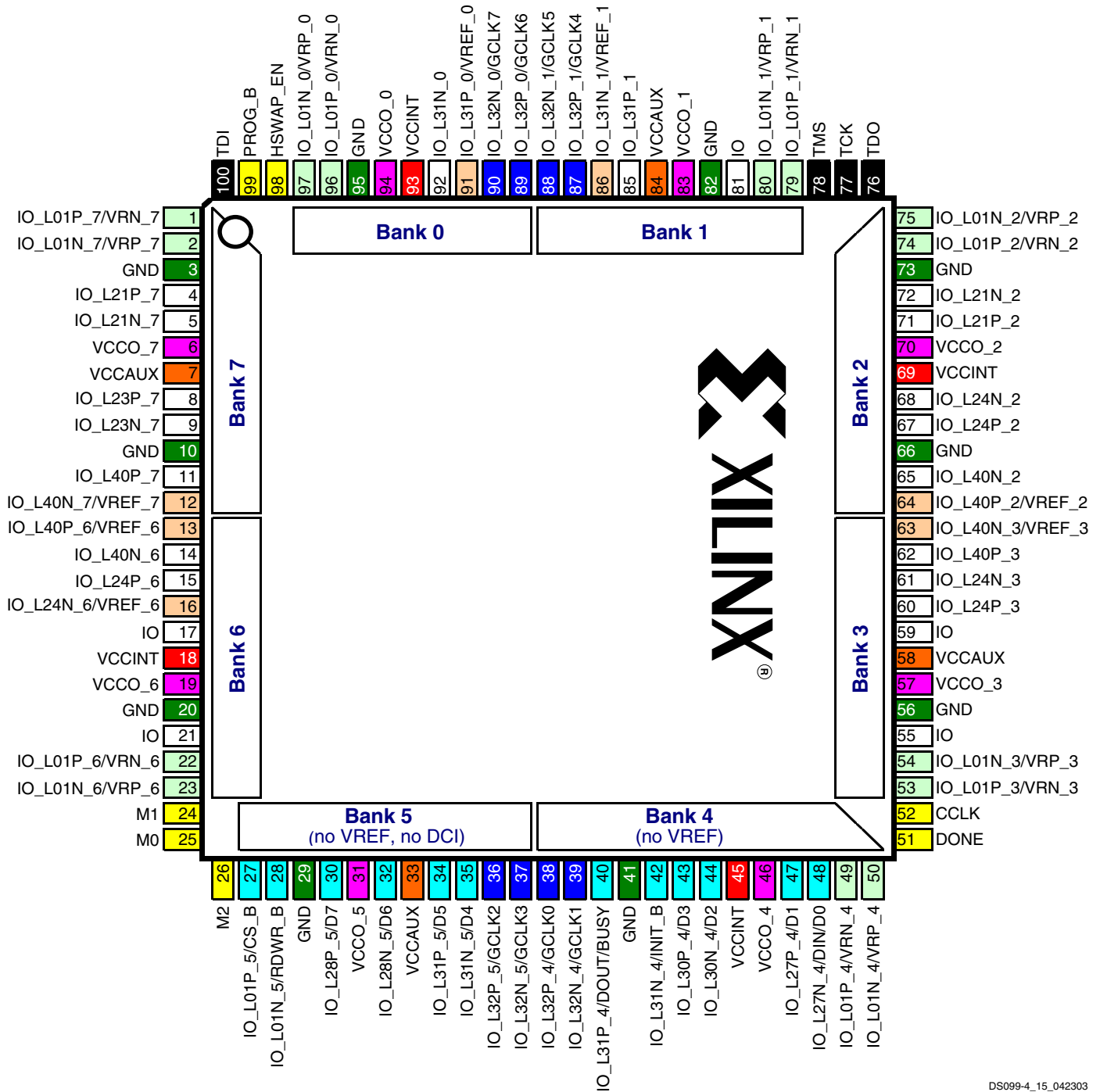
## User I/Os by Bank

Table 88 indicates how the available user-I/O pins are distributed between the eight I/O banks on the VQ100 package.

Table 88: User I/Os Per Bank in VQ100 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 6           | 1                             | 0    | 2   | 1    | 2    |
|              | 1        | 7           | 2                             | 0    | 2   | 1    | 2    |
| Right        | 2        | 8           | 5                             | 0    | 2   | 1    | 0    |
|              | 3        | 8           | 5                             | 0    | 2   | 1    | 0    |
| Bottom       | 4        | 10          | 0                             | 6    | 2   | 0    | 2    |
|              | 5        | 8           | 0                             | 6    | 0   | 0    | 2    |
| Left         | 6        | 8           | 4                             | 0    | 2   | 2    | 0    |
|              | 7        | 8           | 5                             | 0    | 2   | 1    | 0    |

VQ100 Footprint



DS099-4\_15\_042303

Figure 44: VQ100 Package Footprint (Top View). Note pin 1 indicator in top-left corner and logo orientation.

|    |  |    |   |   |  |
|----|--|----|---|---|--|
| 22 | I/O: Unrestricted, general-purpose user I/O                | 12 | <b>DUAL</b> : Configuration pin, then possible user I/O | 7 | <b>VREF</b> : User I/O or input voltage reference for bank |
| 14 | <b>DCI</b> : User I/O or reference resistor input for bank | 8  | <b>GCLK</b> : User I/O or global clock buffer input     | 8 | <b>VCCO</b> : Output voltage supply for bank               |
| 7  | <b>CONFIG</b> : Dedicated configuration pins               | 4  | <b>JTAG</b> : Dedicated JTAG port pins                  | 4 | <b>VCCINT</b> : Internal core voltage supply (+1.2V)       |
| 0  | <b>N.C.:</b> No unconnected pins in this package           | 10 | <b>GND</b> : Ground                                     | 4 | <b>VCCAUX</b> : Auxiliary voltage supply (+2.5V)           |

## CP132: 132-Ball Chip-Scale Package

**Note:** The CP132 and CPG132 packages are discontinued. See [www.xilinx.com/support/documentation/spartan-3.htm#19600](http://www.xilinx.com/support/documentation/spartan-3.htm#19600).

The pinout and footprint for the XC3S50 in the 132-ball chip-scale package, CP132, appear in [Table 89](#) and [Figure 45](#).

All the package pins appear in [Table 89](#) and are sorted by bank number, then by pin name. 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.

The CP132 footprint has eight I/O banks. However, the voltage supplies for the two I/O banks along an edge are connected together internally. Consequently, there are four output voltage supplies, labeled VCCO\_TOP, VCCO\_RIGHT, VCCO\_BOTTOM, and VCCO\_LEFT.

### Pinout Table

Table 89: CP132 Package Pinout

| Bank | XC3S50 Pin Name  | CP132 Ball | Type |
|------|------------------|------------|------|
| 0    | IO_L01N_0/VRP_0  | A3         | DCI  |
| 0    | IO_L01P_0/VRN_0  | C4         | DCI  |
| 0    | IO_L27N_0        | C5         | I/O  |
| 0    | IO_L27P_0        | B5         | I/O  |
| 0    | IO_L30N_0        | B6         | I/O  |
| 0    | IO_L30P_0        | A6         | I/O  |
| 0    | IO_L31N_0        | C7         | I/O  |
| 0    | IO_L31P_0/VREF_0 | B7         | VREF |
| 0    | IO_L32N_0/GCLK7  | A7         | GCLK |
| 0    | IO_L32P_0/GCLK6  | C8         | GCLK |
| 1    | IO_L01N_1/VRP_1  | A13        | DCI  |
| 1    | IO_L01P_1/VRN_1  | B13        | DCI  |
| 1    | IO_L27N_1        | C11        | I/O  |
| 1    | IO_L27P_1        | A12        | I/O  |
| 1    | IO_L28N_1        | A11        | I/O  |
| 1    | IO_L28P_1        | B11        | I/O  |
| 1    | IO_L31N_1/VREF_1 | C9         | VREF |
| 1    | IO_L31P_1        | A10        | I/O  |
| 1    | IO_L32N_1/GCLK5  | A8         | GCLK |
| 1    | IO_L32P_1/GCLK4  | A9         | GCLK |
| 2    | IO_L01N_2/VRP_2  | D12        | DCI  |
| 2    | IO_L01P_2/VRN_2  | C14        | DCI  |
| 2    | IO_L20N_2        | E12        | I/O  |
| 2    | IO_L20P_2        | E13        | I/O  |
| 2    | IO_L21N_2        | E14        | I/O  |
| 2    | IO_L21P_2        | F12        | I/O  |
| 2    | IO_L23N_2/VREF_2 | F13        | VREF |
| 2    | IO_L23P_2        | F14        | I/O  |
| 2    | IO_L24N_2        | G12        | I/O  |

Table 89: CP132 Package Pinout (Cont'd)

| Bank | XC3S50 Pin Name     | CP132 Ball | Type |
|------|---------------------|------------|------|
| 2    | IO_L24P_2           | G13        | I/O  |
| 2    | IO_L40N_2           | G14        | I/O  |
| 2    | IO_L40P_2/VREF_2    | H12        | VREF |
| 3    | IO_L01N_3/VRP_3     | N13        | DCI  |
| 3    | IO_L01P_3/VRN_3     | N14        | DCI  |
| 3    | IO_L20N_3           | L12        | I/O  |
| 3    | IO_L20P_3           | M14        | I/O  |
| 3    | IO_L22N_3           | L14        | I/O  |
| 3    | IO_L22P_3           | L13        | I/O  |
| 3    | IO_L23N_3           | K13        | I/O  |
| 3    | IO_L23P_3/VREF_3    | K12        | VREF |
| 3    | IO_L24N_3           | J12        | I/O  |
| 3    | IO_L24P_3           | K14        | I/O  |
| 3    | IO_L40N_3/VREF_3    | H14        | VREF |
| 3    | IO_L40P_3           | J13        | I/O  |
| 4    | IO/VREF_4           | N12        | VREF |
| 4    | IO_L01N_4/VRP_4     | P12        | DCI  |
| 4    | IO_L01P_4/VRN_4     | M11        | DCI  |
| 4    | IO_L27N_4/DIN/D0    | M10        | DUAL |
| 4    | IO_L27P_4/D1        | N10        | DUAL |
| 4    | IO_L30N_4/D2        | N9         | DUAL |
| 4    | IO_L30P_4/D3        | P9         | DUAL |
| 4    | IO_L31N_4/INIT_B    | M8         | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY | N8         | DUAL |
| 4    | IO_L32N_4/GCLK1     | P8         | GCLK |
| 4    | IO_L32P_4/GCLK0     | M7         | GCLK |
| 5    | IO_L01N_5/RDWR_B    | P2         | DUAL |
| 5    | IO_L01P_5/CS_B      | N2         | DUAL |
| 5    | IO_L27N_5/VREF_5    | M4         | VREF |
| 5    | IO_L27P_5           | P3         | I/O  |
| 5    | IO_L28N_5/D6        | P4         | DUAL |
| 5    | IO_L28P_5/D7        | N4         | DUAL |
| 5    | IO_L31N_5/D4        | M6         | DUAL |
| 5    | IO_L31P_5/D5        | P5         | DUAL |
| 5    | IO_L32N_5/GCLK3     | P7         | GCLK |
| 5    | IO_L32P_5/GCLK2     | P6         | GCLK |
| 6    | IO_L01N_6/VRP_6     | L3         | DCI  |
| 6    | IO_L01P_6/VRN_6     | M1         | DCI  |
| 6    | IO_L20N_6           | K3         | I/O  |
| 6    | IO_L20P_6           | K2         | I/O  |

Table 89: CP132 Package Pinout (Cont'd)

| Bank | XC3S50 Pin Name  | CP132 Ball | Type |
|------|------------------|------------|------|
| 6    | IO_L22N_6        | K1         | I/O  |
| 6    | IO_L22P_6        | J3         | I/O  |
| 6    | IO_L23N_6        | J2         | I/O  |
| 6    | IO_L23P_6        | J1         | I/O  |
| 6    | IO_L24N_6/VREF_6 | H3         | VREF |
| 6    | IO_L24P_6        | H2         | I/O  |
| 6    | IO_L40N_6        | H1         | I/O  |
| 6    | IO_L40P_6/VREF_6 | G3         | VREF |
| 7    | IO_L01N_7/VRP_7  | B2         | DCI  |
| 7    | IO_L01P_7/VRN_7  | B1         | DCI  |
| 7    | IO_L21N_7        | C1         | I/O  |
| 7    | IO_L21P_7        | D3         | I/O  |
| 7    | IO_L22N_7        | D1         | I/O  |
| 7    | IO_L22P_7        | D2         | I/O  |
| 7    | IO_L23N_7        | E2         | I/O  |
| 7    | IO_L23P_7        | E3         | I/O  |
| 7    | IO_L24N_7        | F3         | I/O  |
| 7    | IO_L24P_7        | E1         | I/O  |
| 7    | IO_L40N_7/VREF_7 | G1         | VREF |
| 7    | IO_L40P_7        | F2         | I/O  |
| 0,1  | VCCO_TOP         | B12        | VCCO |
| 0,1  | VCCO_TOP         | A4         | VCCO |
| 0,1  | VCCO_TOP         | B8         | VCCO |
| 2,3  | VCCO_RIGHT       | D13        | VCCO |
| 2,3  | VCCO_RIGHT       | H13        | VCCO |
| 2,3  | VCCO_RIGHT       | M12        | VCCO |
| 4,5  | VCCO_BOTTOM      | N7         | VCCO |
| 4,5  | VCCO_BOTTOM      | P11        | VCCO |
| 4,5  | VCCO_BOTTOM      | N3         | VCCO |
| 6,7  | VCCO_LEFT        | G2         | VCCO |
| 6,7  | VCCO_LEFT        | L2         | VCCO |
| 6,7  | VCCO_LEFT        | C3         | VCCO |
| N/A  | GND              | B4         | GND  |
| N/A  | GND              | B9         | GND  |
| N/A  | GND              | C2         | GND  |
| N/A  | GND              | C12        | GND  |
| N/A  | GND              | D14        | GND  |
| N/A  | GND              | F1         | GND  |
| N/A  | GND              | J14        | GND  |
| N/A  | GND              | L1         | GND  |

Table 89: CP132 Package Pinout (Cont'd)

| Bank   | XC3S50 Pin Name | CP132 Ball | Type   |
|--------|-----------------|------------|--------|
| N/A    | GND             | M3         | GND    |
| N/A    | GND             | M13        | GND    |
| N/A    | GND             | N6         | GND    |
| N/A    | GND             | N11        | GND    |
| N/A    | VCCAUX          | A5         | VCCAUX |
| N/A    | VCCAUX          | C10        | VCCAUX |
| N/A    | VCCAUX          | M5         | VCCAUX |
| N/A    | VCCAUX          | P10        | VCCAUX |
| N/A    | VCCINT          | B10        | VCCINT |
| N/A    | VCCINT          | C6         | VCCINT |
| N/A    | VCCINT          | M9         | VCCINT |
| N/A    | VCCINT          | N5         | VCCINT |
| VCCAUX | CCLK            | P14        | CONFIG |
| VCCAUX | DONE            | P13        | CONFIG |
| VCCAUX | HSWAP_EN        | B3         | CONFIG |
| VCCAUX | M0              | N1         | CONFIG |
| VCCAUX | M1              | M2         | CONFIG |
| VCCAUX | M2              | P1         | CONFIG |
| VCCAUX | PROG_B          | A2         | CONFIG |
| VCCAUX | TCK             | B14        | JTAG   |
| VCCAUX | TDI             | A1         | JTAG   |
| VCCAUX | TDO             | C13        | JTAG   |
| VCCAUX | TMS             | A14        | JTAG   |

### User I/Os by Bank

Table 90 indicates how the 89 available user-I/O pins are distributed between the eight I/O banks on the CP132 package. There are only four output banks, each with its own VCCO voltage input.

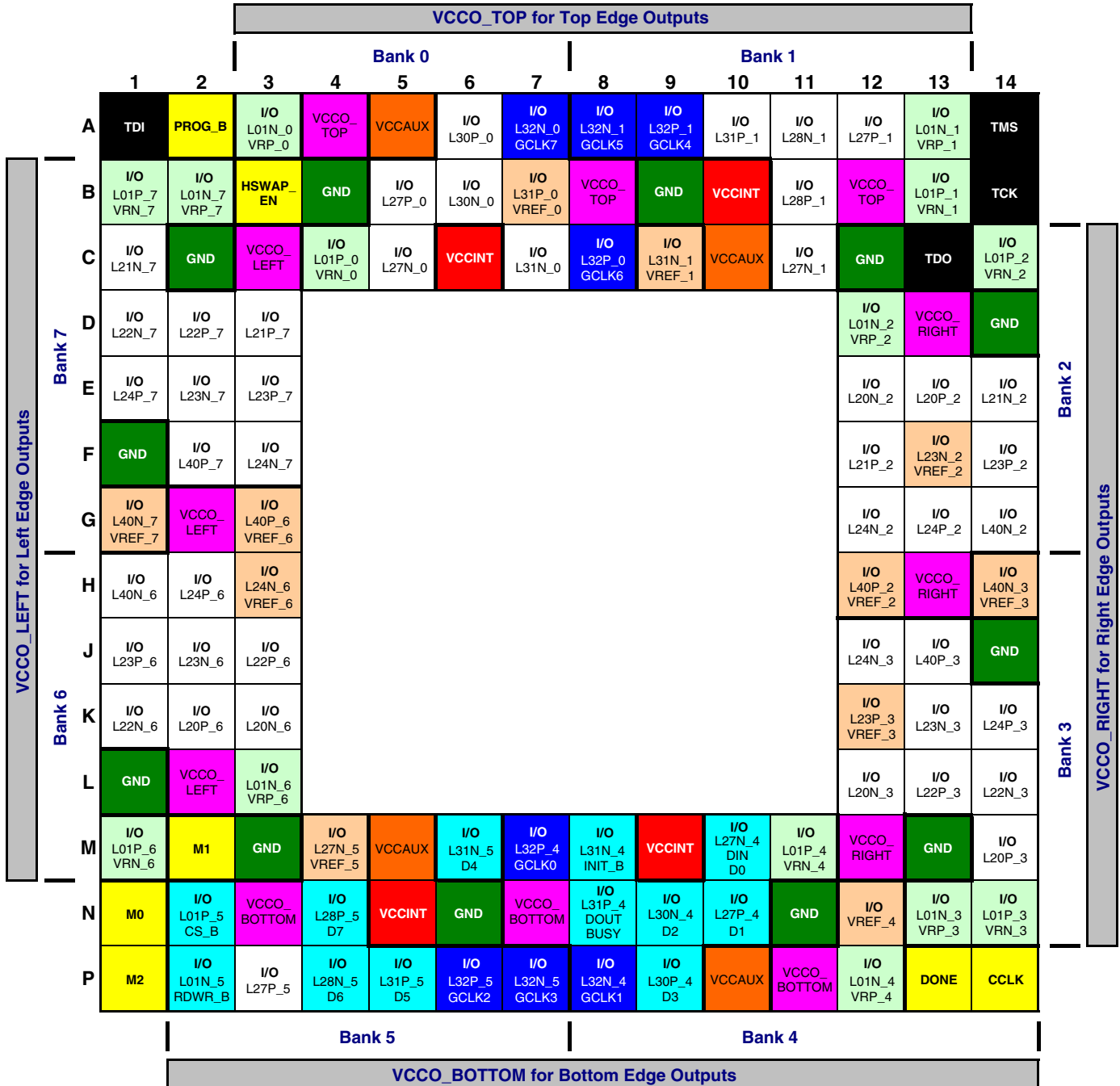
Table 90: User I/Os Per Bank for XC3S50 in CP132 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 10          | 5                             | 0    | 2   | 1    | 2    |
|              | 1        | 10          | 5                             | 0    | 2   | 1    | 2    |
| Right        | 2        | 12          | 8                             | 0    | 2   | 2    | 0    |
|              | 3        | 12          | 8                             | 0    | 2   | 2    | 0    |
| Bottom       | 4        | 11          | 0                             | 6    | 2   | 1    | 2    |
|              | 5        | 10          | 1                             | 6    | 0   | 1    | 2    |
| Left         | 6        | 12          | 8                             | 0    | 2   | 2    | 0    |
|              | 7        | 12          | 9                             | 0    | 2   | 1    | 0    |

**Notes:**

1. The CP132 and CPG132 packages are discontinued. See [www.xilinx.com/support/documentation/spartan-3.htm#19600](http://www.xilinx.com/support/documentation/spartan-3.htm#19600).

CP132 Footprint



DS099-4\_17\_011005

Figure 45: CP132 Package Footprint (Top View). Note pin 1 indicator in top-left corner and logo orientation.

- 44 I/O: Unrestricted, general-purpose user I/O

14 DCI: User I/O or reference resistor input for bank

7 CONFIG: Dedicated configuration pins

0 N.C.: No unconnected pins in this package
- 12 DUAL: Configuration pin, then possible user I/O

8 GCLK: User I/O, input, or global buffer input

4 JTAG: Dedicated JTAG port pins

12 GND: Ground
- 11 VREF: User I/O or input voltage reference for bank

12 VCCO: Output voltage supply for bank

4 VCCINT: Internal core voltage supply (+1.2V)

4 VCCAUX: Auxiliary voltage supply (+2.5V)



## TQ144: 144-lead Thin Quad Flat Package

The XC3S50, the XC3S200, and the XC3S400 are available in the 144-lead thin quad flat package, TQ144. All devices share a common footprint for this package as shown in [Table 91](#) and [Figure 46](#).

The TQ144 package only has four separate VCCO inputs, unlike the BGA packages, which have eight separate VCCO inputs. The TQ144 package has a separate VCCO input for the top, bottom, left, and right. However, there are still eight separate I/O banks, as shown in [Table 91](#) and [Figure 46](#). Banks 0 and 1 share the VCCO\_TOP input, Banks 2 and 3 share the VCCO\_RIGHT input, Banks 4 and 5 share the VCCO\_BOTTOM input, and Banks 6 and 7 share the VCCO\_LEFT input.

All the package pins appear in [Table 91](#) and are sorted by bank number, 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 [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 91: TQ144 Package Pinout

| Bank | XC3S50, XC3S200, XC3S400 Pin Name | TQ144 Pin Number | Type |
|------|-----------------------------------|------------------|------|
| 0    | IO_L01N_0/VRP_0                   | P141             | DCI  |
| 0    | IO_L01P_0/VRN_0                   | P140             | DCI  |
| 0    | IO_L27N_0                         | P137             | I/O  |
| 0    | IO_L27P_0                         | P135             | I/O  |
| 0    | IO_L30N_0                         | P132             | I/O  |
| 0    | IO_L30P_0                         | P131             | I/O  |
| 0    | IO_L31N_0                         | P130             | I/O  |
| 0    | IO_L31P_0/VREF_0                  | P129             | VREF |
| 0    | IO_L32N_0/GCLK7                   | P128             | GCLK |
| 0    | IO_L32P_0/GCLK6                   | P127             | GCLK |
| 1    | IO                                | P116             | I/O  |
| 1    | IO_L01N_1/VRP_1                   | P113             | DCI  |
| 1    | IO_L01P_1/VRN_1                   | P112             | DCI  |
| 1    | IO_L28N_1                         | P119             | I/O  |
| 1    | IO_L28P_1                         | P118             | I/O  |
| 1    | IO_L31N_1/VREF_1                  | P123             | VREF |
| 1    | IO_L31P_1                         | P122             | I/O  |
| 1    | IO_L32N_1/GCLK5                   | P125             | GCLK |
| 1    | IO_L32P_1/GCLK4                   | P124             | GCLK |
| 2    | IO_L01N_2/VRP_2                   | P108             | DCI  |
| 2    | IO_L01P_2/VRN_2                   | P107             | DCI  |
| 2    | IO_L20N_2                         | P105             | I/O  |
| 2    | IO_L20P_2                         | P104             | I/O  |
| 2    | IO_L21N_2                         | P103             | I/O  |
| 2    | IO_L21P_2                         | P102             | I/O  |
| 2    | IO_L22N_2                         | P100             | I/O  |
| 2    | IO_L22P_2                         | P99              | I/O  |

Table 91: TQ144 Package Pinout (Cont'd)

| Bank | XC3S50, XC3S200,<br>XC3S400 Pin Name | TQ144 Pin<br>Number | Type |
|------|--------------------------------------|---------------------|------|
| 2    | IO_L23N_2/VREF_2                     | P98                 | VREF |
| 2    | IO_L23P_2                            | P97                 | I/O  |
| 2    | IO_L24N_2                            | P96                 | I/O  |
| 2    | IO_L24P_2                            | P95                 | I/O  |
| 2    | IO_L40N_2                            | P93                 | I/O  |
| 2    | IO_L40P_2/VREF_2                     | P92                 | VREF |
| 3    | IO                                   | P76                 | I/O  |
| 3    | IO_L01N_3/VRP_3                      | P74                 | DCI  |
| 3    | IO_L01P_3/VRN_3                      | P73                 | DCI  |
| 3    | IO_L20N_3                            | P78                 | I/O  |
| 3    | IO_L20P_3                            | P77                 | I/O  |
| 3    | IO_L21N_3                            | P80                 | I/O  |
| 3    | IO_L21P_3                            | P79                 | I/O  |
| 3    | IO_L22N_3                            | P83                 | I/O  |
| 3    | IO_L22P_3                            | P82                 | I/O  |
| 3    | IO_L23N_3                            | P85                 | I/O  |
| 3    | IO_L23P_3/VREF_3                     | P84                 | VREF |
| 3    | IO_L24N_3                            | P87                 | I/O  |
| 3    | IO_L24P_3                            | P86                 | I/O  |
| 3    | IO_L40N_3/VREF_3                     | P90                 | VREF |
| 3    | IO_L40P_3                            | P89                 | I/O  |
| 4    | IO/VREF_4                            | P70                 | VREF |
| 4    | IO_L01N_4/VRP_4                      | P69                 | DCI  |
| 4    | IO_L01P_4/VRN_4                      | P68                 | DCI  |
| 4    | IO_L27N_4/DIN/D0                     | P65                 | DUAL |
| 4    | IO_L27P_4/D1                         | P63                 | DUAL |
| 4    | IO_L30N_4/D2                         | P60                 | DUAL |
| 4    | IO_L30P_4/D3                         | P59                 | DUAL |
| 4    | IO_L31N_4/INIT_B                     | P58                 | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY                  | P57                 | DUAL |
| 4    | IO_L32N_4/GCLK1                      | P56                 | GCLK |
| 4    | IO_L32P_4/GCLK0                      | P55                 | GCLK |
| 5    | IO/VREF_5                            | P44                 | VREF |
| 5    | IO_L01N_5/RDWR_B                     | P41                 | DUAL |
| 5    | IO_L01P_5/CS_B                       | P40                 | DUAL |
| 5    | IO_L28N_5/D6                         | P47                 | DUAL |
| 5    | IO_L28P_5/D7                         | P46                 | DUAL |
| 5    | IO_L31N_5/D4                         | P51                 | DUAL |
| 5    | IO_L31P_5/D5                         | P50                 | DUAL |
| 5    | IO_L32N_5/GCLK3                      | P53                 | GCLK |

Table 91: TQ144 Package Pinout (Cont'd)

| Bank | XC3S50, XC3S200,<br>XC3S400 Pin Name | TQ144 Pin<br>Number | Type |
|------|--------------------------------------|---------------------|------|
| 5    | IO_L32P_5/GCLK2                      | P52                 | GCLK |
| 6    | IO_L01N_6/VRP_6                      | P36                 | DCI  |
| 6    | IO_L01P_6/VRN_6                      | P35                 | DCI  |
| 6    | IO_L20N_6                            | P33                 | I/O  |
| 6    | IO_L20P_6                            | P32                 | I/O  |
| 6    | IO_L21N_6                            | P31                 | I/O  |
| 6    | IO_L21P_6                            | P30                 | I/O  |
| 6    | IO_L22N_6                            | P28                 | I/O  |
| 6    | IO_L22P_6                            | P27                 | I/O  |
| 6    | IO_L23N_6                            | P26                 | I/O  |
| 6    | IO_L23P_6                            | P25                 | I/O  |
| 6    | IO_L24N_6/VREF_6                     | P24                 | VREF |
| 6    | IO_L24P_6                            | P23                 | I/O  |
| 6    | IO_L40N_6                            | P21                 | I/O  |
| 6    | IO_L40P_6/VREF_6                     | P20                 | VREF |
| 7    | IO/VREF_7                            | P4                  | VREF |
| 7    | IO_L01N_7/VRP_7                      | P2                  | DCI  |
| 7    | IO_L01P_7/VRN_7                      | P1                  | DCI  |
| 7    | IO_L20N_7                            | P6                  | I/O  |
| 7    | IO_L20P_7                            | P5                  | I/O  |
| 7    | IO_L21N_7                            | P8                  | I/O  |
| 7    | IO_L21P_7                            | P7                  | I/O  |
| 7    | IO_L22N_7                            | P11                 | I/O  |
| 7    | IO_L22P_7                            | P10                 | I/O  |
| 7    | IO_L23N_7                            | P13                 | I/O  |
| 7    | IO_L23P_7                            | P12                 | I/O  |
| 7    | IO_L24N_7                            | P15                 | I/O  |
| 7    | IO_L24P_7                            | P14                 | I/O  |
| 7    | IO_L40N_7/VREF_7                     | P18                 | VREF |
| 7    | IO_L40P_7                            | P17                 | I/O  |
| 0,1  | VCCO_TOP                             | P126                | VCCO |
| 0,1  | VCCO_TOP                             | P138                | VCCO |
| 0,1  | VCCO_TOP                             | P115                | VCCO |
| 2,3  | VCCO_RIGHT                           | P106                | VCCO |
| 2,3  | VCCO_RIGHT                           | P75                 | VCCO |
| 2,3  | VCCO_RIGHT                           | P91                 | VCCO |
| 4,5  | VCCO_BOTTOM                          | P54                 | VCCO |
| 4,5  | VCCO_BOTTOM                          | P43                 | VCCO |
| 4,5  | VCCO_BOTTOM                          | P66                 | VCCO |
| 6,7  | VCCO_LEFT                            | P19                 | VCCO |

Table 91: TQ144 Package Pinout (Cont'd)

| Bank   | XC3S50, XC3S200,<br>XC3S400 Pin Name | TQ144 Pin<br>Number | Type   |
|--------|--------------------------------------|---------------------|--------|
| 6,7    | VCCO_LEFT                            | P34                 | VCCO   |
| 6,7    | VCCO_LEFT                            | P3                  | VCCO   |
| N/A    | GND                                  | P136                | GND    |
| N/A    | GND                                  | P139                | GND    |
| N/A    | GND                                  | P114                | GND    |
| N/A    | GND                                  | P117                | GND    |
| N/A    | GND                                  | P94                 | GND    |
| N/A    | GND                                  | P101                | GND    |
| N/A    | GND                                  | P81                 | GND    |
| N/A    | GND                                  | P88                 | GND    |
| N/A    | GND                                  | P64                 | GND    |
| N/A    | GND                                  | P67                 | GND    |
| N/A    | GND                                  | P42                 | GND    |
| N/A    | GND                                  | P45                 | GND    |
| N/A    | GND                                  | P22                 | GND    |
| N/A    | GND                                  | P29                 | GND    |
| N/A    | GND                                  | P9                  | GND    |
| N/A    | GND                                  | P16                 | GND    |
| N/A    | VCCAUX                               | P134                | VCCAUX |
| N/A    | VCCAUX                               | P120                | VCCAUX |
| N/A    | VCCAUX                               | P62                 | VCCAUX |
| N/A    | VCCAUX                               | P48                 | VCCAUX |
| N/A    | VCCINT                               | P133                | VCCINT |
| N/A    | VCCINT                               | P121                | VCCINT |
| N/A    | VCCINT                               | P61                 | VCCINT |
| N/A    | VCCINT                               | P49                 | VCCINT |
| VCCAUX | CCLK                                 | P72                 | CONFIG |
| VCCAUX | DONE                                 | P71                 | CONFIG |
| VCCAUX | HSWAP_EN                             | P142                | CONFIG |
| VCCAUX | M0                                   | P38                 | CONFIG |
| VCCAUX | M1                                   | P37                 | CONFIG |
| VCCAUX | M2                                   | P39                 | CONFIG |
| VCCAUX | PROG_B                               | P143                | CONFIG |
| VCCAUX | TCK                                  | P110                | JTAG   |
| VCCAUX | TDI                                  | P144                | JTAG   |
| VCCAUX | TDO                                  | P109                | JTAG   |
| VCCAUX | TMS                                  | P111                | JTAG   |

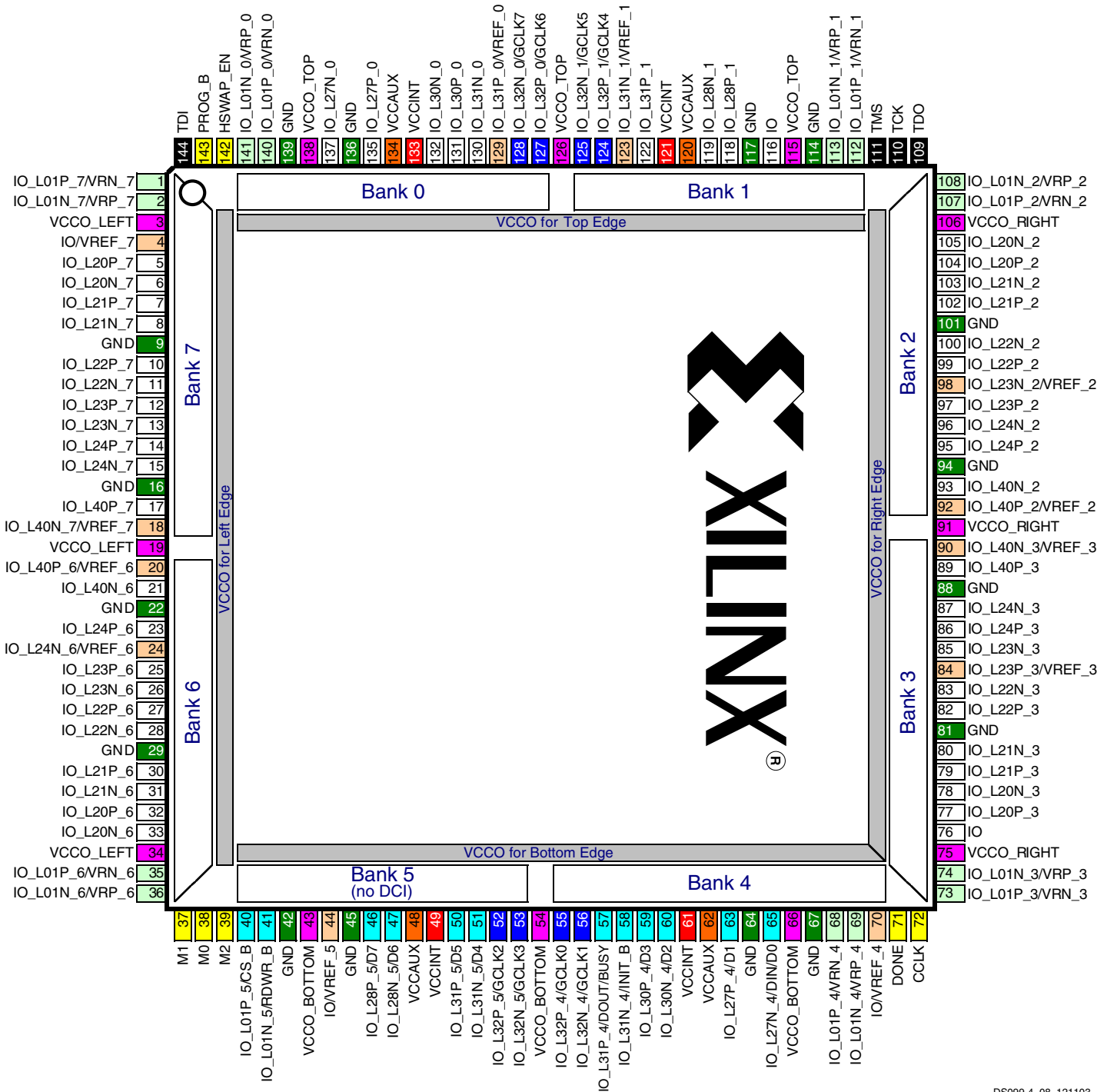
## User I/Os by Bank

Table 92 indicates how the available user-I/O pins are distributed between the eight I/O banks on the TQ144 package.

Table 92: User I/Os Per Bank in TQ144 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 10          | 5                             | 0    | 2   | 1    | 2    |
|              | 1        | 9           | 4                             | 0    | 2   | 1    | 2    |
| Right        | 2        | 14          | 10                            | 0    | 2   | 2    | 0    |
|              | 3        | 15          | 11                            | 0    | 2   | 2    | 0    |
| Bottom       | 4        | 11          | 0                             | 6    | 2   | 1    | 2    |
|              | 5        | 9           | 0                             | 6    | 0   | 1    | 2    |
| Left         | 6        | 14          | 10                            | 0    | 2   | 2    | 0    |
|              | 7        | 15          | 11                            | 0    | 2   | 2    | 0    |

TQ144 Footprint



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Figure 46: TQ144 Package Footprint (Top View). Note pin 1 indicator in top-left corner and logo orientation.

|    |   |    |  |    |   |
|----|---|----|--|----|---|
| 51 | <b>I/O:</b> Unrestricted, general-purpose user I/O        | 12 | <b>DUAL:</b> Configuration pin, then possible user I/O | 12 | <b>VREF:</b> User I/O or input voltage reference for bank |
| 14 | <b>DCI:</b> User I/O or reference resistor input for bank | 8  | <b>GCLK:</b> User I/O or global clock buffer input     | 12 | <b>VCCO:</b> Output voltage supply for bank               |
| 7  | <b>CONFIG:</b> Dedicated configuration pins               | 4  | <b>JTAG:</b> Dedicated JTAG port pins                  | 4  | <b>VCCINT:</b> Internal core voltage supply (+1.2V)       |
| 0  | <b>N.C.:</b> No unconnected pins in this package          | 16 | <b>GND:</b> Ground                                     | 4  | <b>VCCAUX:</b> Auxiliary voltage supply (+2.5V)           |

## PQ208: 208-lead Plastic Quad Flat Pack

The 208-lead plastic quad flat package, PQ208, supports three different Spartan-3 devices, including the XC3S50, the XC3S200, and the XC3S400. The footprints for the XC3S200 and XC3S400 are identical, as shown in [Table 93](#) and [Figure 47](#). The XC3S50, however, has fewer I/O pins resulting in 17 unconnected pins on the PQ208 package, labeled as “N.C.” In [Table 93](#) and [Figure 47](#), these unconnected pins are indicated with a black diamond symbol (◆).

All the package pins appear in [Table 93](#) and are sorted by bank number, 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.

If there is a difference between the XC3S50 pinout and the pinout for the XC3S200 and XC3S400, then that difference is highlighted in [Table 93](#). If the table entry is shaded grey, then there is an unconnected pin on the XC3S50 that maps to a user-I/O pin on the XC3S200 and XC3S400. If the table entry is shaded tan, then the unconnected pin on the XC3S50 maps to a VREF-type pin on the XC3S200 and XC3S400. If the other VREF pins in the bank all connect to a voltage reference to support a special I/O standard, then also connect the N.C. pin on the XC3S50 to the same VREF voltage. This provides maximum flexibility as you could potentially migrate a design from the XC3S50 device to an XC3S200 or XC3S400 FPGA without changing the printed circuit board.

An electronic version of this package pinout table and footprint diagram is available for download from the Xilinx website at [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip)

### Pinout Table

Table 93: PQ208 Package Pinout

| Bank | XC3S50 Pin Name  | XC3S200, XC3S400 Pin Names | PQ208 Pin Number | Type |
|------|------------------|----------------------------|------------------|------|
| 0    | IO               | IO                         | P189             | I/O  |
| 0    | IO               | IO                         | P197             | I/O  |
| 0    | N.C. (◆)         | IO/VREF_0                  | P200             | VREF |
| 0    | IO/VREF_0        | IO/VREF_0                  | P205             | VREF |
| 0    | IO_L01N_0/VRP_0  | IO_L01N_0/VRP_0            | P204             | DCI  |
| 0    | IO_L01P_0/VRN_0  | IO_L01P_0/VRN_0            | P203             | DCI  |
| 0    | IO_L25N_0        | IO_L25N_0                  | P199             | I/O  |
| 0    | IO_L25P_0        | IO_L25P_0                  | P198             | I/O  |
| 0    | IO_L27N_0        | IO_L27N_0                  | P196             | I/O  |
| 0    | IO_L27P_0        | IO_L27P_0                  | P194             | I/O  |
| 0    | IO_L30N_0        | IO_L30N_0                  | P191             | I/O  |
| 0    | IO_L30P_0        | IO_L30P_0                  | P190             | I/O  |
| 0    | IO_L31N_0        | IO_L31N_0                  | P187             | I/O  |
| 0    | IO_L31P_0/VREF_0 | IO_L31P_0/VREF_0           | P185             | VREF |
| 0    | IO_L32N_0/GCLK7  | IO_L32N_0/GCLK7            | P184             | GCLK |
| 0    | IO_L32P_0/GCLK6  | IO_L32P_0/GCLK6            | P183             | GCLK |
| 0    | VCCO_0           | VCCO_0                     | P188             | VCCO |
| 0    | VCCO_0           | VCCO_0                     | P201             | VCCO |
| 1    | IO               | IO                         | P167             | I/O  |
| 1    | IO               | IO                         | P175             | I/O  |
| 1    | IO               | IO                         | P182             | I/O  |
| 1    | IO_L01N_1/VRP_1  | IO_L01N_1/VRP_1            | P162             | DCI  |
| 1    | IO_L01P_1/VRN_1  | IO_L01P_1/VRN_1            | P161             | DCI  |

Table 93: PQ208 Package Pinout (Cont'd)

| Bank | XC3S50 Pin Name  | XC3S200, XC3S400 Pin Names | PQ208 Pin Number | Type |
|------|------------------|----------------------------|------------------|------|
| 1    | IO_L10N_1/VREF_1 | IO_L10N_1/VREF_1           | P166             | VREF |
| 1    | IO_L10P_1        | IO_L10P_1                  | P165             | I/O  |
| 1    | IO_L27N_1        | IO_L27N_1                  | P169             | I/O  |
| 1    | IO_L27P_1        | IO_L27P_1                  | P168             | I/O  |
| 1    | IO_L28N_1        | IO_L28N_1                  | P172             | I/O  |
| 1    | IO_L28P_1        | IO_L28P_1                  | P171             | I/O  |
| 1    | IO_L31N_1/VREF_1 | IO_L31N_1/VREF_1           | P178             | VREF |
| 1    | IO_L31P_1        | IO_L31P_1                  | P176             | I/O  |
| 1    | IO_L32N_1/GCLK5  | IO_L32N_1/GCLK5            | P181             | GCLK |
| 1    | IO_L32P_1/GCLK4  | IO_L32P_1/GCLK4            | P180             | GCLK |
| 1    | VCCO_1           | VCCO_1                     | P164             | VCCO |
| 1    | VCCO_1           | VCCO_1                     | P177             | VCCO |
| 2    | N.C. (◆)         | IO/VREF_2                  | P154             | VREF |
| 2    | IO_L01N_2/VRP_2  | IO_L01N_2/VRP_2            | P156             | DCI  |
| 2    | IO_L01P_2/VRN_2  | IO_L01P_2/VRN_2            | P155             | DCI  |
| 2    | IO_L19N_2        | IO_L19N_2                  | P152             | I/O  |
| 2    | IO_L19P_2        | IO_L19P_2                  | P150             | I/O  |
| 2    | IO_L20N_2        | IO_L20N_2                  | P149             | I/O  |
| 2    | IO_L20P_2        | IO_L20P_2                  | P148             | I/O  |
| 2    | IO_L21N_2        | IO_L21N_2                  | P147             | I/O  |
| 2    | IO_L21P_2        | IO_L21P_2                  | P146             | I/O  |
| 2    | IO_L22N_2        | IO_L22N_2                  | P144             | I/O  |
| 2    | IO_L22P_2        | IO_L22P_2                  | P143             | I/O  |
| 2    | IO_L23N_2/VREF_2 | IO_L23N_2/VREF_2           | P141             | VREF |
| 2    | IO_L23P_2        | IO_L23P_2                  | P140             | I/O  |
| 2    | IO_L24N_2        | IO_L24N_2                  | P139             | I/O  |
| 2    | IO_L24P_2        | IO_L24P_2                  | P138             | I/O  |
| 2    | N.C. (◆)         | IO_L39N_2                  | P137             | I/O  |
| 2    | N.C. (◆)         | IO_L39P_2                  | P135             | I/O  |
| 2    | IO_L40N_2        | IO_L40N_2                  | P133             | I/O  |
| 2    | IO_L40P_2/VREF_2 | IO_L40P_2/VREF_2           | P132             | VREF |
| 2    | VCCO_2           | VCCO_2                     | P136             | VCCO |
| 2    | VCCO_2           | VCCO_2                     | P153             | VCCO |
| 3    | IO_L01N_3/VRP_3  | IO_L01N_3/VRP_3            | P107             | DCI  |
| 3    | IO_L01P_3/VRN_3  | IO_L01P_3/VRN_3            | P106             | DCI  |
| 3    | N.C. (◆)         | IO_L17N_3                  | P109             | I/O  |
| 3    | N.C. (◆)         | IO_L17P_3/VREF_3           | P108             | VREF |
| 3    | IO_L19N_3        | IO_L19N_3                  | P113             | I/O  |
| 3    | IO_L19P_3        | IO_L19P_3                  | P111             | I/O  |
| 3    | IO_L20N_3        | IO_L20N_3                  | P115             | I/O  |



Table 93: PQ208 Package Pinout (Cont'd)

| Bank | XC3S50 Pin Name     | XC3S200, XC3S400 Pin Names | PQ208 Pin Number | Type |
|------|---------------------|----------------------------|------------------|------|
| 3    | IO_L20P_3           | IO_L20P_3                  | P114             | I/O  |
| 3    | IO_L21N_3           | IO_L21N_3                  | P117             | I/O  |
| 3    | IO_L21P_3           | IO_L21P_3                  | P116             | I/O  |
| 3    | IO_L22N_3           | IO_L22N_3                  | P120             | I/O  |
| 3    | IO_L22P_3           | IO_L22P_3                  | P119             | I/O  |
| 3    | IO_L23N_3           | IO_L23N_3                  | P123             | I/O  |
| 3    | IO_L23P_3/VREF_3    | IO_L23P_3/VREF_3           | P122             | VREF |
| 3    | IO_L24N_3           | IO_L24N_3                  | P125             | I/O  |
| 3    | IO_L24P_3           | IO_L24P_3                  | P124             | I/O  |
| 3    | N.C. (◆)            | IO_L39N_3                  | P128             | I/O  |
| 3    | N.C. (◆)            | IO_L39P_3                  | P126             | I/O  |
| 3    | IO_L40N_3/VREF_3    | IO_L40N_3/VREF_3           | P131             | VREF |
| 3    | IO_L40P_3           | IO_L40P_3                  | P130             | I/O  |
| 3    | VCCO_3              | VCCO_3                     | P110             | VCCO |
| 3    | VCCO_3              | VCCO_3                     | P127             | VCCO |
| 4    | IO                  | IO                         | P93              | I/O  |
| 4    | N.C. (◆)            | IO                         | P97              | I/O  |
| 4    | IO/VREF_4           | IO/VREF_4                  | P85              | VREF |
| 4    | N.C. (◆)            | IO/VREF_4                  | P96              | VREF |
| 4    | IO/VREF_4           | IO/VREF_4                  | P102             | VREF |
| 4    | IO_L01N_4/VRP_4     | IO_L01N_4/VRP_4            | P101             | DCI  |
| 4    | IO_L01P_4/VRN_4     | IO_L01P_4/VRN_4            | P100             | DCI  |
| 4    | IO_L25N_4           | IO_L25N_4                  | P95              | I/O  |
| 4    | IO_L25P_4           | IO_L25P_4                  | P94              | I/O  |
| 4    | IO_L27N_4/DIN/D0    | IO_L27N_4/DIN/D0           | P92              | DUAL |
| 4    | IO_L27P_4/D1        | IO_L27P_4/D1               | P90              | DUAL |
| 4    | IO_L30N_4/D2        | IO_L30N_4/D2               | P87              | DUAL |
| 4    | IO_L30P_4/D3        | IO_L30P_4/D3               | P86              | DUAL |
| 4    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B           | P83              | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY        | P81              | DUAL |
| 4    | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1            | P80              | GCLK |
| 4    | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0            | P79              | GCLK |
| 4    | VCCO_4              | VCCO_4                     | P84              | VCCO |
| 4    | VCCO_4              | VCCO_4                     | P98              | VCCO |
| 5    | IO                  | IO                         | P63              | I/O  |
| 5    | IO                  | IO                         | P71              | I/O  |
| 5    | IO/VREF_5           | IO/VREF_5                  | P78              | VREF |
| 5    | IO_L01N_5/RDWR_B    | IO_L01N_5/RDWR_B           | P58              | DUAL |
| 5    | IO_L01P_5/CS_B      | IO_L01P_5/CS_B             | P57              | DUAL |
| 5    | IO_L10N_5/VRP_5     | IO_L10N_5/VRP_5            | P62              | DCI  |

Table 93: PQ208 Package Pinout (Cont'd)

| Bank | XC3S50 Pin Name  | XC3S200, XC3S400 Pin Names | PQ208 Pin Number | Type |
|------|------------------|----------------------------|------------------|------|
| 5    | IO_L10P_5/VRN_5  | IO_L10P_5/VRN_5            | P61              | DCI  |
| 5    | IO_L27N_5/VREF_5 | IO_L27N_5/VREF_5           | P65              | VREF |
| 5    | IO_L27P_5        | IO_L27P_5                  | P64              | I/O  |
| 5    | IO_L28N_5/D6     | IO_L28N_5/D6               | P68              | DUAL |
| 5    | IO_L28P_5/D7     | IO_L28P_5/D7               | P67              | DUAL |
| 5    | IO_L31N_5/D4     | IO_L31N_5/D4               | P74              | DUAL |
| 5    | IO_L31P_5/D5     | IO_L31P_5/D5               | P72              | DUAL |
| 5    | IO_L32N_5/GCLK3  | IO_L32N_5/GCLK3            | P77              | GCLK |
| 5    | IO_L32P_5/GCLK2  | IO_L32P_5/GCLK2            | P76              | GCLK |
| 5    | VCCO_5           | VCCO_5                     | P60              | VCCO |
| 5    | VCCO_5           | VCCO_5                     | P73              | VCCO |
| 6    | N.C. (◆)         | IO/VREF_6                  | P50              | VREF |
| 6    | IO_L01N_6/VRP_6  | IO_L01N_6/VRP_6            | P52              | DCI  |
| 6    | IO_L01P_6/VRN_6  | IO_L01P_6/VRN_6            | P51              | DCI  |
| 6    | IO_L19N_6        | IO_L19N_6                  | P48              | I/O  |
| 6    | IO_L19P_6        | IO_L19P_6                  | P46              | I/O  |
| 6    | IO_L20N_6        | IO_L20N_6                  | P45              | I/O  |
| 6    | IO_L20P_6        | IO_L20P_6                  | P44              | I/O  |
| 6    | IO_L21N_6        | IO_L21N_6                  | P43              | I/O  |
| 6    | IO_L21P_6        | IO_L21P_6                  | P42              | I/O  |
| 6    | IO_L22N_6        | IO_L22N_6                  | P40              | I/O  |
| 6    | IO_L22P_6        | IO_L22P_6                  | P39              | I/O  |
| 6    | IO_L23N_6        | IO_L23N_6                  | P37              | I/O  |
| 6    | IO_L23P_6        | IO_L23P_6                  | P36              | I/O  |
| 6    | IO_L24N_6/VREF_6 | IO_L24N_6/VREF_6           | P35              | VREF |
| 6    | IO_L24P_6        | IO_L24P_6                  | P34              | I/O  |
| 6    | N.C. (◆)         | IO_L39N_6                  | P33              | I/O  |
| 6    | N.C. (◆)         | IO_L39P_6                  | P31              | I/O  |
| 6    | IO_L40N_6        | IO_L40N_6                  | P29              | I/O  |
| 6    | IO_L40P_6/VREF_6 | IO_L40P_6/VREF_6           | P28              | VREF |
| 6    | VCCO_6           | VCCO_6                     | P32              | VCCO |
| 6    | VCCO_6           | VCCO_6                     | P49              | VCCO |
| 7    | IO_L01N_7/VRP_7  | IO_L01N_7/VRP_7            | P3               | DCI  |
| 7    | IO_L01P_7/VRN_7  | IO_L01P_7/VRN_7            | P2               | DCI  |
| 7    | N.C. (◆)         | IO_L16N_7                  | P5               | I/O  |
| 7    | N.C. (◆)         | IO_L16P_7/VREF_7           | P4               | VREF |
| 7    | IO_L19N_7/VREF_7 | IO_L19N_7/VREF_7           | P9               | VREF |
| 7    | IO_L19P_7        | IO_L19P_7                  | P7               | I/O  |
| 7    | IO_L20N_7        | IO_L20N_7                  | P11              | I/O  |
| 7    | IO_L20P_7        | IO_L20P_7                  | P10              | I/O  |

Table 93: PQ208 Package Pinout (Cont'd)

| Bank | XC3S50 Pin Name  | XC3S200, XC3S400 Pin Names | PQ208 Pin Number | Type |
|------|------------------|----------------------------|------------------|------|
| 7    | IO_L21N_7        | IO_L21N_7                  | P13              | I/O  |
| 7    | IO_L21P_7        | IO_L21P_7                  | P12              | I/O  |
| 7    | IO_L22N_7        | IO_L22N_7                  | P16              | I/O  |
| 7    | IO_L22P_7        | IO_L22P_7                  | P15              | I/O  |
| 7    | IO_L23N_7        | IO_L23N_7                  | P19              | I/O  |
| 7    | IO_L23P_7        | IO_L23P_7                  | P18              | I/O  |
| 7    | IO_L24N_7        | IO_L24N_7                  | P21              | I/O  |
| 7    | IO_L24P_7        | IO_L24P_7                  | P20              | I/O  |
| 7    | N.C. (◆)         | IO_L39N_7                  | P24              | I/O  |
| 7    | N.C. (◆)         | IO_L39P_7                  | P22              | I/O  |
| 7    | IO_L40N_7/VREF_7 | IO_L40N_7/VREF_7           | P27              | VREF |
| 7    | IO_L40P_7        | IO_L40P_7                  | P26              | I/O  |
| 7    | VCCO_7           | VCCO_7                     | P6               | VCCO |
| 7    | VCCO_7           | VCCO_7                     | P23              | VCCO |
| N/A  | GND              | GND                        | P1               | GND  |
| N/A  | GND              | GND                        | P186             | GND  |
| N/A  | GND              | GND                        | P195             | GND  |
| N/A  | GND              | GND                        | P202             | GND  |
| N/A  | GND              | GND                        | P163             | GND  |
| N/A  | GND              | GND                        | P170             | GND  |
| N/A  | GND              | GND                        | P179             | GND  |
| N/A  | GND              | GND                        | P134             | GND  |
| N/A  | GND              | GND                        | P145             | GND  |
| N/A  | GND              | GND                        | P151             | GND  |
| N/A  | GND              | GND                        | P157             | GND  |
| N/A  | GND              | GND                        | P112             | GND  |
| N/A  | GND              | GND                        | P118             | GND  |
| N/A  | GND              | GND                        | P129             | GND  |
| N/A  | GND              | GND                        | P82              | GND  |
| N/A  | GND              | GND                        | P91              | GND  |
| N/A  | GND              | GND                        | P99              | GND  |
| N/A  | GND              | GND                        | P105             | GND  |
| N/A  | GND              | GND                        | P53              | GND  |
| N/A  | GND              | GND                        | P59              | GND  |
| N/A  | GND              | GND                        | P66              | GND  |
| N/A  | GND              | GND                        | P75              | GND  |
| N/A  | GND              | GND                        | P30              | GND  |
| N/A  | GND              | GND                        | P41              | GND  |
| N/A  | GND              | GND                        | P47              | GND  |
| N/A  | GND              | GND                        | P8               | GND  |

Table 93: PQ208 Package Pinout (Cont'd)

| Bank   | XC3S50 Pin Name | XC3S200, XC3S400 Pin Names | PQ208 Pin Number | Type   |
|--------|-----------------|----------------------------|------------------|--------|
| N/A    | GND             | GND                        | P14              | GND    |
| N/A    | GND             | GND                        | P25              | GND    |
| N/A    | VCCAUX          | VCCAUX                     | P193             | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P173             | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P142             | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P121             | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P89              | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P69              | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P38              | VCCAUX |
| N/A    | VCCAUX          | VCCAUX                     | P17              | VCCAUX |
| N/A    | VCCINT          | VCCINT                     | P192             | VCCINT |
| N/A    | VCCINT          | VCCINT                     | P174             | VCCINT |
| N/A    | VCCINT          | VCCINT                     | P88              | VCCINT |
| N/A    | VCCINT          | VCCINT                     | P70              | VCCINT |
| VCCAUX | CCLK            | CCLK                       | P104             | CONFIG |
| VCCAUX | DONE            | DONE                       | P103             | CONFIG |
| VCCAUX | HSWAP_EN        | HSWAP_EN                   | P206             | CONFIG |
| VCCAUX | M0              | M0                         | P55              | CONFIG |
| VCCAUX | M1              | M1                         | P54              | CONFIG |
| VCCAUX | M2              | M2                         | P56              | CONFIG |
| VCCAUX | PROG_B          | PROG_B                     | P207             | CONFIG |
| VCCAUX | TCK             | TCK                        | P159             | JTAG   |
| VCCAUX | TDI             | TDI                        | P208             | JTAG   |
| VCCAUX | TDO             | TDO                        | P158             | JTAG   |
| VCCAUX | TMS             | TMS                        | P160             | JTAG   |

## User I/Os by Bank

Table 94 indicates how the available user-I/O pins are distributed between the eight I/O banks for the XC3S50 in the PQ208 package. Similarly, Table 95 shows how the available user-I/O pins are distributed between the eight I/O banks for the XC3S200 and XC3S400 in the PQ208 package.

Table 94: User I/Os Per Bank for XC3S50 in PQ208 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 15          | 9                             | 0    | 2   | 2    | 2    |
|              | 1        | 15          | 9                             | 0    | 2   | 2    | 2    |
| Right        | 2        | 16          | 13                            | 0    | 2   | 2    | 0    |
|              | 3        | 16          | 12                            | 0    | 2   | 2    | 0    |
| Bottom       | 4        | 15          | 3                             | 6    | 2   | 2    | 2    |
|              | 5        | 15          | 3                             | 6    | 2   | 2    | 2    |
| Left         | 6        | 16          | 12                            | 0    | 2   | 2    | 0    |
|              | 7        | 16          | 12                            | 0    | 2   | 2    | 0    |

Table 95: User I/Os Per Bank for XC3S200 and XC3S400 in PQ208 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 16          | 9                             | 0    | 2   | 3    | 2    |
|              | 1        | 15          | 9                             | 0    | 2   | 2    | 2    |
| Right        | 2        | 19          | 14                            | 0    | 2   | 3    | 0    |
|              | 3        | 20          | 15                            | 0    | 2   | 3    | 0    |
| Bottom       | 4        | 17          | 4                             | 6    | 2   | 3    | 2    |
|              | 5        | 15          | 3                             | 6    | 2   | 2    | 2    |
| Left         | 6        | 19          | 14                            | 0    | 2   | 3    | 0    |
|              | 7        | 20          | 15                            | 0    | 2   | 3    | 0    |

### PQ208 Footprint

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

##### XC3S50

(124 max. user I/O)

72 I/O: Unrestricted, general-purpose user I/O

16 VREF: User I/O or input voltage reference for bank

17 N.C.: Unconnected pins for XC3S50 (◆)

##### XC3S200, XC3S400

(141 max user I/O)

83 I/O: Unrestricted, general-purpose user I/O

22 VREF: User I/O or input voltage reference for bank

0 N.C.: No unconnected pins in this package

##### All devices

12 DUAL: Configuration pin, then possible user I/O

8 GCLK: User I/O or global clock buffer input

16 DCI: User I/O or reference resistor input for bank

7 CONFIG: Dedicated configuration pins

4 JTAG: Dedicated JTAG port pins

4 VCCINT: Internal core voltage supply (+1.2V)

12 VCCO: Output voltage supply for bank

8 VCCAUX: Auxiliary voltage supply (+2.5V)

28 GND: Ground

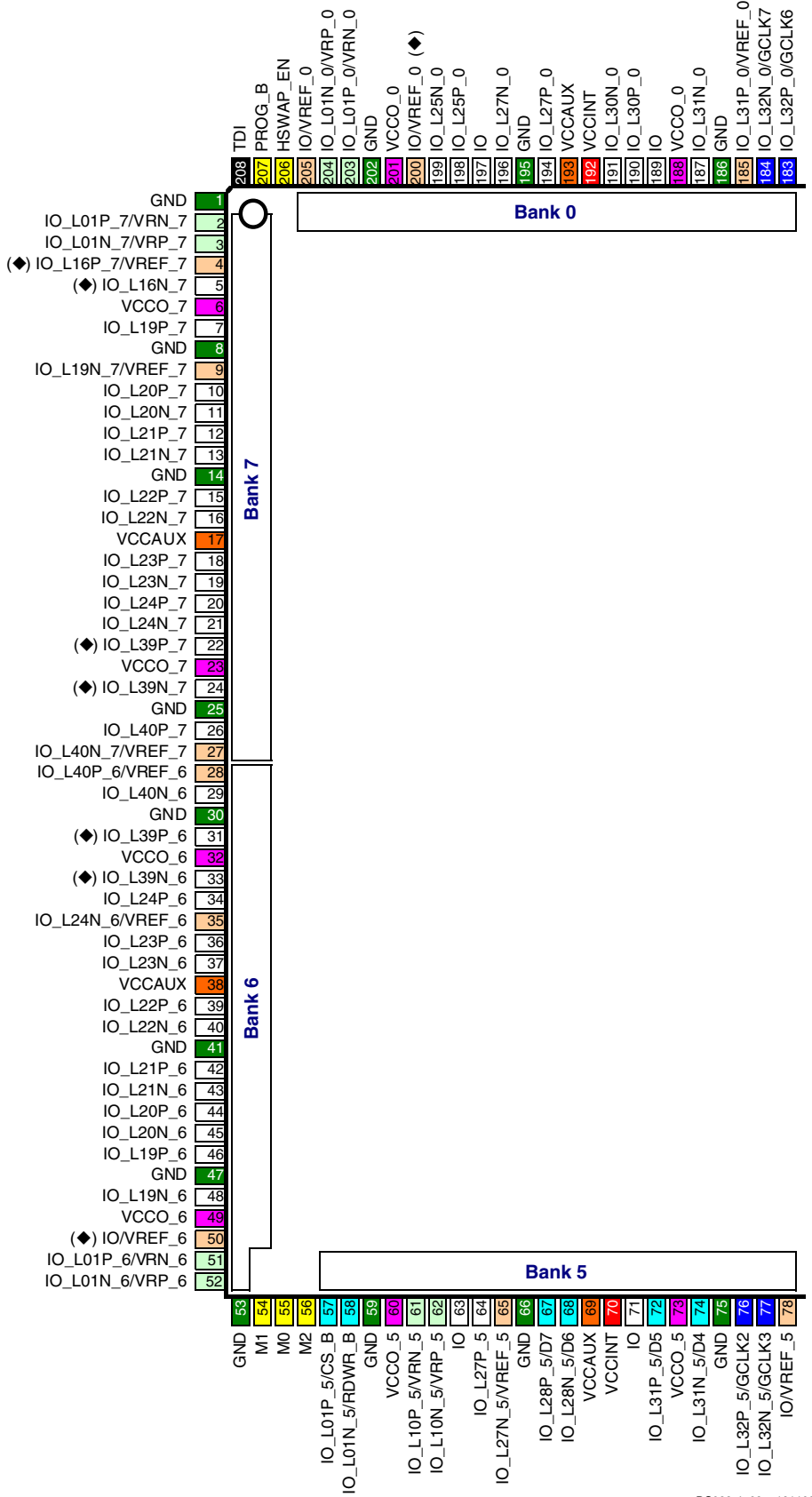
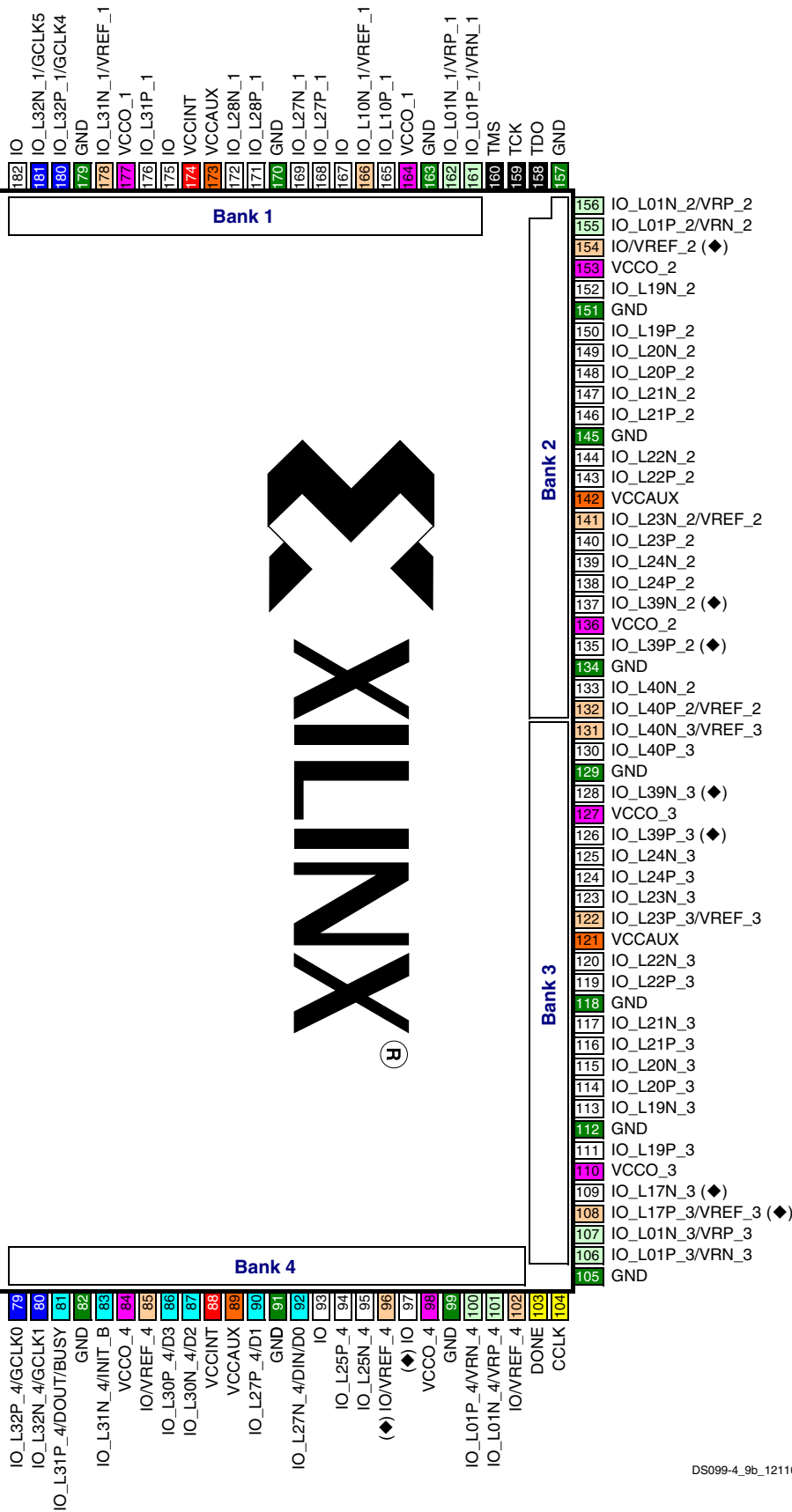


Figure 47: PQ208 Package Footprint (Top View). Note pin 1 indicator in top-left corner and logo orientation.

DS099-4\_09a\_121103



Right Half of Package  
(Top View)

Figure 48: PQ208 Package Footprint (Top View) Continued

DS099-4\_9b\_121103

## FT256: 256-lead Fine-pitch Thin Ball Grid Array

The 256-lead fine-pitch thin ball grid array package, FT256, supports three different Spartan-3 devices, including the XC3S200, the XC3S400, and the XC3S1000. The footprints for all three devices are identical, as shown in [Table 96](#) and [Figure 49](#).

All the package pins appear in [Table 96](#) and are sorted by bank number, 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 [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 96: FT256 Package Pinout

| Bank | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type |
|------|--|---------------------|------|
| 0    | IO                                     | A5                  | I/O  |
| 0    | IO                                     | A7                  | I/O  |
| 0    | IO/VREF_0                              | A3                  | VREF |
| 0    | IO/VREF_0                              | D5                  | VREF |
| 0    | IO_L01N_0/VRP_0                        | B4                  | DCI  |
| 0    | IO_L01P_0/VRN_0                        | A4                  | DCI  |
| 0    | IO_L25N_0                              | C5                  | I/O  |
| 0    | IO_L25P_0                              | B5                  | I/O  |
| 0    | IO_L27N_0                              | E6                  | I/O  |
| 0    | IO_L27P_0                              | D6                  | I/O  |
| 0    | IO_L28N_0                              | C6                  | I/O  |
| 0    | IO_L28P_0                              | B6                  | I/O  |
| 0    | IO_L29N_0                              | E7                  | I/O  |
| 0    | IO_L29P_0                              | D7                  | I/O  |
| 0    | IO_L30N_0                              | C7                  | I/O  |
| 0    | IO_L30P_0                              | B7                  | I/O  |
| 0    | IO_L31N_0                              | D8                  | I/O  |
| 0    | IO_L31P_0/VREF_0                       | C8                  | VREF |
| 0    | IO_L32N_0/GCLK7                        | B8                  | GCLK |
| 0    | IO_L32P_0/GCLK6                        | A8                  | GCLK |
| 0    | VCCO_0                                 | E8                  | VCCO |
| 0    | VCCO_0                                 | F7                  | VCCO |
| 0    | VCCO_0                                 | F8                  | VCCO |
| 1    | IO                                     | A9                  | I/O  |
| 1    | IO                                     | A12                 | I/O  |
| 1    | IO                                     | C10                 | I/O  |
| 1    | IO/VREF_1                              | D12                 | VREF |
| 1    | IO_L01N_1/VRP_1                        | A14                 | DCI  |
| 1    | IO_L01P_1/VRN_1                        | B14                 | DCI  |



Table 96: FT256 Package Pinout (Cont'd)

| Bank | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type |
|------|--|---------------------|------|
| 1    | IO_L10N_1/VREF_1                       | A13                 | VREF |
| 1    | IO_L10P_1                              | B13                 | I/O  |
| 1    | IO_L27N_1                              | B12                 | I/O  |
| 1    | IO_L27P_1                              | C12                 | I/O  |
| 1    | IO_L28N_1                              | D11                 | I/O  |
| 1    | IO_L28P_1                              | E11                 | I/O  |
| 1    | IO_L29N_1                              | B11                 | I/O  |
| 1    | IO_L29P_1                              | C11                 | I/O  |
| 1    | IO_L30N_1                              | D10                 | I/O  |
| 1    | IO_L30P_1                              | E10                 | I/O  |
| 1    | IO_L31N_1/VREF_1                       | A10                 | VREF |
| 1    | IO_L31P_1                              | B10                 | I/O  |
| 1    | IO_L32N_1/GCLK5                        | C9                  | GCLK |
| 1    | IO_L32P_1/GCLK4                        | D9                  | GCLK |
| 1    | VCCO_1                                 | E9                  | VCCO |
| 1    | VCCO_1                                 | F9                  | VCCO |
| 1    | VCCO_1                                 | F10                 | VCCO |
| 2    | IO                                     | G16                 | I/O  |
| 2    | IO_L01N_2/VRP_2                        | B16                 | DCI  |
| 2    | IO_L01P_2/VRN_2                        | C16                 | DCI  |
| 2    | IO_L16N_2                              | C15                 | I/O  |
| 2    | IO_L16P_2                              | D14                 | I/O  |
| 2    | IO_L17N_2                              | D15                 | I/O  |
| 2    | IO_L17P_2/VREF_2                       | D16                 | VREF |
| 2    | IO_L19N_2                              | E13                 | I/O  |
| 2    | IO_L19P_2                              | E14                 | I/O  |
| 2    | IO_L20N_2                              | E15                 | I/O  |
| 2    | IO_L20P_2                              | E16                 | I/O  |
| 2    | IO_L21N_2                              | F12                 | I/O  |
| 2    | IO_L21P_2                              | F13                 | I/O  |
| 2    | IO_L22N_2                              | F14                 | I/O  |
| 2    | IO_L22P_2                              | F15                 | I/O  |
| 2    | IO_L23N_2/VREF_2                       | G12                 | VREF |
| 2    | IO_L23P_2                              | G13                 | I/O  |
| 2    | IO_L24N_2                              | G14                 | I/O  |
| 2    | IO_L24P_2                              | G15                 | I/O  |
| 2    | IO_L39N_2                              | H13                 | I/O  |
| 2    | IO_L39P_2                              | H14                 | I/O  |
| 2    | IO_L40N_2                              | H15                 | I/O  |
| 2    | IO_L40P_2/VREF_2                       | H16                 | VREF |

Table 96: FT256 Package Pinout (Cont'd)

| Bank | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type |
|------|--|---------------------|------|
| 2    | VCCO_2                                 | G11                 | VCCO |
| 2    | VCCO_2                                 | H11                 | VCCO |
| 2    | VCCO_2                                 | H12                 | VCCO |
| 3    | IO                                     | K15                 | I/O  |
| 3    | IO_L01N_3/VRP_3                        | P16                 | DCI  |
| 3    | IO_L01P_3/VRN_3                        | R16                 | DCI  |
| 3    | IO_L16N_3                              | P15                 | I/O  |
| 3    | IO_L16P_3                              | P14                 | I/O  |
| 3    | IO_L17N_3                              | N16                 | I/O  |
| 3    | IO_L17P_3/VREF_3                       | N15                 | VREF |
| 3    | IO_L19N_3                              | M14                 | I/O  |
| 3    | IO_L19P_3                              | N14                 | I/O  |
| 3    | IO_L20N_3                              | M16                 | I/O  |
| 3    | IO_L20P_3                              | M15                 | I/O  |
| 3    | IO_L21N_3                              | L13                 | I/O  |
| 3    | IO_L21P_3                              | M13                 | I/O  |
| 3    | IO_L22N_3                              | L15                 | I/O  |
| 3    | IO_L22P_3                              | L14                 | I/O  |
| 3    | IO_L23N_3                              | K12                 | I/O  |
| 3    | IO_L23P_3/VREF_3                       | L12                 | VREF |
| 3    | IO_L24N_3                              | K14                 | I/O  |
| 3    | IO_L24P_3                              | K13                 | I/O  |
| 3    | IO_L39N_3                              | J14                 | I/O  |
| 3    | IO_L39P_3                              | J13                 | I/O  |
| 3    | IO_L40N_3/VREF_3                       | J16                 | VREF |
| 3    | IO_L40P_3                              | K16                 | I/O  |
| 3    | VCCO_3                                 | J11                 | VCCO |
| 3    | VCCO_3                                 | J12                 | VCCO |
| 3    | VCCO_3                                 | K11                 | VCCO |
| 4    | IO                                     | T12                 | I/O  |
| 4    | IO                                     | T14                 | I/O  |
| 4    | IO/VREF_4                              | N12                 | VREF |
| 4    | IO/VREF_4                              | P13                 | VREF |
| 4    | IO/VREF_4                              | T10                 | VREF |
| 4    | IO_L01N_4/VRP_4                        | R13                 | DCI  |
| 4    | IO_L01P_4/VRN_4                        | T13                 | DCI  |
| 4    | IO_L25N_4                              | P12                 | I/O  |
| 4    | IO_L25P_4                              | R12                 | I/O  |
| 4    | IO_L27N_4/DIN/D0                       | M11                 | DUAL |
| 4    | IO_L27P_4/D1                           | N11                 | DUAL |

Table 96: FT256 Package Pinout (Cont'd)

| Bank | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type |
|------|--|---------------------|------|
| 4    | IO_L28N_4                              | P11                 | I/O  |
| 4    | IO_L28P_4                              | R11                 | I/O  |
| 4    | IO_L29N_4                              | M10                 | I/O  |
| 4    | IO_L29P_4                              | N10                 | I/O  |
| 4    | IO_L30N_4/D2                           | P10                 | DUAL |
| 4    | IO_L30P_4/D3                           | R10                 | DUAL |
| 4    | IO_L31N_4/INIT_B                       | N9                  | DUAL |
| 4    | IO_L31P_4/DOOUT/BUSY                   | P9                  | DUAL |
| 4    | IO_L32N_4/GCLK1                        | R9                  | GCLK |
| 4    | IO_L32P_4/GCLK0                        | T9                  | GCLK |
| 4    | VCCO_4                                 | L9                  | VCCO |
| 4    | VCCO_4                                 | L10                 | VCCO |
| 4    | VCCO_4                                 | M9                  | VCCO |
| 5    | IO                                     | N5                  | I/O  |
| 5    | IO                                     | P7                  | I/O  |
| 5    | IO                                     | T5                  | I/O  |
| 5    | IO/VREF_5                              | T8                  | VREF |
| 5    | IO_L01N_5/RDWR_B                       | T3                  | DUAL |
| 5    | IO_L01P_5/CS_B                         | R3                  | DUAL |
| 5    | IO_L10N_5/VRP_5                        | T4                  | DCI  |
| 5    | IO_L10P_5/VRN_5                        | R4                  | DCI  |
| 5    | IO_L27N_5/VREF_5                       | R5                  | VREF |
| 5    | IO_L27P_5                              | P5                  | I/O  |
| 5    | IO_L28N_5/D6                           | N6                  | DUAL |
| 5    | IO_L28P_5/D7                           | M6                  | DUAL |
| 5    | IO_L29N_5                              | R6                  | I/O  |
| 5    | IO_L29P_5/VREF_5                       | P6                  | VREF |
| 5    | IO_L30N_5                              | N7                  | I/O  |
| 5    | IO_L30P_5                              | M7                  | I/O  |
| 5    | IO_L31N_5/D4                           | T7                  | DUAL |
| 5    | IO_L31P_5/D5                           | R7                  | DUAL |
| 5    | IO_L32N_5/GCLK3                        | P8                  | GCLK |
| 5    | IO_L32P_5/GCLK2                        | N8                  | GCLK |
| 5    | VCCO_5                                 | L7                  | VCCO |
| 5    | VCCO_5                                 | L8                  | VCCO |
| 5    | VCCO_5                                 | M8                  | VCCO |
| 6    | IO                                     | K1                  | I/O  |
| 6    | IO_L01N_6/VRP_6                        | R1                  | DCI  |
| 6    | IO_L01P_6/VRN_6                        | P1                  | DCI  |
| 6    | IO_L16N_6                              | P2                  | I/O  |

Table 96: FT256 Package Pinout (Cont'd)

| Bank | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type |
|------|--|---------------------|------|
| 6    | IO_L16P_6                              | N3                  | I/O  |
| 6    | IO_L17N_6                              | N2                  | I/O  |
| 6    | IO_L17P_6/VREF_6                       | N1                  | VREF |
| 6    | IO_L19N_6                              | M4                  | I/O  |
| 6    | IO_L19P_6                              | M3                  | I/O  |
| 6    | IO_L20N_6                              | M2                  | I/O  |
| 6    | IO_L20P_6                              | M1                  | I/O  |
| 6    | IO_L21N_6                              | L5                  | I/O  |
| 6    | IO_L21P_6                              | L4                  | I/O  |
| 6    | IO_L22N_6                              | L3                  | I/O  |
| 6    | IO_L22P_6                              | L2                  | I/O  |
| 6    | IO_L23N_6                              | K5                  | I/O  |
| 6    | IO_L23P_6                              | K4                  | I/O  |
| 6    | IO_L24N_6/VREF_6                       | K3                  | VREF |
| 6    | IO_L24P_6                              | K2                  | I/O  |
| 6    | IO_L39N_6                              | J4                  | I/O  |
| 6    | IO_L39P_6                              | J3                  | I/O  |
| 6    | IO_L40N_6                              | J2                  | I/O  |
| 6    | IO_L40P_6/VREF_6                       | J1                  | VREF |
| 6    | VCCO_6                                 | J5                  | VCCO |
| 6    | VCCO_6                                 | J6                  | VCCO |
| 6    | VCCO_6                                 | K6                  | VCCO |
| 7    | IO                                     | G2                  | I/O  |
| 7    | IO_L01N_7/VRP_7                        | C1                  | DCI  |
| 7    | IO_L01P_7/VRN_7                        | B1                  | DCI  |
| 7    | IO_L16N_7                              | C2                  | I/O  |
| 7    | IO_L16P_7/VREF_7                       | C3                  | VREF |
| 7    | IO_L17N_7                              | D1                  | I/O  |
| 7    | IO_L17P_7                              | D2                  | I/O  |
| 7    | IO_L19N_7/VREF_7                       | E3                  | VREF |
| 7    | IO_L19P_7                              | D3                  | I/O  |
| 7    | IO_L20N_7                              | E1                  | I/O  |
| 7    | IO_L20P_7                              | E2                  | I/O  |
| 7    | IO_L21N_7                              | F4                  | I/O  |
| 7    | IO_L21P_7                              | E4                  | I/O  |
| 7    | IO_L22N_7                              | F2                  | I/O  |
| 7    | IO_L22P_7                              | F3                  | I/O  |
| 7    | IO_L23N_7                              | G5                  | I/O  |
| 7    | IO_L23P_7                              | F5                  | I/O  |
| 7    | IO_L24N_7                              | G3                  | I/O  |

Table 96: FT256 Package Pinout (Cont'd)

| Bank | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type |
|------|--|---------------------|------|
| 7    | IO_L24P_7                              | G4                  | I/O  |
| 7    | IO_L39N_7                              | H3                  | I/O  |
| 7    | IO_L39P_7                              | H4                  | I/O  |
| 7    | IO_L40N_7/VREF_7                       | H1                  | VREF |
| 7    | IO_L40P_7                              | G1                  | I/O  |
| 7    | VCCO_7                                 | G6                  | VCCO |
| 7    | VCCO_7                                 | H5                  | VCCO |
| 7    | VCCO_7                                 | H6                  | VCCO |
| N/A  | GND                                    | A1                  | GND  |
| N/A  | GND                                    | A16                 | GND  |
| N/A  | GND                                    | B2                  | GND  |
| N/A  | GND                                    | B9                  | GND  |
| N/A  | GND                                    | B15                 | GND  |
| N/A  | GND                                    | F6                  | GND  |
| N/A  | GND                                    | F11                 | GND  |
| N/A  | GND                                    | G7                  | GND  |
| N/A  | GND                                    | G8                  | GND  |
| N/A  | GND                                    | G9                  | GND  |
| N/A  | GND                                    | G10                 | GND  |
| N/A  | GND                                    | H2                  | GND  |
| N/A  | GND                                    | H7                  | GND  |
| N/A  | GND                                    | H8                  | GND  |
| N/A  | GND                                    | H9                  | GND  |
| N/A  | GND                                    | H10                 | GND  |
| N/A  | GND                                    | J7                  | GND  |
| N/A  | GND                                    | J8                  | GND  |
| N/A  | GND                                    | J9                  | GND  |
| N/A  | GND                                    | J10                 | GND  |
| N/A  | GND                                    | J15                 | GND  |
| N/A  | GND                                    | K7                  | GND  |
| N/A  | GND                                    | K8                  | GND  |
| N/A  | GND                                    | K9                  | GND  |
| N/A  | GND                                    | K10                 | GND  |
| N/A  | GND                                    | L6                  | GND  |
| N/A  | GND                                    | L11                 | GND  |
| N/A  | GND                                    | R2                  | GND  |
| N/A  | GND                                    | R8                  | GND  |
| N/A  | GND                                    | R15                 | GND  |
| N/A  | GND                                    | T1                  | GND  |

Table 96: FT256 Package Pinout (Cont'd)

| Bank   | XC3S200, XC3S400, XC3S1000<br>Pin Name | FT256 Pin<br>Number | Type   |
|--------|--|---------------------|--------|
| N/A    | GND                                    | T16                 | GND    |
| N/A    | VCCAUX                                 | A6                  | VCCAUX |
| N/A    | VCCAUX                                 | A11                 | VCCAUX |
| N/A    | VCCAUX                                 | F1                  | VCCAUX |
| N/A    | VCCAUX                                 | F16                 | VCCAUX |
| N/A    | VCCAUX                                 | L1                  | VCCAUX |
| N/A    | VCCAUX                                 | L16                 | VCCAUX |
| N/A    | VCCAUX                                 | T6                  | VCCAUX |
| N/A    | VCCAUX                                 | T11                 | VCCAUX |
| N/A    | VCCINT                                 | D4                  | VCCINT |
| N/A    | VCCINT                                 | D13                 | VCCINT |
| N/A    | VCCINT                                 | E5                  | VCCINT |
| N/A    | VCCINT                                 | E12                 | VCCINT |
| N/A    | VCCINT                                 | M5                  | VCCINT |
| N/A    | VCCINT                                 | M12                 | VCCINT |
| N/A    | VCCINT                                 | N4                  | VCCINT |
| N/A    | VCCINT                                 | N13                 | VCCINT |
| VCCAUX | CCLK                                   | T15                 | CONFIG |
| VCCAUX | DONE                                   | R14                 | CONFIG |
| VCCAUX | HSWAP_EN                               | C4                  | CONFIG |
| VCCAUX | M0                                     | P3                  | CONFIG |
| VCCAUX | M1                                     | T2                  | CONFIG |
| VCCAUX | M2                                     | P4                  | CONFIG |
| VCCAUX | PROG_B                                 | B3                  | CONFIG |
| VCCAUX | TCK                                    | C14                 | JTAG   |
| VCCAUX | TDI                                    | A2                  | JTAG   |
| VCCAUX | TDO                                    | A15                 | JTAG   |
| VCCAUX | TMS                                    | C13                 | JTAG   |

## User I/Os by Bank

Table 97 indicates how the available user-I/O pins are distributed between the eight I/O banks on the FT256 package.

Table 97: User I/Os Per Bank in FT256 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 20          | 13                            | 0    | 2   | 3    | 2    |
|              | 1        | 20          | 13                            | 0    | 2   | 3    | 2    |
| Right        | 2        | 23          | 18                            | 0    | 2   | 3    | 0    |
|              | 3        | 23          | 18                            | 0    | 2   | 3    | 0    |
| Bottom       | 4        | 21          | 8                             | 6    | 2   | 3    | 2    |
|              | 5        | 20          | 7                             | 6    | 2   | 3    | 2    |
| Left         | 6        | 23          | 18                            | 0    | 2   | 3    | 0    |
|              | 7        | 23          | 18                            | 0    | 2   | 3    | 0    |

FT256 Footprint

|        |   | Bank 0            |            |                   |                  |                   |                   |               |                   | Bank 1               |                   |                   |                   |                   |                  |                   |                   |
|--------|---|-------------------|------------|-------------------|------------------|-------------------|-------------------|---------------|-------------------|----------------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|
|        |   | 1                 | 2          | 3                 | 4                | 5                 | 6                 | 7             | 8                 | 9                    | 10                | 11                | 12                | 13                | 14               | 15                | 16                |
| Bank 7 | A | GND               | TDI        | I/O VREF_0        | I/O L01P_0 VRN_0 | I/O               | VCCAUX            | I/O           | I/O L32P_0 GCLK6  | I/O                  | I/O L31N_1 VREF_1 | VCCAUX            | I/O               | I/O L10N_1 VREF_1 | I/O L01N_1 VRP_1 | TDO               | GND               |
|        | B | I/O L01P_7 VRN_7  | GND        | PROG_B            | I/O L01N_0 VRP_0 | I/O L25P_0        | I/O L28P_0        | I/O L30P_0    | I/O L32N_0 GCLK7  | GND                  | I/O L31P_1        | I/O L29N_1        | I/O L27N_1        | I/O L10P_1        | I/O L01P_1 VRN_1 | GND               | I/O L01N_2 VRP_2  |
|        | C | I/O L01N_7 VRP_7  | I/O L16N_7 | I/O L16P_7 VREF_7 | HSWAP_EN         | I/O L25N_0        | I/O L28N_0        | I/O L30N_0    | I/O L31P_0 VREF_0 | I/O L32N_1 GCLK5     | I/O               | I/O L29P_1        | I/O L27P_1        | TMS               | TCK              | I/O L16N_2        | I/O L01P_2 VRN_2  |
|        | D | I/O L17N_7        | I/O L17P_7 | I/O L19P_7        | VCCINT           | I/O VREF_0        | I/O L27P_0        | I/O L29P_0    | I/O L31N_0        | I/O L32P_1 GCLK4     | I/O L30N_1        | I/O L28N_1        | I/O VREF_1        | VCCINT            | I/O L16P_2       | I/O L17N_2        | I/O L17P_2 VREF_2 |
|        | E | I/O L20N_7        | I/O L20P_7 | I/O L19N_7 VREF_7 | I/O L21P_7       | VCCINT            | I/O L27N_0        | I/O L29N_0    | VCCO_0            | VCCO_1               | I/O L30P_1        | I/O L28P_1        | VCCINT            | I/O L19N_2        | I/O L19P_2       | I/O L20N_2        | I/O L20P_2        |
|        | F | VCCAUX            | I/O L22N_7 | I/O L22P_7        | I/O L21N_7       | I/O L23P_7        | GND               | VCCO_0        | VCCO_0            | VCCO_1               | VCCO_1            | GND               | I/O L21N_2        | I/O L21P_2        | I/O L22N_2       | I/O L22P_2        | VCCAUX            |
|        | G | I/O L40P_7        | I/O        | I/O L24N_7        | I/O L24P_7       | I/O L23N_7        | VCCO_7            | GND           | GND               | GND                  | GND               | VCCO_2            | I/O L23N_2 VREF_2 | I/O L23P_2        | I/O L24N_2       | I/O L24P_2        | I/O               |
| Bank 6 | H | I/O L40N_7 VREF_7 | GND        | I/O L39N_7        | I/O L39P_7       | VCCO_7            | VCCO_7            | GND           | GND               | GND                  | GND               | VCCO_2            | VCCO_2            | I/O L39N_2        | I/O L39P_2       | I/O L40N_2        | I/O L40P_2 VREF_2 |
|        | J | I/O L40P_6 VREF_6 | I/O L40N_6 | I/O L39P_6        | I/O L39N_6       | VCCO_6            | VCCO_6            | GND           | GND               | GND                  | GND               | VCCO_3            | VCCO_3            | I/O L39P_3        | I/O L39N_3       | GND               | I/O L40N_3 VREF_3 |
|        | K | I/O               | I/O L24P_6 | I/O L24N_6 VREF_6 | I/O L23P_6       | I/O L23N_6        | VCCO_6            | GND           | GND               | GND                  | GND               | VCCO_3            | I/O L23N_3        | I/O L24P_3        | I/O L24N_3       | I/O               | I/O L40P_3        |
|        | L | VCCAUX            | I/O L22P_6 | I/O L22N_6        | I/O L21P_6       | I/O L21N_6        | GND               | VCCO_5        | VCCO_5            | VCCO_4               | VCCO_4            | GND               | I/O L23P_3 VREF_3 | I/O L21N_3        | I/O L22P_3       | I/O L22N_3        | VCCAUX            |
|        | M | I/O L20P_6        | I/O L20N_6 | I/O L19P_6        | I/O L19N_6       | VCCINT            | I/O L28P_5 D7     | I/O L30P_5    | VCCO_5            | VCCO_4               | I/O L29N_4        | I/O L27N_4 DIN D0 | VCCINT            | I/O L21P_3        | I/O L19N_3       | I/O L20P_3        | I/O L20N_3        |
|        | N | I/O L17P_6 VREF_6 | I/O L17N_6 | I/O L16P_6        | VCCINT           | I/O               | I/O L28N_5 D6     | I/O L30N_5    | I/O L32P_5 GCLK2  | I/O L31N_4 INIT_B    | I/O L29P_4        | I/O L27P_4 D1     | I/O VREF_4        | VCCINT            | I/O L19P_3       | I/O L17P_3 VREF_3 | I/O L17N_3        |
|        | P | I/O L01P_6 VRN_6  | I/O L16N_6 | M0                | M2               | I/O L27P_5        | I/O L29P_5 VREF_5 | I/O           | I/O L32N_5 GCLK3  | I/O L31P_4 DOUT BUSY | I/O L30N_4 D2     | I/O L28N_4        | I/O L25N_4        | I/O VREF_4        | I/O L16P_3       | I/O L01N_3 VRP_3  | I/O               |
| Bank 3 | R | I/O L01N_6 VRP_6  | GND        | I/O L01P_5 CS_B   | I/O L10P_5 VRN_5 | I/O L27N_5 VREF_5 | I/O L29N_5        | I/O L31P_5 D5 | GND               | I/O L32N_4 GCLK1     | I/O L30P_4 D3     | I/O L28P_4        | I/O L25P_4        | I/O L01N_4 VRP_4  | DONE             | GND               | I/O L01P_3 VRN_3  |
|        | T | GND               | M1         | I/O L01N_5 RDWR_B | I/O L10N_5 VRP_5 | I/O               | VCCAUX            | I/O L31N_5 D4 | I/O VREF_5        | I/O L32P_4 GCLK0     | I/O VREF_4        | VCCAUX            | I/O               | I/O L01P_4 VRN_4  | I/O              | CCLK              | GND               |
|        |   | Bank 5            |            |                   |                  |                   |                   |               |                   | Bank 4               |                   |                   |                   |                   |                  |                   |                   |

Figure 49: FT256 Package Footprint (Top View)

DS099-4\_10\_030503

- |   |  |   |
|---|--|---|
| 113 I/O: Unrestricted, general-purpose user I/O       | 12 DUAL: Configuration pin, then possible user I/O | 24 VREF: User I/O or input voltage reference for bank |
| 16 DCI: User I/O or reference resistor input for bank | 8 GCLK: User I/O or global clock buffer input      | 24 VCCO: Output voltage supply for bank               |
| 7 CONFIG: Dedicated configuration pins                | 4 JTAG: Dedicated JTAG port pins                   | 8 VCCINT: Internal core voltage supply (+1.2V)        |
| 0 N.C.: No unconnected pins in this package           | 32 GND: Ground                                     | 8 VCCAUX: Auxiliary voltage supply (+2.5V)            |



## FG320: 320-lead Fine-pitch Ball Grid Array

The 320-lead fine-pitch ball grid array package, FG320, supports three different Spartan-3 devices, including the XC3S400, the XC3S1000, and the XC3S1500. The footprint for all three devices is identical, as shown in [Table 98](#) and [Figure 50](#).

The FG320 package is an 18 x 18 array of solder balls minus the four center balls.

All the package pins appear in [Table 98](#) and are sorted by bank number, 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 [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 98: FG320 Package Pinout

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 0    | IO                                      | D9                  | I/O  |
| 0    | IO                                      | E7                  | I/O  |
| 0    | IO/VREF_0                               | B3                  | VREF |
| 0    | IO/VREF_0                               | D6                  | VREF |
| 0    | IO_L01N_0/VRP_0                         | A2                  | DCI  |
| 0    | IO_L01P_0/VRN_0                         | A3                  | DCI  |
| 0    | IO_L09N_0                               | B4                  | I/O  |
| 0    | IO_L09P_0                               | C4                  | I/O  |
| 0    | IO_L10N_0                               | C5                  | I/O  |
| 0    | IO_L10P_0                               | D5                  | I/O  |
| 0    | IO_L15N_0                               | A4                  | I/O  |
| 0    | IO_L15P_0                               | A5                  | I/O  |
| 0    | IO_L25N_0                               | B5                  | I/O  |
| 0    | IO_L25P_0                               | B6                  | I/O  |
| 0    | IO_L27N_0                               | C7                  | I/O  |
| 0    | IO_L27P_0                               | D7                  | I/O  |
| 0    | IO_L28N_0                               | C8                  | I/O  |
| 0    | IO_L28P_0                               | D8                  | I/O  |
| 0    | IO_L29N_0                               | E8                  | I/O  |
| 0    | IO_L29P_0                               | F8                  | I/O  |
| 0    | IO_L30N_0                               | A7                  | I/O  |
| 0    | IO_L30P_0                               | A8                  | I/O  |
| 0    | IO_L31N_0                               | B9                  | I/O  |
| 0    | IO_L31P_0/VREF_0                        | A9                  | VREF |
| 0    | IO_L32N_0/GCLK7                         | E9                  | GCLK |
| 0    | IO_L32P_0/GCLK6                         | F9                  | GCLK |
| 0    | VCCO_0                                  | B8                  | VCCO |
| 0    | VCCO_0                                  | C6                  | VCCO |
| 0    | VCCO_0                                  | G8                  | VCCO |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 0    | VCCO_0                                  | G9                  | VCCO |
| 1    | IO                                      | A11                 | I/O  |
| 1    | IO                                      | B13                 | I/O  |
| 1    | IO                                      | D10                 | I/O  |
| 1    | IO/VREF_1                               | A12                 | VREF |
| 1    | IO_L01N_1/VRP_1                         | A16                 | DCI  |
| 1    | IO_L01P_1/VRN_1                         | A17                 | DCI  |
| 1    | IO_L10N_1/VREF_1                        | A15                 | VREF |
| 1    | IO_L10P_1                               | B15                 | I/O  |
| 1    | IO_L15N_1                               | C14                 | I/O  |
| 1    | IO_L15P_1                               | C15                 | I/O  |
| 1    | IO_L16N_1                               | A14                 | I/O  |
| 1    | IO_L16P_1                               | B14                 | I/O  |
| 1    | IO_L24N_1                               | D14                 | I/O  |
| 1    | IO_L24P_1                               | D13                 | I/O  |
| 1    | IO_L27N_1                               | E13                 | I/O  |
| 1    | IO_L27P_1                               | E12                 | I/O  |
| 1    | IO_L28N_1                               | C12                 | I/O  |
| 1    | IO_L28P_1                               | D12                 | I/O  |
| 1    | IO_L29N_1                               | F11                 | I/O  |
| 1    | IO_L29P_1                               | E11                 | I/O  |
| 1    | IO_L30N_1                               | C11                 | I/O  |
| 1    | IO_L30P_1                               | D11                 | I/O  |
| 1    | IO_L31N_1/VREF_1                        | A10                 | VREF |
| 1    | IO_L31P_1                               | B10                 | I/O  |
| 1    | IO_L32N_1/GCLK5                         | E10                 | GCLK |
| 1    | IO_L32P_1/GCLK4                         | F10                 | GCLK |
| 1    | VCCO_1                                  | B11                 | VCCO |
| 1    | VCCO_1                                  | C13                 | VCCO |
| 1    | VCCO_1                                  | G10                 | VCCO |
| 1    | VCCO_1                                  | G11                 | VCCO |
| 2    | IO                                      | J13                 | I/O  |
| 2    | IO_L01N_2/VRP_2                         | C16                 | DCI  |
| 2    | IO_L01P_2/VRN_2                         | C17                 | DCI  |
| 2    | IO_L16N_2                               | B18                 | I/O  |
| 2    | IO_L16P_2                               | C18                 | I/O  |
| 2    | IO_L17N_2                               | D17                 | I/O  |
| 2    | IO_L17P_2/VREF_2                        | D18                 | VREF |
| 2    | IO_L19N_2                               | D16                 | I/O  |
| 2    | IO_L19P_2                               | E16                 | I/O  |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 2    | IO_L20N_2                               | E17                 | I/O  |
| 2    | IO_L20P_2                               | E18                 | I/O  |
| 2    | IO_L21N_2                               | F15                 | I/O  |
| 2    | IO_L21P_2                               | E15                 | I/O  |
| 2    | IO_L22N_2                               | F14                 | I/O  |
| 2    | IO_L22P_2                               | G14                 | I/O  |
| 2    | IO_L23N_2/VREF_2                        | G18                 | VREF |
| 2    | IO_L23P_2                               | F17                 | I/O  |
| 2    | IO_L24N_2                               | G15                 | I/O  |
| 2    | IO_L24P_2                               | G16                 | I/O  |
| 2    | IO_L27N_2                               | H13                 | I/O  |
| 2    | IO_L27P_2                               | H14                 | I/O  |
| 2    | IO_L34N_2/VREF_2                        | H16                 | VREF |
| 2    | IO_L34P_2                               | H15                 | I/O  |
| 2    | IO_L35N_2                               | H17                 | I/O  |
| 2    | IO_L35P_2                               | H18                 | I/O  |
| 2    | IO_L39N_2                               | J18                 | I/O  |
| 2    | IO_L39P_2                               | J17                 | I/O  |
| 2    | IO_L40N_2                               | J15                 | I/O  |
| 2    | IO_L40P_2/VREF_2                        | J14                 | VREF |
| 2    | VCCO_2                                  | F16                 | VCCO |
| 2    | VCCO_2                                  | H12                 | VCCO |
| 2    | VCCO_2                                  | J12                 | VCCO |
| 3    | IO                                      | K15                 | I/O  |
| 3    | IO_L01N_3/VRP_3                         | T17                 | DCI  |
| 3    | IO_L01P_3/VRN_3                         | T16                 | DCI  |
| 3    | IO_L16N_3                               | T18                 | I/O  |
| 3    | IO_L16P_3                               | U18                 | I/O  |
| 3    | IO_L17N_3                               | P16                 | I/O  |
| 3    | IO_L17P_3/VREF_3                        | R16                 | VREF |
| 3    | IO_L19N_3                               | R17                 | I/O  |
| 3    | IO_L19P_3                               | R18                 | I/O  |
| 3    | IO_L20N_3                               | P18                 | I/O  |
| 3    | IO_L20P_3                               | P17                 | I/O  |
| 3    | IO_L21N_3                               | P15                 | I/O  |
| 3    | IO_L21P_3                               | N15                 | I/O  |
| 3    | IO_L22N_3                               | M14                 | I/O  |
| 3    | IO_L22P_3                               | N14                 | I/O  |
| 3    | IO_L23N_3                               | M15                 | I/O  |
| 3    | IO_L23P_3/VREF_3                        | M16                 | VREF |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 3    | IO_L24N_3                               | M18                 | I/O  |
| 3    | IO_L24P_3                               | N17                 | I/O  |
| 3    | IO_L27N_3                               | L14                 | I/O  |
| 3    | IO_L27P_3                               | L13                 | I/O  |
| 3    | IO_L34N_3                               | L15                 | I/O  |
| 3    | IO_L34P_3/VREF_3                        | L16                 | VREF |
| 3    | IO_L35N_3                               | L18                 | I/O  |
| 3    | IO_L35P_3                               | L17                 | I/O  |
| 3    | IO_L39N_3                               | K13                 | I/O  |
| 3    | IO_L39P_3                               | K14                 | I/O  |
| 3    | IO_L40N_3/VREF_3                        | K17                 | VREF |
| 3    | IO_L40P_3                               | K18                 | I/O  |
| 3    | VCCO_3                                  | K12                 | VCCO |
| 3    | VCCO_3                                  | L12                 | VCCO |
| 3    | VCCO_3                                  | N16                 | VCCO |
| 4    | IO                                      | P12                 | I/O  |
| 4    | IO                                      | V14                 | I/O  |
| 4    | IO/VREF_4                               | R10                 | VREF |
| 4    | IO/VREF_4                               | U13                 | VREF |
| 4    | IO/VREF_4                               | V17                 | VREF |
| 4    | IO_L01N_4/VRP_4                         | U16                 | DCI  |
| 4    | IO_L01P_4/VRN_4                         | V16                 | DCI  |
| 4    | IO_L06N_4/VREF_4                        | P14                 | VREF |
| 4    | IO_L06P_4                               | R14                 | I/O  |
| 4    | IO_L09N_4                               | U15                 | I/O  |
| 4    | IO_L09P_4                               | V15                 | I/O  |
| 4    | IO_L10N_4                               | T14                 | I/O  |
| 4    | IO_L10P_4                               | U14                 | I/O  |
| 4    | IO_L25N_4                               | R13                 | I/O  |
| 4    | IO_L25P_4                               | P13                 | I/O  |
| 4    | IO_L27N_4/DIN/D0                        | T12                 | DUAL |
| 4    | IO_L27P_4/D1                            | R12                 | DUAL |
| 4    | IO_L28N_4                               | V12                 | I/O  |
| 4    | IO_L28P_4                               | V11                 | I/O  |
| 4    | IO_L29N_4                               | R11                 | I/O  |
| 4    | IO_L29P_4                               | T11                 | I/O  |
| 4    | IO_L30N_4/D2                            | N11                 | DUAL |
| 4    | IO_L30P_4/D3                            | P11                 | DUAL |
| 4    | IO_L31N_4/INIT_B                        | U10                 | DUAL |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 4    | IO_L31P_4/<br>DOUT/BUSY                 | V10                 | DUAL |
| 4    | IO_L32N_4/GCLK1                         | N10                 | GCLK |
| 4    | IO_L32P_4/GCLK0                         | P10                 | GCLK |
| 4    | VCCO_4                                  | M10                 | VCCO |
| 4    | VCCO_4                                  | M11                 | VCCO |
| 4    | VCCO_4                                  | T13                 | VCCO |
| 4    | VCCO_4                                  | U11                 | VCCO |
| 5    | IO                                      | N8                  | I/O  |
| 5    | IO                                      | P8                  | I/O  |
| 5    | IO                                      | U6                  | I/O  |
| 5    | IO/VREF_5                               | R9                  | VREF |
| 5    | IO_L01N_5/RDWR_B                        | V3                  | DUAL |
| 5    | IO_L01P_5/CS_B                          | V2                  | DUAL |
| 5    | IO_L06N_5                               | T5                  | I/O  |
| 5    | IO_L06P_5                               | T4                  | I/O  |
| 5    | IO_L10N_5/VRP_5                         | V4                  | DCI  |
| 5    | IO_L10P_5/VRN_5                         | U4                  | DCI  |
| 5    | IO_L15N_5                               | R6                  | I/O  |
| 5    | IO_L15P_5                               | R5                  | I/O  |
| 5    | IO_L16N_5                               | V5                  | I/O  |
| 5    | IO_L16P_5                               | U5                  | I/O  |
| 5    | IO_L27N_5/VREF_5                        | P6                  | VREF |
| 5    | IO_L27P_5                               | P7                  | I/O  |
| 5    | IO_L28N_5/D6                            | R7                  | DUAL |
| 5    | IO_L28P_5/D7                            | T7                  | DUAL |
| 5    | IO_L29N_5                               | V8                  | I/O  |
| 5    | IO_L29P_5/VREF_5                        | V7                  | VREF |
| 5    | IO_L30N_5                               | R8                  | I/O  |
| 5    | IO_L30P_5                               | T8                  | I/O  |
| 5    | IO_L31N_5/D4                            | U9                  | DUAL |
| 5    | IO_L31P_5/D5                            | V9                  | DUAL |
| 5    | IO_L32N_5/GCLK3                         | N9                  | GCLK |
| 5    | IO_L32P_5/GCLK2                         | P9                  | GCLK |
| 5    | VCCO_5                                  | M8                  | VCCO |
| 5    | VCCO_5                                  | M9                  | VCCO |
| 5    | VCCO_5                                  | T6                  | VCCO |
| 5    | VCCO_5                                  | U8                  | VCCO |
| 6    | IO                                      | K6                  | I/O  |
| 6    | IO_L01N_6/VRP_6                         | T3                  | DCI  |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 6    | IO_L01P_6/VRN_6                         | T2                  | DCI  |
| 6    | IO_L16N_6                               | U1                  | I/O  |
| 6    | IO_L16P_6                               | T1                  | I/O  |
| 6    | IO_L17N_6                               | R2                  | I/O  |
| 6    | IO_L17P_6/VREF_6                        | R1                  | VREF |
| 6    | IO_L19N_6                               | R3                  | I/O  |
| 6    | IO_L19P_6                               | P3                  | I/O  |
| 6    | IO_L20N_6                               | P2                  | I/O  |
| 6    | IO_L20P_6                               | P1                  | I/O  |
| 6    | IO_L21N_6                               | N4                  | I/O  |
| 6    | IO_L21P_6                               | P4                  | I/O  |
| 6    | IO_L22N_6                               | N5                  | I/O  |
| 6    | IO_L22P_6                               | M5                  | I/O  |
| 6    | IO_L23N_6                               | M3                  | I/O  |
| 6    | IO_L23P_6                               | M4                  | I/O  |
| 6    | IO_L24N_6/VREF_6                        | N2                  | VREF |
| 6    | IO_L24P_6                               | M1                  | I/O  |
| 6    | IO_L27N_6                               | L6                  | I/O  |
| 6    | IO_L27P_6                               | L5                  | I/O  |
| 6    | IO_L34N_6/VREF_6                        | L3                  | VREF |
| 6    | IO_L34P_6                               | L4                  | I/O  |
| 6    | IO_L35N_6                               | L2                  | I/O  |
| 6    | IO_L35P_6                               | L1                  | I/O  |
| 6    | IO_L39N_6                               | K5                  | I/O  |
| 6    | IO_L39P_6                               | K4                  | I/O  |
| 6    | IO_L40N_6                               | K1                  | I/O  |
| 6    | IO_L40P_6/VREF_6                        | K2                  | VREF |
| 6    | VCCO_6                                  | K7                  | VCCO |
| 6    | VCCO_6                                  | L7                  | VCCO |
| 6    | VCCO_6                                  | N3                  | VCCO |
| 7    | IO                                      | J6                  | I/O  |
| 7    | IO_L01N_7/VRP_7                         | C3                  | DCI  |
| 7    | IO_L01P_7/VRN_7                         | C2                  | DCI  |
| 7    | IO_L16N_7                               | C1                  | I/O  |
| 7    | IO_L16P_7/VREF_7                        | B1                  | VREF |
| 7    | IO_L17N_7                               | D1                  | I/O  |
| 7    | IO_L17P_7                               | D2                  | I/O  |
| 7    | IO_L19N_7/VREF_7                        | E3                  | VREF |
| 7    | IO_L19P_7                               | D3                  | I/O  |
| 7    | IO_L20N_7                               | E2                  | I/O  |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type |
|------|---|---------------------|------|
| 7    | IO_L20P_7                               | E1                  | I/O  |
| 7    | IO_L21N_7                               | E4                  | I/O  |
| 7    | IO_L21P_7                               | F4                  | I/O  |
| 7    | IO_L22N_7                               | G5                  | I/O  |
| 7    | IO_L22P_7                               | F5                  | I/O  |
| 7    | IO_L23N_7                               | G1                  | I/O  |
| 7    | IO_L23P_7                               | F2                  | I/O  |
| 7    | IO_L24N_7                               | G4                  | I/O  |
| 7    | IO_L24P_7                               | G3                  | I/O  |
| 7    | IO_L27N_7                               | H5                  | I/O  |
| 7    | IO_L27P_7/VREF_7                        | H6                  | VREF |
| 7    | IO_L34N_7                               | H4                  | I/O  |
| 7    | IO_L34P_7                               | H3                  | I/O  |
| 7    | IO_L35N_7                               | H1                  | I/O  |
| 7    | IO_L35P_7                               | H2                  | I/O  |
| 7    | IO_L39N_7                               | J1                  | I/O  |
| 7    | IO_L39P_7                               | J2                  | I/O  |
| 7    | IO_L40N_7/VREF_7                        | J5                  | VREF |
| 7    | IO_L40P_7                               | J4                  | I/O  |
| 7    | VCCO_7                                  | F3                  | VCCO |
| 7    | VCCO_7                                  | H7                  | VCCO |
| 7    | VCCO_7                                  | J7                  | VCCO |
| N/A  | GND                                     | A1                  | GND  |
| N/A  | GND                                     | A13                 | GND  |
| N/A  | GND                                     | A18                 | GND  |
| N/A  | GND                                     | A6                  | GND  |
| N/A  | GND                                     | B17                 | GND  |
| N/A  | GND                                     | B2                  | GND  |
| N/A  | GND                                     | C10                 | GND  |
| N/A  | GND                                     | C9                  | GND  |
| N/A  | GND                                     | F1                  | GND  |
| N/A  | GND                                     | F18                 | GND  |
| N/A  | GND                                     | G12                 | GND  |
| N/A  | GND                                     | G7                  | GND  |
| N/A  | GND                                     | H10                 | GND  |
| N/A  | GND                                     | H11                 | GND  |
| N/A  | GND                                     | H8                  | GND  |
| N/A  | GND                                     | H9                  | GND  |
| N/A  | GND                                     | J11                 | GND  |
| N/A  | GND                                     | J16                 | GND  |

Table 98: FG320 Package Pinout (Cont'd)

| Bank | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type   |
|------|---|---------------------|--------|
| N/A  | GND                                     | J3                  | GND    |
| N/A  | GND                                     | J8                  | GND    |
| N/A  | GND                                     | K11                 | GND    |
| N/A  | GND                                     | K16                 | GND    |
| N/A  | GND                                     | K3                  | GND    |
| N/A  | GND                                     | K8                  | GND    |
| N/A  | GND                                     | L10                 | GND    |
| N/A  | GND                                     | L11                 | GND    |
| N/A  | GND                                     | L8                  | GND    |
| N/A  | GND                                     | L9                  | GND    |
| N/A  | GND                                     | M12                 | GND    |
| N/A  | GND                                     | M7                  | GND    |
| N/A  | GND                                     | N1                  | GND    |
| N/A  | GND                                     | N18                 | GND    |
| N/A  | GND                                     | T10                 | GND    |
| N/A  | GND                                     | T9                  | GND    |
| N/A  | GND                                     | U17                 | GND    |
| N/A  | GND                                     | U2                  | GND    |
| N/A  | GND                                     | V1                  | GND    |
| N/A  | GND                                     | V13                 | GND    |
| N/A  | GND                                     | V18                 | GND    |
| N/A  | GND                                     | V6                  | GND    |
| N/A  | VCCAUX                                  | B12                 | VCCAUX |
| N/A  | VCCAUX                                  | B7                  | VCCAUX |
| N/A  | VCCAUX                                  | G17                 | VCCAUX |
| N/A  | VCCAUX                                  | G2                  | VCCAUX |
| N/A  | VCCAUX                                  | M17                 | VCCAUX |
| N/A  | VCCAUX                                  | M2                  | VCCAUX |
| N/A  | VCCAUX                                  | U12                 | VCCAUX |
| N/A  | VCCAUX                                  | U7                  | VCCAUX |
| N/A  | VCCINT                                  | F12                 | VCCINT |
| N/A  | VCCINT                                  | F13                 | VCCINT |
| N/A  | VCCINT                                  | F6                  | VCCINT |
| N/A  | VCCINT                                  | F7                  | VCCINT |
| N/A  | VCCINT                                  | G13                 | VCCINT |
| N/A  | VCCINT                                  | G6                  | VCCINT |
| N/A  | VCCINT                                  | M13                 | VCCINT |
| N/A  | VCCINT                                  | M6                  | VCCINT |
| N/A  | VCCINT                                  | N12                 | VCCINT |
| N/A  | VCCINT                                  | N13                 | VCCINT |



Table 98: FG320 Package Pinout (Cont'd)

| Bank   | XC3S400, XC3S1000, XC3S1500<br>Pin Name | FG320<br>Pin Number | Type   |
|--------|---|---------------------|--------|
| N/A    | VCCINT                                  | N6                  | VCCINT |
| N/A    | VCCINT                                  | N7                  | VCCINT |
| VCCAUX | CCLK                                    | T15                 | CONFIG |
| VCCAUX | DONE                                    | R15                 | CONFIG |
| VCCAUX | HSWAP_EN                                | E6                  | CONFIG |
| VCCAUX | M0                                      | P5                  | CONFIG |
| VCCAUX | M1                                      | U3                  | CONFIG |
| VCCAUX | M2                                      | R4                  | CONFIG |
| VCCAUX | PROG_B                                  | E5                  | CONFIG |
| VCCAUX | TCK                                     | E14                 | JTAG   |
| VCCAUX | TDI                                     | D4                  | JTAG   |
| VCCAUX | TDO                                     | D15                 | JTAG   |
| VCCAUX | TMS                                     | B16                 | JTAG   |

### User I/Os by Bank

Table 99 indicates how the available user-I/O pins are distributed between the eight I/O banks on the FG320 package.

Table 99: User I/Os Per Bank in FG320 Package

| Package Edge | I/O Bank | Maximum<br>I/O | Maximum<br>LVDS Pairs | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|----------------|-----------------------|-------------------------------|------|-----|------|------|
|              |          |                |                       | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 26             | 11                    | 19                            | 0    | 2   | 3    | 2    |
|              | 1        | 26             | 11                    | 19                            | 0    | 2   | 3    | 2    |
| Right        | 2        | 29             | 14                    | 23                            | 0    | 2   | 4    | 0    |
|              | 3        | 29             | 14                    | 23                            | 0    | 2   | 4    | 0    |
| Bottom       | 4        | 27             | 11                    | 13                            | 6    | 2   | 4    | 2    |
|              | 5        | 26             | 11                    | 13                            | 6    | 2   | 3    | 2    |
| Left         | 6        | 29             | 14                    | 23                            | 0    | 2   | 4    | 0    |
|              | 7        | 29             | 14                    | 23                            | 0    | 2   | 4    | 0    |

FG320 Footprint

|        |        | Bank 0            |                   |                   |                   |                   |                   |                   |                   | Bank 1            |                   |                      |               |                   |                   |                   |                   |                   |                   |                   |            |  |
|--------|--------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|----------------------|---------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------|--|
|        |        | 1                 | 2                 | 3                 | 4                 | 5                 | 6                 | 7                 | 8                 | 9                 | 10                | 11                   | 12            | 13                | 14                | 15                | 16                | 17                | 18                |                   |            |  |
| Bank 7 | A      | GND               | I/O L01N_0 VRP_0  | I/O L01P_0 VRN_0  | I/O L15N_0        | I/O L15P_0        | GND               | I/O L30N_0        | I/O L30P_0        | I/O L31P_0 VREF_0 | I/O L31N_1 VREF_1 | I/O                  | I/O VREF_1    | GND               | I/O L16N_1        | I/O L10N_1 VREF_1 | I/O L01N_1 VRP_1  | I/O L01P_1 VRN_1  | GND               |                   |            |  |
|        | B      | I/O L16P_7 VREF_7 | GND               | I/O VREF_0        | I/O L09N_0        | I/O L25N_0        | I/O L25P_0        | VCCAUX            | VCCO_0            | I/O L31N_0        | I/O L31P_1        | VCCO_1               | VCCAUX        | I/O               | I/O L16P_1        | I/O L10P_1        | TMS               | GND               | I/O L16N_2        |                   |            |  |
|        | C      | I/O L16N_7        | I/O L01P_7 VRN_7  | I/O L01N_7 VRP_7  | I/O L09P_0        | I/O L10N_0        | VCCO_0            | I/O L27N_0        | I/O L28N_0        | GND               | GND               | I/O L30N_1           | I/O L28N_1    | VCCO_1            | I/O L15N_1        | I/O L15P_1        | I/O L01N_2 VRP_2  | I/O L01P_2 VRN_2  | I/O L16P_2        |                   |            |  |
|        | D      | I/O L17N_7        | I/O L17P_7        | I/O L19P_7        | TDI               | I/O L10P_0        | I/O VREF_0        | I/O L27P_0        | I/O L28P_0        | I/O               | I/O               | I/O L30P_1           | I/O L28P_1    | I/O L24P_1        | I/O L24N_1        | TDO               | I/O L19N_2        | I/O L17N_2        | I/O L17P_2 VREF_2 |                   |            |  |
|        | E      | I/O L20P_7        | I/O L20N_7        | I/O L19N_7 VREF_7 | I/O L21N_7        | PROG_B            | HSWAP_EN          | I/O               | I/O L29N_0        | I/O L32N_0 GCLK7  | I/O L32N_1 GCLK5  | I/O L29P_1           | I/O L27P_1    | I/O L27N_1        | TCK               | I/O L21P_2        | I/O L19P_2        | I/O L20N_2        | I/O L20P_2        | Bank 2            |            |  |
|        | F      | GND               | I/O L23P_7        | VCCO_7            | I/O L21P_7        | I/O L22P_7        | VCCINT            | VCCINT            | I/O L29P_0        | I/O L32P_0 GCLK6  | I/O L32P_1 GCLK4  | I/O L29N_1           | VCCINT        | VCCINT            | I/O L22N_2        | I/O L21N_2        | VCCO_2            | I/O L23P_2        | GND               |                   |            |  |
|        | G      | I/O L23N_7        | VCCAUX            | I/O L24P_7        | I/O L24N_7        | I/O L22N_7        | VCCINT            | GND               | VCCO_0            | VCCO_0            | VCCO_1            | VCCO_1               | GND           | VCCINT            | I/O L22P_2        | I/O L24N_2        | I/O L24P_2        | VCCAUX            | I/O L23N_2 VREF_2 |                   |            |  |
|        | H      | I/O L35N_7        | I/O L35P_7        | I/O L34P_7        | I/O L34N_7        | I/O L27N_7        | I/O L27P_7 VREF_7 | VCCO_7            | GND               | GND               | GND               | GND                  | VCCO_2        | I/O L27N_2        | I/O L27P_2        | I/O L34P_2        | I/O L34N_2 VREF_2 | I/O L35N_2        | I/O L35P_2        |                   |            |  |
|        | J      | I/O L39N_7        | I/O L39P_7        | GND               | I/O L40P_7        | I/O L40N_7 VREF_7 | I/O               | VCCO_7            | GND               | X                 |                   | GND                  | VCCO_2        | I/O               | I/O L40P_2 VREF_2 | I/O L40N_2        | GND               | I/O L39P_2        | I/O L39N_2        |                   |            |  |
|        | K      | I/O L40N_6        | I/O L40P_6 VREF_6 | GND               | I/O L39P_6        | I/O L39N_6        | I/O               | VCCO_6            | GND               |                   |                   | GND                  | GND           | GND               | VCCO_3            | I/O L39N_3        | I/O L39P_3        | I/O               | GND               | I/O L40N_3 VREF_3 | I/O L40P_3 |  |
|        | L      | I/O L35P_6        | I/O L35N_6        | I/O L34N_6 VREF_6 | I/O L34P_6        | I/O L27P_6        | I/O L27N_6        | VCCO_6            | GND               | GND               | GND               | GND                  | VCCO_3        | I/O L27P_3        | I/O L27N_3        | I/O L34N_3        | I/O L34P_3 VREF_3 | I/O L35P_3        | I/O L35N_3        |                   |            |  |
|        | M      | I/O L24P_6        | VCCAUX            | I/O L23N_6        | I/O L23P_6        | I/O L22P_6        | VCCINT            | GND               | VCCO_5            | VCCO_5            | VCCO_4            | VCCO_4               | GND           | VCCINT            | I/O L22N_3        | I/O L23N_3        | I/O L23P_3 VREF_3 | VCCAUX            | I/O L24N_3        |                   |            |  |
|        | Bank 6 | N                 | GND               | I/O L24N_6 VREF_6 | VCCO_6            | I/O L21N_6        | I/O L22N_6        | VCCINT            | VCCINT            | I/O               | I/O L32N_5 GCLK3  | I/O L32N_4 GCLK1     | I/O L30N_4 D2 | VCCINT            | VCCINT            | I/O L22P_3        | I/O L21P_3        | VCCO_3            | I/O L24P_3        | GND               | Bank 3     |  |
|        |        | P                 | I/O L20P_6        | I/O L20N_6        | I/O L19P_6        | I/O L21P_6        | M0                | I/O L27N_5 VREF_5 | I/O L27P_5        | I/O               | I/O L32P_5 GCLK2  | I/O L32P_4 GCLK0     | I/O L30P_4 D3 | I/O               | I/O L25P_4        | I/O L06N_4 VREF_4 | I/O L21N_3        | I/O L17N_3        | I/O L20P_3        | I/O L20N_3        |            |  |
|        |        | R                 | I/O L17P_6 VREF_6 | I/O L17N_6        | I/O L19N_6        | M2                | I/O L15P_5        | I/O L15N_5        | I/O L28N_5 D6     | I/O L30N_5        | I/O VREF_5        | I/O VREF_4           | I/O L29N_4    | I/O L27P_4 D1     | I/O L25N_4        | I/O L06P_4        | DONE              | I/O L17P_3 VREF_3 | I/O L19N_3        | I/O L19P_3        |            |  |
|        |        | T                 | I/O L16P_6        | I/O L01P_6 VRN_6  | I/O L01N_6 VRP_6  | I/O L06P_5        | I/O L06N_5        | VCCO_5            | I/O L28P_5 D7     | I/O L30P_5        | GND               | GND                  | I/O L29P_4    | I/O L27N_4 DIN D0 | VCCO_4            | I/O L10N_4        | CCLK              | I/O L01P_3 VRN_3  | I/O L01N_3 VRP_3  | I/O L16N_3        |            |  |
|        |        | U                 | I/O L16N_6        | GND               | M1                | I/O L10P_5 VRN_5  | I/O L16P_5        | I/O               | VCCAUX            | VCCO_5            | I/O L31N_5 D4     | I/O L31N_4 INIT_B    | VCCO_4        | VCCAUX            | I/O VREF_4        | I/O L10P_4        | I/O L09N_4        | I/O L01N_4 VRP_4  | GND               | I/O L16P_3        |            |  |
|        |        | V                 | GND               | I/O L01P_5 CS_B   | I/O L01N_5 RDWR_B | I/O L10N_5 VRP_5  | I/O L16N_5        | GND               | I/O L29P_5 VREF_5 | I/O L29N_5        | I/O L31P_5 D5     | I/O L31P_4 DOUT BUSY | I/O L28P_4    | I/O L28N_4        | GND               | I/O               | I/O L09P_4        | I/O L01P_4 VRN_4  | I/O VREF_4        | GND               |            |  |
|        |        | Bank 5            |                   |                   |                   |                   |                   |                   |                   | Bank 4            |                   |                      |               |                   |                   |                   |                   |                   |                   |                   |            |  |

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Figure 50: FG320 Package Footprint (Top View)

|     |  |    |   |    |  |
|-----|--|----|---|----|--|
| 156 | I/O: Unrestricted, general-purpose user I/O        | 12 | DUAL: Configuration pin, then possible user I/O | 29 | VREF: User I/O or input voltage reference for bank |
| 16  | DCI: User I/O or reference resistor input for bank | 8  | GCLK: User I/O or global clock buffer input     | 28 | VCCO: Output voltage supply for bank               |
| 7   | CONFIG: Dedicated configuration pins               | 4  | JTAG: Dedicated JTAG port pins                  | 12 | VCCINT: Internal core voltage supply (+1.2V)       |
| 0   | N.C.: No unconnected pins in this package          | 40 | GND: Ground                                     | 8  | VCCAUX: Auxiliary voltage supply (+2.5V)           |

## FG456: 456-lead Fine-pitch Ball Grid Array

The 456-lead fine-pitch ball grid array package, FG456, supports four different Spartan-3 devices, including the XC3S400, the XC3S1000, the XC3S1500, and the XC3S2000. The footprints for the XC3S1000, the XC3S1500, and the XC3S2000 are identical, as shown in [Table 100](#) and [Figure 51](#). The XC3S400, however, has fewer I/O pins which consequently results in 69 unconnected pins on the FG456 package, labeled as “N.C.” In [Table 100](#) and [Figure 51](#), these unconnected pins are indicated with a black diamond symbol (◆).

All the package pins appear in [Table 100](#) and are sorted by bank number, 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.

If there is a difference between the XC3S400 pinout and the pinout for the XC3S1000, the XC3S1500, or the XC3S2000, then that difference is highlighted in [Table 100](#). If the table entry is shaded grey, then there is an unconnected pin on the XC3S400 that maps to a user-I/O pin on the XC3S1000, XC3S1500, and XC3S2000. If the table entry is shaded tan, then the unconnected pin on the XC3S400 maps to a VREF-type pin on the XC3S1000, the XC3S1500, or the XC3S2000. If the other VREF pins in the bank all connect to a voltage reference to support a special I/O standard, then also connect the N.C. pin on the XC3S400 to the same VREF voltage. This provides maximum flexibility as you could potentially migrate a design from the XC3S400 device to an XC3S1000, an XC3S1500, or an XC3S2000 FPGA without changing the printed circuit board.

An electronic version of this package pinout table and footprint diagram is available for download from the Xilinx website at [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 100: FG456 Package Pinout

| Bank | 3S400 Pin Name  | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|-----------------|---------------------------------|------------------|------|
| 0    | IO              | IO                              | A10              | I/O  |
| 0    | IO              | IO                              | D9               | I/O  |
| 0    | IO              | IO                              | D10              | I/O  |
| 0    | IO              | IO                              | F6               | I/O  |
| 0    | IO/VREF_0       | IO/VREF_0                       | A3               | VREF |
| 0    | IO/VREF_0       | IO/VREF_0                       | C7               | VREF |
| 0    | N.C. (◆)        | IO/VREF_0                       | E5               | VREF |
| 0    | IO/VREF_0       | IO/VREF_0                       | F7               | VREF |
| 0    | IO_L01N_0/VRP_0 | IO_L01N_0/VRP_0                 | B4               | DCI  |
| 0    | IO_L01P_0/VRN_0 | IO_L01P_0/VRN_0                 | A4               | DCI  |
| 0    | IO_L06N_0       | IO_L06N_0                       | D5               | I/O  |
| 0    | IO_L06P_0       | IO_L06P_0                       | C5               | I/O  |
| 0    | IO_L09N_0       | IO_L09N_0                       | B5               | I/O  |
| 0    | IO_L09P_0       | IO_L09P_0                       | A5               | I/O  |
| 0    | IO_L10N_0       | IO_L10N_0                       | E6               | I/O  |
| 0    | IO_L10P_0       | IO_L10P_0                       | D6               | I/O  |
| 0    | IO_L15N_0       | IO_L15N_0                       | C6               | I/O  |
| 0    | IO_L15P_0       | IO_L15P_0                       | B6               | I/O  |
| 0    | IO_L16N_0       | IO_L16N_0                       | E7               | I/O  |
| 0    | IO_L16P_0       | IO_L16P_0                       | D7               | I/O  |
| 0    | N.C. (◆)        | IO_L19N_0                       | B7               | I/O  |
| 0    | N.C. (◆)        | IO_L19P_0                       | A7               | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 0    | N.C. (◆)         | IO_L22N_0                       | E8               | I/O  |
| 0    | N.C. (◆)         | IO_L22P_0                       | D8               | I/O  |
| 0    | IO_L24N_0        | IO_L24N_0                       | B8               | I/O  |
| 0    | IO_L24P_0        | IO_L24P_0                       | A8               | I/O  |
| 0    | IO_L25N_0        | IO_L25N_0                       | F9               | I/O  |
| 0    | IO_L25P_0        | IO_L25P_0                       | E9               | I/O  |
| 0    | IO_L27N_0        | IO_L27N_0                       | B9               | I/O  |
| 0    | IO_L27P_0        | IO_L27P_0                       | A9               | I/O  |
| 0    | IO_L28N_0        | IO_L28N_0                       | F10              | I/O  |
| 0    | IO_L28P_0        | IO_L28P_0                       | E10              | I/O  |
| 0    | IO_L29N_0        | IO_L29N_0                       | C10              | I/O  |
| 0    | IO_L29P_0        | IO_L29P_0                       | B10              | I/O  |
| 0    | IO_L30N_0        | IO_L30N_0                       | F11              | I/O  |
| 0    | IO_L30P_0        | IO_L30P_0                       | E11              | I/O  |
| 0    | IO_L31N_0        | IO_L31N_0                       | D11              | I/O  |
| 0    | IO_L31P_0/VREF_0 | IO_L31P_0/VREF_0                | C11              | VREF |
| 0    | IO_L32N_0/GCLK7  | IO_L32N_0/GCLK7                 | B11              | GCLK |
| 0    | IO_L32P_0/GCLK6  | IO_L32P_0/GCLK6                 | A11              | GCLK |
| 0    | VCCO_0           | VCCO_0                          | C8               | VCCO |
| 0    | VCCO_0           | VCCO_0                          | F8               | VCCO |
| 0    | VCCO_0           | VCCO_0                          | G9               | VCCO |
| 0    | VCCO_0           | VCCO_0                          | G10              | VCCO |
| 0    | VCCO_0           | VCCO_0                          | G11              | VCCO |
| 1    | IO               | IO                              | A12              | I/O  |
| 1    | IO               | IO                              | E16              | I/O  |
| 1    | IO               | IO                              | F12              | I/O  |
| 1    | IO               | IO                              | F13              | I/O  |
| 1    | IO               | IO                              | F16              | I/O  |
| 1    | IO               | IO                              | F17              | I/O  |
| 1    | IO/VREF_1        | IO/VREF_1                       | E13              | VREF |
| 1    | N.C. (◆)         | IO/VREF_1                       | F14              | VREF |
| 1    | IO_L01N_1/VRP_1  | IO_L01N_1/VRP_1                 | C19              | DCI  |
| 1    | IO_L01P_1/VRN_1  | IO_L01P_1/VRN_1                 | B20              | DCI  |
| 1    | IO_L06N_1/VREF_1 | IO_L06N_1/VREF_1                | A19              | VREF |
| 1    | IO_L06P_1        | IO_L06P_1                       | B19              | I/O  |
| 1    | IO_L09N_1        | IO_L09N_1                       | C18              | I/O  |
| 1    | IO_L09P_1        | IO_L09P_1                       | D18              | I/O  |
| 1    | IO_L10N_1/VREF_1 | IO_L10N_1/VREF_1                | A18              | VREF |
| 1    | IO_L10P_1        | IO_L10P_1                       | B18              | I/O  |
| 1    | IO_L15N_1        | IO_L15N_1                       | D17              | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 1    | IO_L15P_1        | IO_L15P_1                       | E17              | I/O  |
| 1    | IO_L16N_1        | IO_L16N_1                       | B17              | I/O  |
| 1    | IO_L16P_1        | IO_L16P_1                       | C17              | I/O  |
| 1    | N.C. (◆)         | IO_L19N_1                       | C16              | I/O  |
| 1    | N.C. (◆)         | IO_L19P_1                       | D16              | I/O  |
| 1    | N.C. (◆)         | IO_L22N_1                       | A16              | I/O  |
| 1    | N.C. (◆)         | IO_L22P_1                       | B16              | I/O  |
| 1    | IO_L24N_1        | IO_L24N_1                       | D15              | I/O  |
| 1    | IO_L24P_1        | IO_L24P_1                       | E15              | I/O  |
| 1    | IO_L25N_1        | IO_L25N_1                       | B15              | I/O  |
| 1    | IO_L25P_1        | IO_L25P_1                       | A15              | I/O  |
| 1    | IO_L27N_1        | IO_L27N_1                       | D14              | I/O  |
| 1    | IO_L27P_1        | IO_L27P_1                       | E14              | I/O  |
| 1    | IO_L28N_1        | IO_L28N_1                       | A14              | I/O  |
| 1    | IO_L28P_1        | IO_L28P_1                       | B14              | I/O  |
| 1    | IO_L29N_1        | IO_L29N_1                       | C13              | I/O  |
| 1    | IO_L29P_1        | IO_L29P_1                       | D13              | I/O  |
| 1    | IO_L30N_1        | IO_L30N_1                       | A13              | I/O  |
| 1    | IO_L30P_1        | IO_L30P_1                       | B13              | I/O  |
| 1    | IO_L31N_1/VREF_1 | IO_L31N_1/VREF_1                | D12              | VREF |
| 1    | IO_L31P_1        | IO_L31P_1                       | E12              | I/O  |
| 1    | IO_L32N_1/GCLK5  | IO_L32N_1/GCLK5                 | B12              | GCLK |
| 1    | IO_L32P_1/GCLK4  | IO_L32P_1/GCLK4                 | C12              | GCLK |
| 1    | VCCO_1           | VCCO_1                          | C15              | VCCO |
| 1    | VCCO_1           | VCCO_1                          | F15              | VCCO |
| 1    | VCCO_1           | VCCO_1                          | G12              | VCCO |
| 1    | VCCO_1           | VCCO_1                          | G13              | VCCO |
| 1    | VCCO_1           | VCCO_1                          | G14              | VCCO |
| 2    | IO               | IO                              | C22              | I/O  |
| 2    | IO_L01N_2/VRP_2  | IO_L01N_2/VRP_2                 | C20              | DCI  |
| 2    | IO_L01P_2/VRN_2  | IO_L01P_2/VRN_2                 | C21              | DCI  |
| 2    | IO_L16N_2        | IO_L16N_2                       | D20              | I/O  |
| 2    | IO_L16P_2        | IO_L16P_2                       | D19              | I/O  |
| 2    | IO_L17N_2        | IO_L17N_2                       | D21              | I/O  |
| 2    | IO_L17P_2/VREF_2 | IO_L17P_2/VREF_2                | D22              | VREF |
| 2    | IO_L19N_2        | IO_L19N_2                       | E18              | I/O  |
| 2    | IO_L19P_2        | IO_L19P_2                       | F18              | I/O  |
| 2    | IO_L20N_2        | IO_L20N_2                       | E19              | I/O  |
| 2    | IO_L20P_2        | IO_L20P_2                       | E20              | I/O  |
| 2    | IO_L21N_2        | IO_L21N_2                       | E21              | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 2    | IO_L21P_2        | IO_L21P_2                       | E22              | I/O  |
| 2    | IO_L22N_2        | IO_L22N_2                       | G17              | I/O  |
| 2    | IO_L22P_2        | IO_L22P_2                       | G18              | I/O  |
| 2    | IO_L23N_2/VREF_2 | IO_L23N_2/VREF_2                | F19              | VREF |
| 2    | IO_L23P_2        | IO_L23P_2                       | G19              | I/O  |
| 2    | IO_L24N_2        | IO_L24N_2                       | F20              | I/O  |
| 2    | IO_L24P_2        | IO_L24P_2                       | F21              | I/O  |
| 2    | N.C. (◆)         | IO_L26N_2                       | G20              | I/O  |
| 2    | N.C. (◆)         | IO_L26P_2                       | H19              | I/O  |
| 2    | IO_L27N_2        | IO_L27N_2                       | G21              | I/O  |
| 2    | IO_L27P_2        | IO_L27P_2                       | G22              | I/O  |
| 2    | N.C. (◆)         | IO_L28N_2                       | H18              | I/O  |
| 2    | N.C. (◆)         | IO_L28P_2                       | J17              | I/O  |
| 2    | N.C. (◆)         | IO_L29N_2                       | H21              | I/O  |
| 2    | N.C. (◆)         | IO_L29P_2                       | H22              | I/O  |
| 2    | N.C. (◆)         | IO_L31N_2                       | J18              | I/O  |
| 2    | N.C. (◆)         | IO_L31P_2                       | J19              | I/O  |
| 2    | N.C. (◆)         | IO_L32N_2                       | J21              | I/O  |
| 2    | N.C. (◆)         | IO_L32P_2                       | J22              | I/O  |
| 2    | N.C. (◆)         | IO_L33N_2                       | K17              | I/O  |
| 2    | N.C. (◆)         | IO_L33P_2                       | K18              | I/O  |
| 2    | IO_L34N_2/VREF_2 | IO_L34N_2/VREF_2                | K19              | VREF |
| 2    | IO_L34P_2        | IO_L34P_2                       | K20              | I/O  |
| 2    | IO_L35N_2        | IO_L35N_2                       | K21              | I/O  |
| 2    | IO_L35P_2        | IO_L35P_2                       | K22              | I/O  |
| 2    | IO_L38N_2        | IO_L38N_2                       | L17              | I/O  |
| 2    | IO_L38P_2        | IO_L38P_2                       | L18              | I/O  |
| 2    | IO_L39N_2        | IO_L39N_2                       | L19              | I/O  |
| 2    | IO_L39P_2        | IO_L39P_2                       | L20              | I/O  |
| 2    | IO_L40N_2        | IO_L40N_2                       | L21              | I/O  |
| 2    | IO_L40P_2/VREF_2 | IO_L40P_2/VREF_2                | L22              | VREF |
| 2    | VCCO_2           | VCCO_2                          | H17              | VCCO |
| 2    | VCCO_2           | VCCO_2                          | H20              | VCCO |
| 2    | VCCO_2           | VCCO_2                          | J16              | VCCO |
| 2    | VCCO_2           | VCCO_2                          | K16              | VCCO |
| 2    | VCCO_2           | VCCO_2                          | L16              | VCCO |
| 3    | IO               | IO                              | Y21              | I/O  |
| 3    | IO_L01N_3/VRP_3  | IO_L01N_3/VRP_3                 | Y20              | DCI  |
| 3    | IO_L01P_3/VRN_3  | IO_L01P_3/VRN_3                 | Y19              | DCI  |
| 3    | IO_L16N_3        | IO_L16N_3                       | W22              | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 3    | IO_L16P_3        | IO_L16P_3                       | Y22              | I/O  |
| 3    | IO_L17N_3        | IO_L17N_3                       | V19              | I/O  |
| 3    | IO_L17P_3/VREF_3 | IO_L17P_3/VREF_3                | W19              | VREF |
| 3    | IO_L19N_3        | IO_L19N_3                       | W21              | I/O  |
| 3    | IO_L19P_3        | IO_L19P_3                       | W20              | I/O  |
| 3    | IO_L20N_3        | IO_L20N_3                       | U19              | I/O  |
| 3    | IO_L20P_3        | IO_L20P_3                       | V20              | I/O  |
| 3    | IO_L21N_3        | IO_L21N_3                       | V22              | I/O  |
| 3    | IO_L21P_3        | IO_L21P_3                       | V21              | I/O  |
| 3    | IO_L22N_3        | IO_L22N_3                       | T17              | I/O  |
| 3    | IO_L22P_3        | IO_L22P_3                       | U18              | I/O  |
| 3    | IO_L23N_3        | IO_L23N_3                       | U21              | I/O  |
| 3    | IO_L23P_3/VREF_3 | IO_L23P_3/VREF_3                | U20              | VREF |
| 3    | IO_L24N_3        | IO_L24N_3                       | R18              | I/O  |
| 3    | IO_L24P_3        | IO_L24P_3                       | T18              | I/O  |
| 3    | N.C. (◆)         | IO_L26N_3                       | T20              | I/O  |
| 3    | N.C. (◆)         | IO_L26P_3                       | T19              | I/O  |
| 3    | IO_L27N_3        | IO_L27N_3                       | T22              | I/O  |
| 3    | IO_L27P_3        | IO_L27P_3                       | T21              | I/O  |
| 3    | N.C. (◆)         | IO_L28N_3                       | R22              | I/O  |
| 3    | N.C. (◆)         | IO_L28P_3                       | R21              | I/O  |
| 3    | N.C. (◆)         | IO_L29N_3                       | P19              | I/O  |
| 3    | N.C. (◆)         | IO_L29P_3                       | R19              | I/O  |
| 3    | N.C. (◆)         | IO_L31N_3                       | P18              | I/O  |
| 3    | N.C. (◆)         | IO_L31P_3                       | P17              | I/O  |
| 3    | N.C. (◆)         | IO_L32N_3                       | P22              | I/O  |
| 3    | N.C. (◆)         | IO_L32P_3                       | P21              | I/O  |
| 3    | N.C. (◆)         | IO_L33N_3                       | N18              | I/O  |
| 3    | N.C. (◆)         | IO_L33P_3                       | N17              | I/O  |
| 3    | IO_L34N_3        | IO_L34N_3                       | N20              | I/O  |
| 3    | IO_L34P_3/VREF_3 | IO_L34P_3/VREF_3                | N19              | VREF |
| 3    | IO_L35N_3        | IO_L35N_3                       | N22              | I/O  |
| 3    | IO_L35P_3        | IO_L35P_3                       | N21              | I/O  |
| 3    | IO_L38N_3        | IO_L38N_3                       | M18              | I/O  |
| 3    | IO_L38P_3        | IO_L38P_3                       | M17              | I/O  |
| 3    | IO_L39N_3        | IO_L39N_3                       | M20              | I/O  |
| 3    | IO_L39P_3        | IO_L39P_3                       | M19              | I/O  |
| 3    | IO_L40N_3/VREF_3 | IO_L40N_3/VREF_3                | M22              | VREF |
| 3    | IO_L40P_3        | IO_L40P_3                       | M21              | I/O  |
| 3    | VCCO_3           | VCCO_3                          | M16              | VCCO |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 3    | VCCO_3           | VCCO_3                          | N16              | VCCO |
| 3    | VCCO_3           | VCCO_3                          | P16              | VCCO |
| 3    | VCCO_3           | VCCO_3                          | R17              | VCCO |
| 3    | VCCO_3           | VCCO_3                          | R20              | VCCO |
| 4    | IO               | IO                              | U16              | I/O  |
| 4    | IO               | IO                              | U17              | I/O  |
| 4    | IO               | IO                              | W13              | I/O  |
| 4    | IO               | IO                              | W14              | I/O  |
| 4    | IO/VREF_4        | IO/VREF_4                       | AB13             | VREF |
| 4    | IO/VREF_4        | IO/VREF_4                       | V18              | VREF |
| 4    | IO/VREF_4        | IO/VREF_4                       | Y16              | VREF |
| 4    | IO_L01N_4/VRP_4  | IO_L01N_4/VRP_4                 | AA20             | DCI  |
| 4    | IO_L01P_4/VRN_4  | IO_L01P_4/VRN_4                 | AB20             | DCI  |
| 4    | N.C. (◆)         | IO_L05N_4                       | AA19             | I/O  |
| 4    | N.C. (◆)         | IO_L05P_4                       | AB19             | I/O  |
| 4    | IO_L06N_4/VREF_4 | IO_L06N_4/VREF_4                | W18              | VREF |
| 4    | IO_L06P_4        | IO_L06P_4                       | Y18              | I/O  |
| 4    | IO_L09N_4        | IO_L09N_4                       | AA18             | I/O  |
| 4    | IO_L09P_4        | IO_L09P_4                       | AB18             | I/O  |
| 4    | IO_L10N_4        | IO_L10N_4                       | V17              | I/O  |
| 4    | IO_L10P_4        | IO_L10P_4                       | W17              | I/O  |
| 4    | IO_L15N_4        | IO_L15N_4                       | Y17              | I/O  |
| 4    | IO_L15P_4        | IO_L15P_4                       | AA17             | I/O  |
| 4    | IO_L16N_4        | IO_L16N_4                       | V16              | I/O  |
| 4    | IO_L16P_4        | IO_L16P_4                       | W16              | I/O  |
| 4    | N.C. (◆)         | IO_L19N_4                       | AA16             | I/O  |
| 4    | N.C. (◆)         | IO_L19P_4                       | AB16             | I/O  |
| 4    | N.C. (◆)         | IO_L22N_4/<br>VREF_4            | V15              | VREF |
| 4    | N.C. (◆)         | IO_L22P_4                       | W15              | I/O  |
| 4    | IO_L24N_4        | IO_L24N_4                       | AA15             | I/O  |
| 4    | IO_L24P_4        | IO_L24P_4                       | AB15             | I/O  |
| 4    | IO_L25N_4        | IO_L25N_4                       | U14              | I/O  |
| 4    | IO_L25P_4        | IO_L25P_4                       | V14              | I/O  |
| 4    | IO_L27N_4/DIN/D0 | IO_L27N_4/DIN/D0                | AA14             | DUAL |
| 4    | IO_L27P_4/D1     | IO_L27P_4/D1                    | AB14             | DUAL |
| 4    | IO_L28N_4        | IO_L28N_4                       | U13              | I/O  |
| 4    | IO_L28P_4        | IO_L28P_4                       | V13              | I/O  |
| 4    | IO_L29N_4        | IO_L29N_4                       | Y13              | I/O  |
| 4    | IO_L29P_4        | IO_L29P_4                       | AA13             | I/O  |



Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name      | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|---------------------|---------------------------------|------------------|------|
| 4    | IO_L30N_4/D2        | IO_L30N_4/D2                    | U12              | DUAL |
| 4    | IO_L30P_4/D3        | IO_L30P_4/D3                    | V12              | DUAL |
| 4    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B                | W12              | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY             | Y12              | DUAL |
| 4    | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1                 | AA12             | GCLK |
| 4    | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0                 | AB12             | GCLK |
| 4    | VCCO_4              | VCCO_4                          | T12              | VCCO |
| 4    | VCCO_4              | VCCO_4                          | T13              | VCCO |
| 4    | VCCO_4              | VCCO_4                          | T14              | VCCO |
| 4    | VCCO_4              | VCCO_4                          | U15              | VCCO |
| 4    | VCCO_4              | VCCO_4                          | Y15              | VCCO |
| 5    | IO                  | IO                              | U7               | I/O  |
| 5    | N.C. (◆)            | IO                              | U9               | I/O  |
| 5    | IO                  | IO                              | U10              | I/O  |
| 5    | IO                  | IO                              | U11              | I/O  |
| 5    | IO                  | IO                              | V7               | I/O  |
| 5    | IO                  | IO                              | V10              | I/O  |
| 5    | IO/VREF_5           | IO/VREF_5                       | AB11             | VREF |
| 5    | IO/VREF_5           | IO/VREF_5                       | U6               | VREF |
| 5    | IO_L01N_5/RDWR_B    | IO_L01N_5/RDWR_B                | Y4               | DUAL |
| 5    | IO_L01P_5/CS_B      | IO_L01P_5/CS_B                  | AA3              | DUAL |
| 5    | IO_L06N_5           | IO_L06N_5                       | AB4              | I/O  |
| 5    | IO_L06P_5           | IO_L06P_5                       | AA4              | I/O  |
| 5    | IO_L09N_5           | IO_L09N_5                       | Y5               | I/O  |
| 5    | IO_L09P_5           | IO_L09P_5                       | W5               | I/O  |
| 5    | IO_L10N_5/VRP_5     | IO_L10N_5/VRP_5                 | AB5              | DCI  |
| 5    | IO_L10P_5/VRN_5     | IO_L10P_5/VRN_5                 | AA5              | DCI  |
| 5    | IO_L15N_5           | IO_L15N_5                       | W6               | I/O  |
| 5    | IO_L15P_5           | IO_L15P_5                       | V6               | I/O  |
| 5    | IO_L16N_5           | IO_L16N_5                       | AA6              | I/O  |
| 5    | IO_L16P_5           | IO_L16P_5                       | Y6               | I/O  |
| 5    | N.C. (◆)            | IO_L19N_5                       | Y7               | I/O  |
| 5    | N.C. (◆)            | IO_L19P_5/<br>VREF_5            | W7               | VREF |
| 5    | N.C. (◆)            | IO_L22N_5                       | AB7              | I/O  |
| 5    | N.C. (◆)            | IO_L22P_5                       | AA7              | I/O  |
| 5    | IO_L24N_5           | IO_L24N_5                       | W8               | I/O  |
| 5    | IO_L24P_5           | IO_L24P_5                       | V8               | I/O  |
| 5    | IO_L25N_5           | IO_L25N_5                       | AB8              | I/O  |
| 5    | IO_L25P_5           | IO_L25P_5                       | AA8              | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 5    | IO_L27N_5/VREF_5 | IO_L27N_5/VREF_5                | W9               | VREF |
| 5    | IO_L27P_5        | IO_L27P_5                       | V9               | I/O  |
| 5    | IO_L28N_5/D6     | IO_L28N_5/D6                    | AB9              | DUAL |
| 5    | IO_L28P_5/D7     | IO_L28P_5/D7                    | AA9              | DUAL |
| 5    | IO_L29N_5        | IO_L29N_5                       | Y10              | I/O  |
| 5    | IO_L29P_5/VREF_5 | IO_L29P_5/VREF_5                | W10              | VREF |
| 5    | IO_L30N_5        | IO_L30N_5                       | AB10             | I/O  |
| 5    | IO_L30P_5        | IO_L30P_5                       | AA10             | I/O  |
| 5    | IO_L31N_5/D4     | IO_L31N_5/D4                    | W11              | DUAL |
| 5    | IO_L31P_5/D5     | IO_L31P_5/D5                    | V11              | DUAL |
| 5    | IO_L32N_5/GCLK3  | IO_L32N_5/GCLK3                 | AA11             | GCLK |
| 5    | IO_L32P_5/GCLK2  | IO_L32P_5/GCLK2                 | Y11              | GCLK |
| 5    | VCCO_5           | VCCO_5                          | T9               | VCCO |
| 5    | VCCO_5           | VCCO_5                          | T10              | VCCO |
| 5    | VCCO_5           | VCCO_5                          | T11              | VCCO |
| 5    | VCCO_5           | VCCO_5                          | U8               | VCCO |
| 5    | VCCO_5           | VCCO_5                          | Y8               | VCCO |
| 6    | IO               | IO                              | Y1               | I/O  |
| 6    | IO_L01N_6/VRP_6  | IO_L01N_6/VRP_6                 | Y3               | DCI  |
| 6    | IO_L01P_6/VRN_6  | IO_L01P_6/VRN_6                 | Y2               | DCI  |
| 6    | IO_L16N_6        | IO_L16N_6                       | W4               | I/O  |
| 6    | IO_L16P_6        | IO_L16P_6                       | W3               | I/O  |
| 6    | IO_L17N_6        | IO_L17N_6                       | W2               | I/O  |
| 6    | IO_L17P_6/VREF_6 | IO_L17P_6/VREF_6                | W1               | VREF |
| 6    | IO_L19N_6        | IO_L19N_6                       | V5               | I/O  |
| 6    | IO_L19P_6        | IO_L19P_6                       | U5               | I/O  |
| 6    | IO_L20N_6        | IO_L20N_6                       | V4               | I/O  |
| 6    | IO_L20P_6        | IO_L20P_6                       | V3               | I/O  |
| 6    | IO_L21N_6        | IO_L21N_6                       | V2               | I/O  |
| 6    | IO_L21P_6        | IO_L21P_6                       | V1               | I/O  |
| 6    | IO_L22N_6        | IO_L22N_6                       | T6               | I/O  |
| 6    | IO_L22P_6        | IO_L22P_6                       | T5               | I/O  |
| 6    | IO_L23N_6        | IO_L23N_6                       | U4               | I/O  |
| 6    | IO_L23P_6        | IO_L23P_6                       | T4               | I/O  |
| 6    | IO_L24N_6/VREF_6 | IO_L24N_6/VREF_6                | U3               | VREF |
| 6    | IO_L24P_6        | IO_L24P_6                       | U2               | I/O  |
| 6    | N.C. (◆)         | IO_L26N_6                       | T3               | I/O  |
| 6    | N.C. (◆)         | IO_L26P_6                       | R4               | I/O  |
| 6    | IO_L27N_6        | IO_L27N_6                       | T2               | I/O  |
| 6    | IO_L27P_6        | IO_L27P_6                       | T1               | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 6    | N.C. (◆)         | IO_L28N_6                       | R5               | I/O  |
| 6    | N.C. (◆)         | IO_L28P_6                       | P6               | I/O  |
| 6    | N.C. (◆)         | IO_L29N_6                       | R2               | I/O  |
| 6    | N.C. (◆)         | IO_L29P_6                       | R1               | I/O  |
| 6    | N.C. (◆)         | IO_L31N_6                       | P5               | I/O  |
| 6    | N.C. (◆)         | IO_L31P_6                       | P4               | I/O  |
| 6    | N.C. (◆)         | IO_L32N_6                       | P2               | I/O  |
| 6    | N.C. (◆)         | IO_L32P_6                       | P1               | I/O  |
| 6    | N.C. (◆)         | IO_L33N_6                       | N6               | I/O  |
| 6    | N.C. (◆)         | IO_L33P_6                       | N5               | I/O  |
| 6    | IO_L34N_6/VREF_6 | IO_L34N_6/VREF_6                | N4               | VREF |
| 6    | IO_L34P_6        | IO_L34P_6                       | N3               | I/O  |
| 6    | IO_L35N_6        | IO_L35N_6                       | N2               | I/O  |
| 6    | IO_L35P_6        | IO_L35P_6                       | N1               | I/O  |
| 6    | IO_L38N_6        | IO_L38N_6                       | M6               | I/O  |
| 6    | IO_L38P_6        | IO_L38P_6                       | M5               | I/O  |
| 6    | IO_L39N_6        | IO_L39N_6                       | M4               | I/O  |
| 6    | IO_L39P_6        | IO_L39P_6                       | M3               | I/O  |
| 6    | IO_L40N_6        | IO_L40N_6                       | M2               | I/O  |
| 6    | IO_L40P_6/VREF_6 | IO_L40P_6/VREF_6                | M1               | VREF |
| 6    | VCCO_6           | VCCO_6                          | M7               | VCCO |
| 6    | VCCO_6           | VCCO_6                          | N7               | VCCO |
| 6    | VCCO_6           | VCCO_6                          | P7               | VCCO |
| 6    | VCCO_6           | VCCO_6                          | R3               | VCCO |
| 6    | VCCO_6           | VCCO_6                          | R6               | VCCO |
| 7    | IO               | IO                              | C2               | I/O  |
| 7    | IO_L01N_7/VRP_7  | IO_L01N_7/VRP_7                 | C3               | DCI  |
| 7    | IO_L01P_7/VRN_7  | IO_L01P_7/VRN_7                 | C4               | DCI  |
| 7    | IO_L16N_7        | IO_L16N_7                       | D1               | I/O  |
| 7    | IO_L16P_7/VREF_7 | IO_L16P_7/VREF_7                | C1               | VREF |
| 7    | IO_L17N_7        | IO_L17N_7                       | E4               | I/O  |
| 7    | IO_L17P_7        | IO_L17P_7                       | D4               | I/O  |
| 7    | IO_L19N_7/VREF_7 | IO_L19N_7/VREF_7                | D3               | VREF |
| 7    | IO_L19P_7        | IO_L19P_7                       | D2               | I/O  |
| 7    | IO_L20N_7        | IO_L20N_7                       | F4               | I/O  |
| 7    | IO_L20P_7        | IO_L20P_7                       | E3               | I/O  |
| 7    | IO_L21N_7        | IO_L21N_7                       | E1               | I/O  |
| 7    | IO_L21P_7        | IO_L21P_7                       | E2               | I/O  |
| 7    | IO_L22N_7        | IO_L22N_7                       | G6               | I/O  |
| 7    | IO_L22P_7        | IO_L22P_7                       | F5               | I/O  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400 Pin Name   | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type |
|------|------------------|---------------------------------|------------------|------|
| 7    | IO_L23N_7        | IO_L23N_7                       | F2               | I/O  |
| 7    | IO_L23P_7        | IO_L23P_7                       | F3               | I/O  |
| 7    | IO_L24N_7        | IO_L24N_7                       | H5               | I/O  |
| 7    | IO_L24P_7        | IO_L24P_7                       | G5               | I/O  |
| 7    | N.C. (◆)         | IO_L26N_7                       | G3               | I/O  |
| 7    | N.C. (◆)         | IO_L26P_7                       | G4               | I/O  |
| 7    | IO_L27N_7        | IO_L27N_7                       | G1               | I/O  |
| 7    | IO_L27P_7/VREF_7 | IO_L27P_7/VREF_7                | G2               | VREF |
| 7    | N.C. (◆)         | IO_L28N_7                       | H1               | I/O  |
| 7    | N.C. (◆)         | IO_L28P_7                       | H2               | I/O  |
| 7    | N.C. (◆)         | IO_L29N_7                       | J4               | I/O  |
| 7    | N.C. (◆)         | IO_L29P_7                       | H4               | I/O  |
| 7    | N.C. (◆)         | IO_L31N_7                       | J5               | I/O  |
| 7    | N.C. (◆)         | IO_L31P_7                       | J6               | I/O  |
| 7    | N.C. (◆)         | IO_L32N_7                       | J1               | I/O  |
| 7    | N.C. (◆)         | IO_L32P_7                       | J2               | I/O  |
| 7    | N.C. (◆)         | IO_L33N_7                       | K5               | I/O  |
| 7    | N.C. (◆)         | IO_L33P_7                       | K6               | I/O  |
| 7    | IO_L34N_7        | IO_L34N_7                       | K3               | I/O  |
| 7    | IO_L34P_7        | IO_L34P_7                       | K4               | I/O  |
| 7    | IO_L35N_7        | IO_L35N_7                       | K1               | I/O  |
| 7    | IO_L35P_7        | IO_L35P_7                       | K2               | I/O  |
| 7    | IO_L38N_7        | IO_L38N_7                       | L5               | I/O  |
| 7    | IO_L38P_7        | IO_L38P_7                       | L6               | I/O  |
| 7    | IO_L39N_7        | IO_L39N_7                       | L3               | I/O  |
| 7    | IO_L39P_7        | IO_L39P_7                       | L4               | I/O  |
| 7    | IO_L40N_7/VREF_7 | IO_L40N_7/VREF_7                | L1               | VREF |
| 7    | IO_L40P_7        | IO_L40P_7                       | L2               | I/O  |
| 7    | VCCO_7           | VCCO_7                          | H3               | VCCO |
| 7    | VCCO_7           | VCCO_7                          | H6               | VCCO |
| 7    | VCCO_7           | VCCO_7                          | J7               | VCCO |
| 7    | VCCO_7           | VCCO_7                          | K7               | VCCO |
| 7    | VCCO_7           | VCCO_7                          | L7               | VCCO |
| N/A  | GND              | GND                             | A1               | GND  |
| N/A  | GND              | GND                             | A22              | GND  |
| N/A  | GND              | GND                             | AA2              | GND  |
| N/A  | GND              | GND                             | AA21             | GND  |
| N/A  | GND              | GND                             | AB1              | GND  |
| N/A  | GND              | GND                             | AB22             | GND  |
| N/A  | GND              | GND                             | B2               | GND  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank | 3S400<br>Pin Name | 3S1000, 3S1500, 3S2000<br>Pin Name | FG456<br>Pin Number | Type |
|------|-------------------|------------------------------------|---------------------|------|
| N/A  | GND               | GND                                | B21                 | GND  |
| N/A  | GND               | GND                                | C9                  | GND  |
| N/A  | GND               | GND                                | C14                 | GND  |
| N/A  | GND               | GND                                | J3                  | GND  |
| N/A  | GND               | GND                                | J9                  | GND  |
| N/A  | GND               | GND                                | J10                 | GND  |
| N/A  | GND               | GND                                | J11                 | GND  |
| N/A  | GND               | GND                                | J12                 | GND  |
| N/A  | GND               | GND                                | J13                 | GND  |
| N/A  | GND               | GND                                | J14                 | GND  |
| N/A  | GND               | GND                                | J20                 | GND  |
| N/A  | GND               | GND                                | K9                  | GND  |
| N/A  | GND               | GND                                | K10                 | GND  |
| N/A  | GND               | GND                                | K11                 | GND  |
| N/A  | GND               | GND                                | K12                 | GND  |
| N/A  | GND               | GND                                | K13                 | GND  |
| N/A  | GND               | GND                                | K14                 | GND  |
| N/A  | GND               | GND                                | L9                  | GND  |
| N/A  | GND               | GND                                | L10                 | GND  |
| N/A  | GND               | GND                                | L11                 | GND  |
| N/A  | GND               | GND                                | L12                 | GND  |
| N/A  | GND               | GND                                | L13                 | GND  |
| N/A  | GND               | GND                                | L14                 | GND  |
| N/A  | GND               | GND                                | M9                  | GND  |
| N/A  | GND               | GND                                | M10                 | GND  |
| N/A  | GND               | GND                                | M11                 | GND  |
| N/A  | GND               | GND                                | M12                 | GND  |
| N/A  | GND               | GND                                | M13                 | GND  |
| N/A  | GND               | GND                                | M14                 | GND  |
| N/A  | GND               | GND                                | N9                  | GND  |
| N/A  | GND               | GND                                | N10                 | GND  |
| N/A  | GND               | GND                                | N11                 | GND  |
| N/A  | GND               | GND                                | N12                 | GND  |
| N/A  | GND               | GND                                | N13                 | GND  |
| N/A  | GND               | GND                                | N14                 | GND  |
| N/A  | GND               | GND                                | P3                  | GND  |
| N/A  | GND               | GND                                | P9                  | GND  |
| N/A  | GND               | GND                                | P10                 | GND  |
| N/A  | GND               | GND                                | P11                 | GND  |
| N/A  | GND               | GND                                | P12                 | GND  |

Table 100: FG456 Package Pinout (Cont'd)

| Bank   | 3S400 Pin Name | 3S1000, 3S1500, 3S2000 Pin Name | FG456 Pin Number | Type   |
|--------|----------------|---------------------------------|------------------|--------|
| N/A    | GND            | GND                             | P13              | GND    |
| N/A    | GND            | GND                             | P14              | GND    |
| N/A    | GND            | GND                             | P20              | GND    |
| N/A    | GND            | GND                             | Y9               | GND    |
| N/A    | GND            | GND                             | Y14              | GND    |
| N/A    | VCCAUX         | VCCAUX                          | A6               | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | A17              | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | AB6              | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | AB17             | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | F1               | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | F22              | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | U1               | VCCAUX |
| N/A    | VCCAUX         | VCCAUX                          | U22              | VCCAUX |
| N/A    | VCCINT         | VCCINT                          | G7               | VCCINT |
| N/A    | VCCINT         | VCCINT                          | G8               | VCCINT |
| N/A    | VCCINT         | VCCINT                          | G15              | VCCINT |
| N/A    | VCCINT         | VCCINT                          | G16              | VCCINT |
| N/A    | VCCINT         | VCCINT                          | H7               | VCCINT |
| N/A    | VCCINT         | VCCINT                          | H16              | VCCINT |
| N/A    | VCCINT         | VCCINT                          | R7               | VCCINT |
| N/A    | VCCINT         | VCCINT                          | R16              | VCCINT |
| N/A    | VCCINT         | VCCINT                          | T7               | VCCINT |
| N/A    | VCCINT         | VCCINT                          | T8               | VCCINT |
| N/A    | VCCINT         | VCCINT                          | T15              | VCCINT |
| N/A    | VCCINT         | VCCINT                          | T16              | VCCINT |
| VCCAUX | CCLK           | CCLK                            | AA22             | CONFIG |
| VCCAUX | DONE           | DONE                            | AB21             | CONFIG |
| VCCAUX | HSWAP_EN       | HSWAP_EN                        | B3               | CONFIG |
| VCCAUX | M0             | M0                              | AB2              | CONFIG |
| VCCAUX | M1             | M1                              | AA1              | CONFIG |
| VCCAUX | M2             | M2                              | AB3              | CONFIG |
| VCCAUX | PROG_B         | PROG_B                          | A2               | CONFIG |
| VCCAUX | TCK            | TCK                             | A21              | JTAG   |
| VCCAUX | TDI            | TDI                             | B1               | JTAG   |
| VCCAUX | TDO            | TDO                             | B22              | JTAG   |
| VCCAUX | TMS            | TMS                             | A20              | JTAG   |

## User I/Os by Bank

Table 101 indicates how the available user-I/O pins are distributed between the eight I/O banks for the XC3S400 in the FG456 package. Similarly, Table 102 shows how the available user-I/O pins are distributed between the eight I/O banks for the XC3S1000, XC3S1500, and XC3S2000 in the FG456 package.

Table 101: User I/Os Per Bank for XC3S400 in FG456 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 35          | 27                            | 0    | 2   | 4    | 2    |
|        | 1        | 35          | 27                            | 0    | 2   | 4    | 2    |
| Right  | 2        | 31          | 25                            | 0    | 2   | 4    | 0    |
|        | 3        | 31          | 25                            | 0    | 2   | 4    | 0    |
| Bottom | 4        | 35          | 21                            | 6    | 2   | 4    | 2    |
|        | 5        | 35          | 21                            | 6    | 2   | 4    | 2    |
| Left   | 6        | 31          | 25                            | 0    | 2   | 4    | 0    |
|        | 7        | 31          | 25                            | 0    | 2   | 4    | 0    |

Table 102: User I/Os Per Bank for XC3S1000, XC3S1500, and XC3S2000 in FG456 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 40          | 31                            | 0    | 2   | 5    | 2    |
|        | 1        | 40          | 31                            | 0    | 2   | 5    | 2    |
| Right  | 2        | 43          | 37                            | 0    | 2   | 4    | 0    |
|        | 3        | 43          | 37                            | 0    | 2   | 4    | 0    |
| Bottom | 4        | 41          | 26                            | 6    | 2   | 5    | 2    |
|        | 5        | 40          | 25                            | 6    | 2   | 5    | 2    |
| Left   | 6        | 43          | 37                            | 0    | 2   | 4    | 0    |
|        | 7        | 43          | 37                            | 0    | 2   | 4    | 0    |

FG456 Footprint

Left Half of FG456 Package (Top View)

XC3S400

(264 max. user I/O)

196 I/O: Unrestricted, general-purpose user I/O

32 VREF: User I/O or input voltage reference for bank

69 N.C.: Unconnected pins for XC3S400 (◆)

XC3S1000, XC3S1500, XC3S2000 (333 max user I/O)

261 I/O: Unrestricted, general-purpose user I/O

36 VREF: User I/O or input voltage reference for bank

0 N.C.: No unconnected pins in this package

All devices

12 DUAL: Configuration pin, then possible user I/O

8 GCLK: User I/O or global clock buffer input

16 DCI: User I/O or reference resistor input for bank

7 CONFIG: Dedicated configuration pins

4 JTAG: Dedicated JTAG port pins

12 VCCINT: Internal core voltage supply (+1.2V)

40 VCCO: Output voltage supply for bank

8 VCCAUX: Auxiliary voltage supply (+2.5V)

52 GND: Ground

|        |        | Bank 0            |                   |                   |                   |                  |            |                   |               |                   |                   |                   |            |
|--------|--------|-------------------|-------------------|-------------------|-------------------|------------------|------------|-------------------|---------------|-------------------|-------------------|-------------------|------------|
|        |        | 1                 | 2                 | 3                 | 4                 | 5                | 6          | 7                 | 8             | 9                 | 10                | 11                |            |
| Bank 7 | A      | GND               | PROG_B            | I/O VREF_0        | I/O L01P_0 VRN_0  | I/O L09P_0       | VCCAUX     | I/O L19P_0        | I/O L24P_0    | I/O L27P_0        | I/O               | I/O L32P_0 GCLK6  |            |
|        | B      | TDI               | GND               | HSWAP_EN          | I/O L01N_0 VRP_0  | I/O L09N_0       | I/O L15P_0 | I/O L19N_0        | I/O L24N_0    | I/O L27N_0        | I/O L29P_0        | I/O L32N_0 GCLK7  |            |
|        | C      | I/O L16P_7 VREF_7 | I/O               | I/O L01N_7 VRP_7  | I/O L01P_7 VRN_7  | I/O L06P_0       | I/O L15N_0 | I/O VREF_0        | VCCO_0        | GND               | I/O L29N_0        | I/O L31P_0 VREF_0 |            |
|        | D      | I/O L16N_7        | I/O L19P_7        | I/O L19N_7 VREF_7 | I/O L17P_7        | I/O L06N_0       | I/O L10P_0 | I/O L16P_0        | I/O L22P_0    | I/O               | I/O               | I/O L31N_0        |            |
|        | E      | I/O L21N_7        | I/O L21P_7        | I/O L20P_7        | I/O L17N_7        | I/O VREF_0       | I/O L10N_0 | I/O L16N_0        | I/O L22N_0    | I/O               | I/O L25P_0        | I/O L28P_0        | I/O L30P_0 |
|        | F      | VCCAUX            | I/O L23N_7        | I/O L23P_7        | I/O L20N_7        | I/O L22P_7       | I/O        | I/O VREF_0        | VCCO_0        | I/O L25N_0        | I/O L28N_0        | I/O L30N_0        | I/O        |
|        | G      | I/O L27N_7        | I/O L27P_7 VREF_7 | I/O L26N_7        | I/O L26P_7        | I/O L24P_7       | I/O L22N_7 | VCCINT            | VCCINT        | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0     |
|        | H      | I/O L28N_7        | I/O L28P_7        | VCCO_7            | I/O L29P_7        | I/O L24N_7       | VCCO_7     | VCCINT            |               |                   |                   |                   |            |
|        | J      | I/O L32N_7        | I/O L32P_7        | GND               | I/O L29N_7        | I/O L31N_7       | I/O L31P_7 | VCCO_7            |               |                   | GND               | GND               | GND        |
|        | K      | I/O L35N_7        | I/O L35P_7        | I/O L34N_7        | I/O L34P_7        | I/O L33N_7       | I/O L33P_7 | VCCO_7            |               |                   | GND               | GND               | GND        |
|        | Bank 6 | L                 | I/O L40N_7 VREF_7 | I/O L40P_7        | I/O L39N_7        | I/O L39P_7       | I/O L38N_7 | I/O L38P_7        | VCCO_7        |                   |                   | GND               | GND        |
| M      |        | I/O L40P_6 VREF_6 | I/O L40N_6        | I/O L39P_6        | I/O L39N_6        | I/O L38P_6       | I/O L38N_6 | VCCO_6            |               |                   | GND               | GND               | GND        |
| N      |        | I/O L35P_6        | I/O L35N_6        | I/O L34P_6        | I/O L34N_6 VREF_6 | I/O L33P_6       | I/O L33N_6 | VCCO_6            |               |                   | GND               | GND               | GND        |
| P      |        | I/O L32P_6        | I/O L32N_6        | GND               | I/O L31P_6        | I/O L31N_6       | I/O L28P_6 | VCCO_6            |               |                   | GND               | GND               | GND        |
| R      |        | I/O L29P_6        | I/O L29N_6        | VCCO_6            | I/O L26P_6        | I/O L28N_6       | VCCO_6     | VCCINT            |               |                   |                   |                   |            |
| T      |        | I/O L27P_6        | I/O L27N_6        | I/O L26N_6        | I/O L23P_6        | I/O L22P_6       | I/O L22N_6 | VCCINT            | VCCINT        | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5     |
| U      |        | VCCAUX            | I/O L24P_6        | I/O L24N_6 VREF_6 | I/O L23N_6        | I/O L19P_6       | I/O VREF_5 | I/O               | VCCO_5        | I/O               | I/O               | I/O               | I/O        |
| V      |        | I/O L21P_6        | I/O L21N_6        | I/O L20P_6        | I/O L20N_6        | I/O L19N_6       | I/O L15P_5 | I/O               | I/O L24P_5    | I/O L27P_5        | I/O               | I/O L31P_5 D5     |            |
| W      |        | I/O L17P_6 VREF_6 | I/O L17N_6        | I/O L16P_6        | I/O L16N_6        | I/O L09P_5       | I/O L15N_5 | I/O L19P_5 VREF_5 | I/O L24N_5    | I/O L27N_5 VREF_5 | I/O L29P_5 VREF_5 | I/O L31N_5 D4     |            |
| Y      |        | I/O               | I/O L01P_6 VRN_6  | I/O L01N_6 VRP_6  | I/O L01N_5 RDWR_B | I/O L09N_5       | I/O L16P_5 | I/O L19N_5        | VCCO_5        | GND               | I/O L29N_5        | I/O L32P_5 GCLK2  |            |
| AA     |        | M1                | GND               | I/O L01P_5 CS_B   | I/O L06P_5        | I/O L10P_5 VRN_5 | I/O L16N_5 | I/O L22P_5        | I/O L25P_5    | I/O L28P_5 D7     | I/O L30P_5        | I/O L32N_5 GCLK3  |            |
| AB     | GND    | M0                | M2                | I/O L06N_5        | I/O L10N_5 VRP_5  | VCCAUX           | I/O L22N_5 | I/O L25N_5        | I/O L28N_5 D6 | I/O L30N_5        | I/O L32P_5 VREF_5 |                   |            |

Figure 51: FG456 Package Footprint (Top View)

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| Bank 1                     |            |                        |                           |                 |                 |                      |                      |                      |                     |                      |                  |
|----------------------------|------------|------------------------|---------------------------|-----------------|-----------------|----------------------|----------------------|----------------------|---------------------|----------------------|------------------|
| 12                         | 13         | 14                     | 15                        | 16              | 17              | 18                   | 19                   | 20                   | 21                  | 22                   |                  |
| I/O                        | I/O L30N_1 | I/O L28N_1             | I/O L25P_1                | I/O L22N_1<br>◆ | VCCAUX          | I/O L10N_1<br>VREF_1 | I/O L06N_1<br>VREF_1 | TMS                  | TCK                 | GND                  | A                |
| I/O L32N_1<br>GCLK5        | I/O L30P_1 | I/O L28P_1             | I/O L25N_1                | I/O L22P_1<br>◆ | I/O L16N_1      | I/O L10P_1           | I/O L06P_1           | I/O L01P_1<br>VRN_1  | GND                 | TDO                  | B                |
| I/O L32P_1<br>GCLK4        | I/O L29N_1 | GND                    | VCCO_1                    | I/O L19N_1<br>◆ | I/O L16P_1      | I/O L09N_1           | I/O L01N_1<br>VRP_1  | I/O L01N_2<br>VRP_2  | I/O L01P_2<br>VRN_2 | I/O                  | C                |
| I/O L31N_1<br>VREF_1       | I/O L29P_1 | I/O L27N_1             | I/O L24N_1                | I/O L19P_1<br>◆ | I/O L15N_1      | I/O L09P_1           | I/O L16P_2           | I/O L16N_2           | I/O L17N_2          | I/O L17P_2<br>VREF_2 | D                |
| I/O L31P_1                 | I/O VREF_1 | I/O L27P_1             | I/O L24P_1                | I/O             | I/O L15P_1      | I/O L19N_2           | I/O L20N_2           | I/O L20P_2           | I/O L21N_2          | I/O L21P_2           | E                |
| I/O                        | I/O        | I/O VREF_1<br>◆        | VCCO_1                    | I/O             | I/O             | I/O L19P_2           | I/O L23N_2<br>VREF_2 | I/O L24N_2           | I/O L24P_2          | VCCAUX               | F                |
| VCCO_1                     | VCCO_1     | VCCO_1                 | VCCINT                    | VCCINT          | I/O L22N_2      | I/O L22P_2           | I/O L23P_2           | I/O L26N_2<br>◆      | I/O L27N_2          | I/O L27P_2           | Bank 2<br>G      |
|                            |            |                        |                           | VCCINT          | VCCO_2          | I/O L28N_2<br>◆      | I/O L26P_2<br>◆      | VCCO_2               | I/O L29N_2<br>◆     | I/O L29P_2<br>◆      | H                |
| GND                        | GND        | GND                    |                           | VCCO_2          | I/O L28P_2<br>◆ | I/O L31N_2           | I/O L31P_2           | GND                  | I/O L32N_2<br>◆     | I/O L32P_2<br>◆      | J                |
| GND                        | GND        | GND                    |                           | VCCO_2          | I/O L33N_2<br>◆ | I/O L33P_2           | I/O L34N_2<br>VREF_2 | I/O L34P_2           | I/O L35N_2          | I/O L35P_2           | K                |
| GND                        | GND        | GND                    |                           | VCCO_2          | I/O L38N_2      | I/O L38P_2           | I/O L39N_2           | I/O L39P_2           | I/O L40N_2          | I/O L40P_2<br>VREF_2 | L                |
| GND                        | GND        | GND                    |                           | VCCO_3          | I/O L38P_3      | I/O L38N_3           | I/O L39P_3           | I/O L39N_3           | I/O L40P_3          | I/O L40N_3<br>VREF_3 | Bank 2<br>M      |
| GND                        | GND        | GND                    |                           | VCCO_3          | I/O L33P_3<br>◆ | I/O L33N_3           | I/O L34P_3<br>VREF_3 | I/O L34N_3           | I/O L35P_3          | I/O L35N_3           | N                |
| GND                        | GND        | GND                    |                           | VCCO_3          | I/O L31P_3<br>◆ | I/O L31N_3           | I/O L29N_3           | GND                  | I/O L32P_3          | I/O L32N_3           | P                |
|                            |            |                        |                           | VCCINT          | VCCO_3          | I/O L24N_3           | I/O L29P_3           | VCCO_3               | I/O L28P_3<br>◆     | I/O L28N_3<br>◆      | R                |
| VCCO_4                     | VCCO_4     | VCCO_4                 | VCCINT                    | VCCINT          | I/O L22N_3      | I/O L24P_3           | I/O L26P_3<br>◆      | I/O L26N_3<br>◆      | I/O L27P_3          | I/O L27N_3           | Bank 3<br>T      |
| I/O L30N_4<br>D2           | I/O L28N_4 | I/O L25N_4             | VCCO_4                    | I/O             | I/O             | I/O L22P_3           | I/O L20N_3           | I/O L23P_3<br>VREF_3 | I/O L23N_3          | VCCAUX               | U                |
| I/O L30P_4<br>D3           | I/O L28P_4 | I/O L25P_4             | I/O L22N_4<br>VREF_4<br>◆ | I/O L16N_4      | I/O L10N_4      | I/O VREF_4           | I/O L17N_3           | I/O L20P_3           | I/O L21P_3          | I/O L21N_3           | V                |
| I/O L31N_4<br>INIT_B       | I/O        | I/O                    | I/O L22P_4<br>◆           | I/O L16P_4      | I/O L10P_4      | I/O L06N_4<br>VREF_4 | I/O L17P_3<br>VREF_3 | I/O L19P_3           | I/O L19N_3          | I/O L16N_3           | W                |
| I/O L31P_4<br>DOUT<br>BUSY | I/O L29N_4 | GND                    | VCCO_4                    | I/O VREF_4      | I/O L15N_4      | I/O L06P_4           | I/O L01P_3<br>VRN_3  | I/O L01N_3<br>VRP_3  | I/O                 | I/O L16P_3           | Y                |
| I/O L32N_4<br>GCLK1        | I/O L29P_4 | I/O L27N_4<br>DN<br>D0 | I/O L24N_4                | I/O L19N_4<br>◆ | I/O L15P_4      | I/O L09N_4           | I/O L05N_4<br>◆      | I/O L01N_4<br>VRP_4  | GND                 | CCLK                 | Bank 3<br>A<br>A |
| I/O L32P_4<br>GCLK0        | I/O VREF_4 | I/O L27P_4<br>D1       | I/O L24P_4                | I/O L19P_4<br>◆ | VCCAUX          | I/O L09P_4           | I/O L05P_4           | I/O L01P_4<br>VRN_4  | DONE                | GND                  | Bank 3<br>A<br>B |

Right Half of FG456 Package (Top View)

Figure 52: FG456 Package Footprint (Top View) Continued

## FG676: 676-lead Fine-pitch Ball Grid Array

The 676-lead fine-pitch ball grid array package, FG676, supports five different Spartan-3 devices, including the XC3S1000, XC3S1500, XC3S2000, XC3S4000, and XC3S5000. All five have nearly identical footprints but are slightly different, primarily due to unconnected pins on the XC3S1000 and XC3S1500. For example, because the XC3S1000 has fewer I/O pins, this device has 98 unconnected pins on the FG676 package, labeled as “N.C.” In [Table 103](#) and [Figure 53](#), these unconnected pins are indicated with a black diamond symbol (◆). The XC3S1500, however, has only two unconnected pins, also labeled “N.C.” in the pinout table but indicated with a black square symbol (■).

All the package pins appear in [Table 103](#) and are sorted by bank number, 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.

If there is a difference between the XC3S1000, XC3S1500, XC3S2000, XC3S4000, and XC3S5000 pinouts, then that difference is highlighted in [Table 103](#). If the table entry is shaded grey, then there is an unconnected pin on either the XC3S1000 or XC3S1500 that maps to a user-I/O pin on the XC3S2000, XC3S4000, and XC3S5000. If the table entry is shaded tan, then the unconnected pin on either the XC3S1000 or XC3S1500 maps to a VREF-type pin on the XC3S2000, XC3S4000, and XC3S5000. If the other VREF pins in the bank all connect to a voltage reference to support a special I/O standard, then also connect the N.C. pin on the XC3S1000 or XC3S1500 to the same VREF voltage. This provides maximum flexibility as you could potentially migrate a design from the XC3S1000 through to the XC3S5000 FPGA without changing the printed circuit board.

An electronic version of this package pinout table and footprint diagram is available for download from the Xilinx website at [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 103: FG676 Package Pinout

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name        | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|--------------------------|------------------|------|
| 0    | IO                | IO                | IO                | IO                | IO_L04N_0 <sup>(3)</sup> | A3               | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO                       | A5               | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO                       | A6               | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO_L04P_0 <sup>(3)</sup> | C4               | I/O  |
| 0    | N.C. (◆)          | IO                | IO                | IO                | IO_L13N_0 <sup>(3)</sup> | C8               | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO                       | C12              | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO                       | E13              | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO                       | H11              | I/O  |
| 0    | IO                | IO                | IO                | IO                | IO                       | H12              | I/O  |
| 0    | IO/VREF_0         | IO/VREF_0         | IO/VREF_0         | IO/VREF_0         | IO/VREF_0                | B3               | VREF |
| 0    | IO/VREF_0         | IO/VREF_0         | IO/VREF_0         | IO/VREF_0         | IO/VREF_0                | F7               | VREF |
| 0    | IO/VREF_0         | IO/VREF_0         | IO/VREF_0         | IO/VREF_0         | IO/VREF_0                | G10              | VREF |
| 0    | IO_L01N_0/VRP_0   | IO_L01N_0/VRP_0   | IO_L01N_0/VRP_0   | IO_L01N_0/VRP_0   | IO_L01N_0/VRP_0          | E5               | DCI  |
| 0    | IO_L01P_0/VRN_0   | IO_L01P_0/VRN_0   | IO_L01P_0/VRN_0   | IO_L01P_0/VRN_0   | IO_L01P_0/VRN_0          | D5               | DCI  |
| 0    | IO_L05N_0         | IO_L05N_0         | IO_L05N_0         | IO_L05N_0         | IO_L05N_0                | B4               | I/O  |
| 0    | IO_L05P_0/VREF_0  | IO_L05P_0/VREF_0  | IO_L05P_0/VREF_0  | IO_L05P_0/VREF_0  | IO_L05P_0/VREF_0         | A4               | VREF |
| 0    | IO_L06N_0         | IO_L06N_0         | IO_L06N_0         | IO_L06N_0         | IO_L06N_0                | C5               | I/O  |
| 0    | IO_L06P_0         | IO_L06P_0         | IO_L06P_0         | IO_L06P_0         | IO_L06P_0                | B5               | I/O  |
| 0    | IO_L07N_0         | IO_L07N_0         | IO_L07N_0         | IO_L07N_0         | IO_L07N_0                | E6               | I/O  |
| 0    | IO_L07P_0         | IO_L07P_0         | IO_L07P_0         | IO_L07P_0         | IO_L07P_0                | D6               | I/O  |
| 0    | IO_L08N_0         | IO_L08N_0         | IO_L08N_0         | IO_L08N_0         | IO_L08N_0                | C6               | I/O  |
| 0    | IO_L08P_0         | IO_L08P_0         | IO_L08P_0         | IO_L08P_0         | IO_L08P_0                | B6               | I/O  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name        | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|--------------------------|------------------|------|
| 0    | IO_L09N_0         | IO_L09N_0         | IO_L09N_0         | IO_L09N_0         | IO_L09N_0                | E7               | I/O  |
| 0    | IO_L09P_0         | IO_L09P_0         | IO_L09P_0         | IO_L09P_0         | IO_L09P_0                | D7               | I/O  |
| 0    | IO_L10N_0         | IO_L10N_0         | IO_L10N_0         | IO_L10N_0         | IO_L10N_0                | B7               | I/O  |
| 0    | IO_L10P_0         | IO_L10P_0         | IO_L10P_0         | IO_L10P_0         | IO_L10P_0                | A7               | I/O  |
| 0    | N.C. (◆)          | IO_L11N_0         | IO_L11N_0         | IO_L11N_0         | IO_L11N_0                | G8               | I/O  |
| 0    | N.C. (◆)          | IO_L11P_0         | IO_L11P_0         | IO_L11P_0         | IO_L11P_0                | F8               | I/O  |
| 0    | N.C. (◆)          | IO_L12N_0         | IO_L12N_0         | IO_L12N_0         | IO <sup>(3)</sup>        | E8               | I/O  |
| 0    | N.C. (◆)          | IO_L12P_0         | IO_L12P_0         | IO_L12P_0         | IO <sup>(3)</sup>        | D8               | I/O  |
| 0    | IO_L15N_0         | IO_L15N_0         | IO_L15N_0         | IO_L15N_0         | IO_L13P_0 <sup>(3)</sup> | B8               | I/O  |
| 0    | IO_L15P_0         | IO_L15P_0         | IO_L15P_0         | IO_L15P_0         | IO <sup>(3)</sup>        | A8               | I/O  |
| 0    | IO_L16N_0         | IO_L16N_0         | IO_L16N_0         | IO_L16N_0         | IO_L16N_0                | G9               | I/O  |
| 0    | IO_L16P_0         | IO_L16P_0         | IO_L16P_0         | IO_L16P_0         | IO_L16P_0                | F9               | I/O  |
| 0    | N.C. (◆)          | IO_L17N_0         | IO_L17N_0         | IO_L17N_0         | IO_L17N_0                | E9               | I/O  |
| 0    | N.C. (◆)          | IO_L17P_0         | IO_L17P_0         | IO_L17P_0         | IO_L17P_0                | D9               | I/O  |
| 0    | N.C. (◆)          | IO_L18N_0         | IO_L18N_0         | IO_L18N_0         | IO_L18N_0                | C9               | I/O  |
| 0    | N.C. (◆)          | IO_L18P_0         | IO_L18P_0         | IO_L18P_0         | IO_L18P_0                | B9               | I/O  |
| 0    | IO_L19N_0         | IO_L19N_0         | IO_L19N_0         | IO_L19N_0         | IO_L19N_0                | F10              | I/O  |
| 0    | IO_L19P_0         | IO_L19P_0         | IO_L19P_0         | IO_L19P_0         | IO_L19P_0                | E10              | I/O  |
| 0    | IO_L22N_0         | IO_L22N_0         | IO_L22N_0         | IO_L22N_0         | IO_L22N_0                | D10              | I/O  |
| 0    | IO_L22P_0         | IO_L22P_0         | IO_L22P_0         | IO_L22P_0         | IO_L22P_0                | C10              | I/O  |
| 0    | N.C. (◆)          | IO_L23N_0         | IO_L23N_0         | IO_L23N_0         | IO_L23N_0                | B10              | I/O  |
| 0    | N.C. (◆)          | IO_L23P_0         | IO_L23P_0         | IO_L23P_0         | IO_L23P_0                | A10              | I/O  |
| 0    | IO_L24N_0         | IO_L24N_0         | IO_L24N_0         | IO_L24N_0         | IO_L24N_0                | G11              | I/O  |
| 0    | IO_L24P_0         | IO_L24P_0         | IO_L24P_0         | IO_L24P_0         | IO_L24P_0                | F11              | I/O  |
| 0    | IO_L25N_0         | IO_L25N_0         | IO_L25N_0         | IO_L25N_0         | IO_L25N_0                | E11              | I/O  |
| 0    | IO_L25P_0         | IO_L25P_0         | IO_L25P_0         | IO_L25P_0         | IO_L25P_0                | D11              | I/O  |
| 0    | N.C. (◆)          | IO_L26N_0         | IO_L26N_0         | IO_L26N_0         | IO_L26N_0                | B11              | I/O  |
| 0    | N.C. (◆)          | IO_L26P_0/VREF_0  | IO_L26P_0/VREF_0  | IO_L26P_0/VREF_0  | IO_L26P_0/VREF_0         | A11              | VREF |
| 0    | IO_L27N_0         | IO_L27N_0         | IO_L27N_0         | IO_L27N_0         | IO_L27N_0                | G12              | I/O  |
| 0    | IO_L27P_0         | IO_L27P_0         | IO_L27P_0         | IO_L27P_0         | IO_L27P_0                | H13              | I/O  |
| 0    | IO_L28N_0         | IO_L28N_0         | IO_L28N_0         | IO_L28N_0         | IO_L28N_0                | F12              | I/O  |
| 0    | IO_L28P_0         | IO_L28P_0         | IO_L28P_0         | IO_L28P_0         | IO_L28P_0                | E12              | I/O  |
| 0    | IO_L29N_0         | IO_L29N_0         | IO_L29N_0         | IO_L29N_0         | IO_L29N_0                | B12              | I/O  |
| 0    | IO_L29P_0         | IO_L29P_0         | IO_L29P_0         | IO_L29P_0         | IO_L29P_0                | A12              | I/O  |
| 0    | IO_L30N_0         | IO_L30N_0         | IO_L30N_0         | IO_L30N_0         | IO_L30N_0                | G13              | I/O  |
| 0    | IO_L30P_0         | IO_L30P_0         | IO_L30P_0         | IO_L30P_0         | IO_L30P_0                | F13              | I/O  |
| 0    | IO_L31N_0         | IO_L31N_0         | IO_L31N_0         | IO_L31N_0         | IO_L31N_0                | D13              | I/O  |
| 0    | IO_L31P_0/VREF_0  | IO_L31P_0/VREF_0  | IO_L31P_0/VREF_0  | IO_L31P_0/VREF_0  | IO_L31P_0/VREF_0         | C13              | VREF |
| 0    | IO_L32N_0/GCLK7   | IO_L32N_0/GCLK7   | IO_L32N_0/GCLK7   | IO_L32N_0/GCLK7   | IO_L32N_0/GCLK7          | B13              | GCLK |
| 0    | IO_L32P_0/GCLK6   | IO_L32P_0/GCLK6   | IO_L32P_0/GCLK6   | IO_L32P_0/GCLK6   | IO_L32P_0/GCLK6          | A13              | GCLK |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                   | C7               | VCCO |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                   | C11              | VCCO |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name               | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|---------------------------------|------------------|------|
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                          | H9               | VCCO |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                          | H10              | VCCO |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                          | J11              | VCCO |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                          | J12              | VCCO |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                          | J13              | VCCO |
| 0    | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0                          | K13              | VCCO |
| 1    | IO                | IO                | IO                | IO                | IO                              | A14              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO                              | A22              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO                              | A23              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO                              | D16              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO_L17P_1 <sup>(3)</sup>        | E18              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO                              | F14              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO                              | F20              | I/O  |
| 1    | IO                | IO                | IO                | IO                | IO                              | G19              | I/O  |
| 1    | IO/VREF_1         | IO/VREF_1         | IO/VREF_1         | IO/VREF_1         | IO/VREF_1                       | C15              | VREF |
| 1    | IO/VREF_1         | IO/VREF_1         | IO/VREF_1         | IO/VREF_1         | IO/VREF_1                       | C17              | VREF |
| 1    | N.C. (◆)          | IO/VREF_1         | IO/VREF_1         | IO/VREF_1         | IO_L17N_1/VREF_1 <sup>(3)</sup> | D18              | VREF |
| 1    | IO_L01N_1/VRP_1   | IO_L01N_1/VRP_1   | IO_L01N_1/VRP_1   | IO_L01N_1/VRP_1   | IO_L01N_1/VRP_1                 | D22              | DCI  |
| 1    | IO_L01P_1/VRN_1   | IO_L01P_1/VRN_1   | IO_L01P_1/VRN_1   | IO_L01P_1/VRN_1   | IO_L01P_1/VRN_1                 | E22              | DCI  |
| 1    | IO_L04N_1         | IO_L04N_1         | IO_L04N_1         | IO_L04N_1         | IO_L04N_1                       | B23              | I/O  |
| 1    | IO_L04P_1         | IO_L04P_1         | IO_L04P_1         | IO_L04P_1         | IO_L04P_1                       | C23              | I/O  |
| 1    | IO_L05N_1         | IO_L05N_1         | IO_L05N_1         | IO_L05N_1         | IO_L05N_1                       | E21              | I/O  |
| 1    | IO_L05P_1         | IO_L05P_1         | IO_L05P_1         | IO_L05P_1         | IO_L05P_1                       | F21              | I/O  |
| 1    | IO_L06N_1/VREF_1  | IO_L06N_1/VREF_1  | IO_L06N_1/VREF_1  | IO_L06N_1/VREF_1  | IO_L06N_1/VREF_1                | B22              | VREF |
| 1    | IO_L06P_1         | IO_L06P_1         | IO_L06P_1         | IO_L06P_1         | IO_L06P_1                       | C22              | I/O  |
| 1    | IO_L07N_1         | IO_L07N_1         | IO_L07N_1         | IO_L07N_1         | IO_L07N_1                       | C21              | I/O  |
| 1    | IO_L07P_1         | IO_L07P_1         | IO_L07P_1         | IO_L07P_1         | IO_L07P_1                       | D21              | I/O  |
| 1    | IO_L08N_1         | IO_L08N_1         | IO_L08N_1         | IO_L08N_1         | IO_L08N_1                       | A21              | I/O  |
| 1    | IO_L08P_1         | IO_L08P_1         | IO_L08P_1         | IO_L08P_1         | IO_L08P_1                       | B21              | I/O  |
| 1    | IO_L09N_1         | IO_L09N_1         | IO_L09N_1         | IO_L09N_1         | IO_L09N_1                       | D20              | I/O  |
| 1    | IO_L09P_1         | IO_L09P_1         | IO_L09P_1         | IO_L09P_1         | IO_L09P_1                       | E20              | I/O  |
| 1    | IO_L10N_1/VREF_1  | IO_L10N_1/VREF_1  | IO_L10N_1/VREF_1  | IO_L10N_1/VREF_1  | IO_L10N_1/VREF_1                | A20              | VREF |
| 1    | IO_L10P_1         | IO_L10P_1         | IO_L10P_1         | IO_L10P_1         | IO_L10P_1                       | B20              | I/O  |
| 1    | N.C. (◆)          | IO_L11N_1         | IO_L11N_1         | IO_L11N_1         | IO_L11N_1                       | E19              | I/O  |
| 1    | N.C. (◆)          | IO_L11P_1         | IO_L11P_1         | IO_L11P_1         | IO_L11P_1                       | F19              | I/O  |
| 1    | N.C. (◆)          | IO_L12N_1         | IO_L12N_1         | IO_L12N_1         | IO_L12N_1                       | C19              | I/O  |
| 1    | N.C. (◆)          | IO_L12P_1         | IO_L12P_1         | IO_L12P_1         | IO_L12P_1                       | D19              | I/O  |
| 1    | IO_L15N_1         | IO_L15N_1         | IO_L15N_1         | IO_L15N_1         | IO_L15N_1                       | A19              | I/O  |
| 1    | IO_L15P_1         | IO_L15P_1         | IO_L15P_1         | IO_L15P_1         | IO_L15P_1                       | B19              | I/O  |
| 1    | IO_L16N_1         | IO_L16N_1         | IO_L16N_1         | IO_L16N_1         | IO_L16N_1                       | F18              | I/O  |
| 1    | IO_L16P_1         | IO_L16P_1         | IO_L16P_1         | IO_L16P_1         | IO_L16P_1                       | G18              | I/O  |
| 1    | N.C. (◆)          | IO_L18N_1         | IO_L18N_1         | IO_L18N_1         | IO <sup>(3)</sup>               | B18              | I/O  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name               | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type                |
|------|-------------------|---------------------------------|-------------------|-------------------|-------------------|------------------|---------------------|
| 1    | N.C. (◆)          | IO_L18P_1                       | IO_L18P_1         | IO_L18P_1         | IO <sup>(3)</sup> | C18              | I/O                 |
| 1    | IO_L19N_1         | IO_L19N_1                       | IO_L19N_1         | IO_L19N_1         | IO_L19N_1         | F17              | I/O                 |
| 1    | IO_L19P_1         | IO_L19P_1                       | IO_L19P_1         | IO_L19P_1         | IO_L19P_1         | G17              | I/O                 |
| 1    | IO_L22N_1         | IO_L22N_1                       | IO_L22N_1         | IO_L22N_1         | IO_L22N_1         | D17              | I/O                 |
| 1    | IO_L22P_1         | IO_L22P_1                       | IO_L22P_1         | IO_L22P_1         | IO_L22P_1         | E17              | I/O                 |
| 1    | N.C. (◆)          | IO_L23N_1                       | IO_L23N_1         | IO_L23N_1         | IO_L23N_1         | A17              | I/O                 |
| 1    | N.C. (◆)          | IO_L23P_1                       | IO_L23P_1         | IO_L23P_1         | IO_L23P_1         | B17              | I/O                 |
| 1    | IO_L24N_1         | IO_L24N_1                       | IO_L24N_1         | IO_L24N_1         | IO_L24N_1         | G16              | I/O                 |
| 1    | IO_L24P_1         | IO_L24P_1                       | IO_L24P_1         | IO_L24P_1         | IO_L24P_1         | H16              | I/O                 |
| 1    | IO_L25N_1         | IO_L25N_1                       | IO_L25N_1         | IO_L25N_1         | IO_L25N_1         | E16              | I/O                 |
| 1    | IO_L25P_1         | IO_L25P_1                       | IO_L25P_1         | IO_L25P_1         | IO_L25P_1         | F16              | I/O                 |
| 1    | N.C. (◆)          | IO_L26N_1                       | IO_L26N_1         | IO_L26N_1         | IO_L26N_1         | A16              | I/O                 |
| 1    | N.C. (◆)          | IO_L26P_1                       | IO_L26P_1         | IO_L26P_1         | IO_L26P_1         | B16              | I/O                 |
| 1    | IO_L27N_1         | IO_L27N_1                       | IO_L27N_1         | IO_L27N_1         | IO_L27N_1         | G15              | I/O                 |
| 1    | IO_L27P_1         | IO_L27P_1                       | IO_L27P_1         | IO_L27P_1         | IO_L27P_1         | H15              | I/O                 |
| 1    | IO_L28N_1         | IO_L28N_1                       | IO_L28N_1         | IO_L28N_1         | IO_L28N_1         | E15              | I/O                 |
| 1    | IO_L28P_1         | IO_L28P_1                       | IO_L28P_1         | IO_L28P_1         | IO_L28P_1         | F15              | I/O                 |
| 1    | IO_L29N_1         | IO_L29N_1                       | IO_L29N_1         | IO_L29N_1         | IO_L29N_1         | A15              | I/O                 |
| 1    | IO_L29P_1         | IO_L29P_1                       | IO_L29P_1         | IO_L29P_1         | IO_L29P_1         | B15              | I/O                 |
| 1    | IO_L30N_1         | IO_L30N_1                       | IO_L30N_1         | IO_L30N_1         | IO_L30N_1         | G14              | I/O                 |
| 1    | IO_L30P_1         | IO_L30P_1                       | IO_L30P_1         | IO_L30P_1         | IO_L30P_1         | H14              | I/O                 |
| 1    | IO_L31N_1/VREF_1  | IO_L31N_1/VREF_1                | IO_L31N_1/VREF_1  | IO_L31N_1/VREF_1  | IO_L31N_1/VREF_1  | D14              | VREF                |
| 1    | IO_L31P_1         | IO_L31P_1                       | IO_L31P_1         | IO_L31P_1         | IO_L31P_1         | E14              | I/O                 |
| 1    | IO_L32N_1/GCLK5   | IO_L32N_1/GCLK5                 | IO_L32N_1/GCLK5   | IO_L32N_1/GCLK5   | IO_L32N_1/GCLK5   | B14              | GCLK                |
| 1    | IO_L32P_1/GCLK4   | IO_L32P_1/GCLK4                 | IO_L32P_1/GCLK4   | IO_L32P_1/GCLK4   | IO_L32P_1/GCLK4   | C14              | GCLK                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | C16              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | C20              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | H17              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | H18              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | J14              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | J15              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | J16              | VCCO                |
| 1    | VCCO_1            | VCCO_1                          | VCCO_1            | VCCO_1            | VCCO_1            | K14              | VCCO                |
| 2    | N.C. (◆)          | N.C. (■)                        | IO                | IO                | IO                | F22              | I/O                 |
| 2    | IO_L01N_2/VRP_2   | IO_L01N_2/VRP_2                 | IO_L01N_2/VRP_2   | IO_L01N_2/VRP_2   | IO_L01N_2/VRP_2   | C25              | DCI                 |
| 2    | IO_L01P_2/VRN_2   | IO_L01P_2/VRN_2                 | IO_L01P_2/VRN_2   | IO_L01P_2/VRN_2   | IO_L01P_2/VRN_2   | C26              | DCI                 |
| 2    | IO_L02N_2         | IO_L02N_2                       | IO_L02N_2         | IO_L02N_2         | IO_L02N_2         | E23              | I/O                 |
| 2    | IO_L02P_2         | IO_L02P_2                       | IO_L02P_2         | IO_L02P_2         | IO_L02P_2         | E24              | I/O                 |
| 2    | IO_L03N_2/VREF_2  | IO_L03N_2/VREF_2 <sup>(1)</sup> | IO_L03N_2/VREF_2  | IO_L03N_2/VREF_2  | IO_L03N_2/VREF_2  | D25              | VREF <sup>(1)</sup> |
| 2    | IO_L03P_2         | IO_L03P_2                       | IO_L03P_2         | IO_L03P_2         | IO_L03P_2         | D26              | I/O                 |
| 2    | N.C. (◆)          | IO_L05N_2                       | IO_L05N_2         | IO_L05N_2         | IO_L05N_2         | E25              | I/O                 |
| 2    | N.C. (◆)          | IO_L05P_2                       | IO_L05P_2         | IO_L05P_2         | IO_L05P_2         | E26              | I/O                 |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name               | XC3S2000 Pin Name                | XC3S4000 Pin Name                | XC3S5000 Pin Name        | FG676 Pin Number | Type                |
|------|-------------------|---------------------------------|----------------------------------|----------------------------------|--------------------------|------------------|---------------------|
| 2    | N.C. (◆)          | IO_L06N_2                       | IO_L06N_2                        | IO_L06N_2                        | IO_L06N_2                | G20              | I/O                 |
| 2    | N.C. (◆)          | IO_L06P_2                       | IO_L06P_2                        | IO_L06P_2                        | IO_L06P_2                | G21              | I/O                 |
| 2    | N.C. (◆)          | IO_L07N_2                       | IO_L07N_2                        | IO_L07N_2                        | IO_L07N_2                | F23              | I/O                 |
| 2    | N.C. (◆)          | IO_L07P_2                       | IO_L07P_2                        | IO_L07P_2                        | IO_L07P_2                | F24              | I/O                 |
| 2    | N.C. (◆)          | IO_L08N_2                       | IO_L08N_2                        | IO_L08N_2                        | IO_L08N_2                | G22              | I/O                 |
| 2    | N.C. (◆)          | IO_L08P_2                       | IO_L08P_2                        | IO_L08P_2                        | IO_L08P_2                | G23              | I/O                 |
| 2    | N.C. (◆)          | IO_L09N_2/VREF_2 <sup>(1)</sup> | IO_L09N_2/VREF_2                 | IO_L09N_2/VREF_2                 | IO_L09N_2/VREF_2         | F25              | VREF <sup>(1)</sup> |
| 2    | N.C. (◆)          | IO_L09P_2                       | IO_L09P_2                        | IO_L09P_2                        | IO_L09P_2                | F26              | I/O                 |
| 2    | N.C. (◆)          | IO_L10N_2                       | IO_L10N_2                        | IO_L10N_2                        | IO_L10N_2                | G25              | I/O                 |
| 2    | N.C. (◆)          | IO_L10P_2                       | IO_L10P_2                        | IO_L10P_2                        | IO_L10P_2                | G26              | I/O                 |
| 2    | IO_L14N_2         | IO_L14N_2                       | IO_L14N_2 <sup>(2)</sup>         | IO_L11N_2 <sup>(2)</sup>         | IO_L11N_2                | H20              | I/O                 |
| 2    | IO_L14P_2         | IO_L14P_2                       | IO_L14P_2 <sup>(2)</sup>         | IO_L11P_2 <sup>(2)</sup>         | IO_L11P_2                | H21              | I/O                 |
| 2    | IO_L16N_2         | IO_L16N_2                       | IO_L16N_2 <sup>(2)</sup>         | IO_L12N_2 <sup>(2)</sup>         | IO_L12N_2                | H22              | I/O                 |
| 2    | IO_L16P_2         | IO_L16P_2                       | IO_L16P_2 <sup>(2)</sup>         | IO_L12P_2 <sup>(2)</sup>         | IO_L12P_2                | J21              | I/O                 |
| 2    | IO_L17N_2         | IO_L17N_2                       | IO_L17N_2 <sup>(2)</sup>         | IO_L13N_2 <sup>(2)</sup>         | IO <sup>(3)</sup>        | H23              | I/O                 |
| 2    | IO_L17P_2/VREF_2  | IO_L17P_2/VREF_2                | IO_L17P_2 <sup>(2)</sup> /VREF_2 | IO_L13P_2 <sup>(2)</sup> /VREF_2 | IO/VREF_2 <sup>(3)</sup> | H24              | VREF                |
| 2    | IO_L19N_2         | IO_L19N_2                       | IO_L19N_2                        | IO_L19N_2                        | IO_L19N_2                | H25              | I/O                 |
| 2    | IO_L19P_2         | IO_L19P_2                       | IO_L19P_2                        | IO_L19P_2                        | IO_L19P_2                | H26              | I/O                 |
| 2    | IO_L20N_2         | IO_L20N_2                       | IO_L20N_2                        | IO_L20N_2                        | IO_L20N_2                | J20              | I/O                 |
| 2    | IO_L20P_2         | IO_L20P_2                       | IO_L20P_2                        | IO_L20P_2                        | IO_L20P_2                | K20              | I/O                 |
| 2    | IO_L21N_2         | IO_L21N_2                       | IO_L21N_2                        | IO_L21N_2                        | IO_L21N_2                | J22              | I/O                 |
| 2    | IO_L21P_2         | IO_L21P_2                       | IO_L21P_2                        | IO_L21P_2                        | IO_L21P_2                | J23              | I/O                 |
| 2    | IO_L22N_2         | IO_L22N_2                       | IO_L22N_2                        | IO_L22N_2                        | IO_L22N_2                | J24              | I/O                 |
| 2    | IO_L22P_2         | IO_L22P_2                       | IO_L22P_2                        | IO_L22P_2                        | IO_L22P_2                | J25              | I/O                 |
| 2    | IO_L23N_2/VREF_2  | IO_L23N_2/VREF_2                | IO_L23N_2/VREF_2                 | IO_L23N_2/VREF_2                 | IO_L23N_2/VREF_2         | K21              | VREF                |
| 2    | IO_L23P_2         | IO_L23P_2                       | IO_L23P_2                        | IO_L23P_2                        | IO_L23P_2                | K22              | I/O                 |
| 2    | IO_L24N_2         | IO_L24N_2                       | IO_L24N_2                        | IO_L24N_2                        | IO_L24N_2                | K23              | I/O                 |
| 2    | IO_L24P_2         | IO_L24P_2                       | IO_L24P_2                        | IO_L24P_2                        | IO_L24P_2                | K24              | I/O                 |
| 2    | IO_L26N_2         | IO_L26N_2                       | IO_L26N_2                        | IO_L26N_2                        | IO_L26N_2                | K25              | I/O                 |
| 2    | IO_L26P_2         | IO_L26P_2                       | IO_L26P_2                        | IO_L26P_2                        | IO_L26P_2                | K26              | I/O                 |
| 2    | IO_L27N_2         | IO_L27N_2                       | IO_L27N_2                        | IO_L27N_2                        | IO_L27N_2                | L19              | I/O                 |
| 2    | IO_L27P_2         | IO_L27P_2                       | IO_L27P_2                        | IO_L27P_2                        | IO_L27P_2                | L20              | I/O                 |
| 2    | IO_L28N_2         | IO_L28N_2                       | IO_L28N_2                        | IO_L28N_2                        | IO_L28N_2                | L21              | I/O                 |
| 2    | IO_L28P_2         | IO_L28P_2                       | IO_L28P_2                        | IO_L28P_2                        | IO_L28P_2                | L22              | I/O                 |
| 2    | IO_L29N_2         | IO_L29N_2                       | IO_L29N_2                        | IO_L29N_2                        | IO_L29N_2                | L25              | I/O                 |
| 2    | IO_L29P_2         | IO_L29P_2                       | IO_L29P_2                        | IO_L29P_2                        | IO_L29P_2                | L26              | I/O                 |
| 2    | IO_L31N_2         | IO_L31N_2                       | IO_L31N_2                        | IO_L31N_2                        | IO_L31N_2                | M19              | I/O                 |
| 2    | IO_L31P_2         | IO_L31P_2                       | IO_L31P_2                        | IO_L31P_2                        | IO_L31P_2                | M20              | I/O                 |
| 2    | IO_L32N_2         | IO_L32N_2                       | IO_L32N_2                        | IO_L32N_2                        | IO_L32N_2                | M21              | I/O                 |
| 2    | IO_L32P_2         | IO_L32P_2                       | IO_L32P_2                        | IO_L32P_2                        | IO_L32P_2                | M22              | I/O                 |
| 2    | IO_L33N_2         | IO_L33N_2                       | IO_L33N_2                        | IO_L33N_2                        | IO_L33N_2                | L23              | I/O                 |
| 2    | IO_L33P_2         | IO_L33P_2                       | IO_L33P_2                        | IO_L33P_2                        | IO_L33P_2                | M24              | I/O                 |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------|
| 2    | IO_L34N_2/VREF_2  | IO_L34N_2/VREF_2  | IO_L34N_2/VREF_2  | IO_L34N_2/VREF_2  | IO_L34N_2/VREF_2  | M25              | VREF |
| 2    | IO_L34P_2         | IO_L34P_2         | IO_L34P_2         | IO_L34P_2         | IO_L34P_2         | M26              | I/O  |
| 2    | IO_L35N_2         | IO_L35N_2         | IO_L35N_2         | IO_L35N_2         | IO_L35N_2         | N19              | I/O  |
| 2    | IO_L35P_2         | IO_L35P_2         | IO_L35P_2         | IO_L35P_2         | IO_L35P_2         | N20              | I/O  |
| 2    | IO_L38N_2         | IO_L38N_2         | IO_L38N_2         | IO_L38N_2         | IO_L38N_2         | N21              | I/O  |
| 2    | IO_L38P_2         | IO_L38P_2         | IO_L38P_2         | IO_L38P_2         | IO_L38P_2         | N22              | I/O  |
| 2    | IO_L39N_2         | IO_L39N_2         | IO_L39N_2         | IO_L39N_2         | IO_L39N_2         | N23              | I/O  |
| 2    | IO_L39P_2         | IO_L39P_2         | IO_L39P_2         | IO_L39P_2         | IO_L39P_2         | N24              | I/O  |
| 2    | IO_L40N_2         | IO_L40N_2         | IO_L40N_2         | IO_L40N_2         | IO_L40N_2         | N25              | I/O  |
| 2    | IO_L40P_2/VREF_2  | IO_L40P_2/VREF_2  | IO_L40P_2/VREF_2  | IO_L40P_2/VREF_2  | IO_L40P_2/VREF_2  | N26              | VREF |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | G24              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | J19              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | K19              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | L18              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | L24              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | M18              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | N17              | VCCO |
| 2    | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | VCCO_2            | N18              | VCCO |
| 3    | IO_L01N_3/VRP_3   | IO_L01N_3/VRP_3   | IO_L01N_3/VRP_3   | IO_L01N_3/VRP_3   | IO_L01N_3/VRP_3   | AA22             | DCI  |
| 3    | IO_L01P_3/VRN_3   | IO_L01P_3/VRN_3   | IO_L01P_3/VRN_3   | IO_L01P_3/VRN_3   | IO_L01P_3/VRN_3   | AA21             | DCI  |
| 3    | IO_L02N_3/VREF_3  | IO_L02N_3/VREF_3  | IO_L02N_3/VREF_3  | IO_L02N_3/VREF_3  | IO_L02N_3/VREF_3  | AB24             | VREF |
| 3    | IO_L02P_3         | IO_L02P_3         | IO_L02P_3         | IO_L02P_3         | IO_L02P_3         | AB23             | I/O  |
| 3    | IO_L03N_3         | IO_L03N_3         | IO_L03N_3         | IO_L03N_3         | IO_L03N_3         | AC26             | I/O  |
| 3    | IO_L03P_3         | IO_L03P_3         | IO_L03P_3         | IO_L03P_3         | IO_L03P_3         | AC25             | I/O  |
| 3    | N.C. (◆)          | IO_L05N_3         | IO_L05N_3         | IO_L05N_3         | IO_L05N_3         | Y21              | I/O  |
| 3    | N.C. (◆)          | IO_L05P_3         | IO_L05P_3         | IO_L05P_3         | IO_L05P_3         | Y20              | I/O  |
| 3    | N.C. (◆)          | IO_L06N_3         | IO_L06N_3         | IO_L06N_3         | IO_L06N_3         | AB26             | I/O  |
| 3    | N.C. (◆)          | IO_L06P_3         | IO_L06P_3         | IO_L06P_3         | IO_L06P_3         | AB25             | I/O  |
| 3    | N.C. (◆)          | IO_L07N_3         | IO_L07N_3         | IO_L07N_3         | IO_L07N_3         | AA24             | I/O  |
| 3    | N.C. (◆)          | IO_L07P_3         | IO_L07P_3         | IO_L07P_3         | IO_L07P_3         | AA23             | I/O  |
| 3    | N.C. (◆)          | IO_L08N_3         | IO_L08N_3         | IO_L08N_3         | IO_L08N_3         | Y23              | I/O  |
| 3    | N.C. (◆)          | IO_L08P_3         | IO_L08P_3         | IO_L08P_3         | IO_L08P_3         | Y22              | I/O  |
| 3    | N.C. (◆)          | IO_L09N_3         | IO_L09N_3         | IO_L09N_3         | IO_L09N_3         | AA26             | I/O  |
| 3    | N.C. (◆)          | IO_L09P_3/VREF_3  | IO_L09P_3/VREF_3  | IO_L09P_3/VREF_3  | IO_L09P_3/VREF_3  | AA25             | VREF |
| 3    | N.C. (◆)          | IO_L10N_3         | IO_L10N_3         | IO_L10N_3         | IO_L10N_3         | W21              | I/O  |
| 3    | N.C. (◆)          | IO_L10P_3         | IO_L10P_3         | IO_L10P_3         | IO_L10P_3         | W20              | I/O  |
| 3    | IO_L14N_3         | IO_L14N_3         | IO_L14N_3         | IO_L14N_3         | IO_L14N_3         | Y26              | I/O  |
| 3    | IO_L14P_3         | IO_L14P_3         | IO_L14P_3         | IO_L14P_3         | IO_L14P_3         | Y25              | I/O  |
| 3    | IO_L16N_3         | IO_L16N_3         | IO_L16N_3         | IO_L16N_3         | IO_L16N_3         | V21              | I/O  |
| 3    | IO_L16P_3         | IO_L16P_3         | IO_L16P_3         | IO_L16P_3         | IO_L16P_3         | W22              | I/O  |
| 3    | IO_L17N_3         | IO_L17N_3         | IO_L17N_3         | IO_L17N_3         | IO_L17N_3         | W24              | I/O  |
| 3    | IO_L17P_3/VREF_3  | IO_L17P_3/VREF_3  | IO_L17P_3/VREF_3  | IO_L17P_3/VREF_3  | IO_L17P_3/VREF_3  | W23              | VREF |

**Table 103: FG676 Package Pinout (Cont'd)**

| Bank | XC3S1000<br>Pin Name | XC3S1500<br>Pin Name | XC3S2000<br>Pin Name | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG676 Pin<br>Number | Type |
|------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|------|
| 3    | IO_L19N_3            | IO_L19N_3            | IO_L19N_3            | IO_L19N_3            | IO_L19N_3            | W26                 | I/O  |
| 3    | IO_L19P_3            | IO_L19P_3            | IO_L19P_3            | IO_L19P_3            | IO_L19P_3            | W25                 | I/O  |
| 3    | IO_L20N_3            | IO_L20N_3            | IO_L20N_3            | IO_L20N_3            | IO_L20N_3            | U20                 | I/O  |
| 3    | IO_L20P_3            | IO_L20P_3            | IO_L20P_3            | IO_L20P_3            | IO_L20P_3            | V20                 | I/O  |
| 3    | IO_L21N_3            | IO_L21N_3            | IO_L21N_3            | IO_L21N_3            | IO_L21N_3            | V23                 | I/O  |
| 3    | IO_L21P_3            | IO_L21P_3            | IO_L21P_3            | IO_L21P_3            | IO_L21P_3            | V22                 | I/O  |
| 3    | IO_L22N_3            | IO_L22N_3            | IO_L22N_3            | IO_L22N_3            | IO_L22N_3            | V25                 | I/O  |
| 3    | IO_L22P_3            | IO_L22P_3            | IO_L22P_3            | IO_L22P_3            | IO_L22P_3            | V24                 | I/O  |
| 3    | IO_L23N_3            | IO_L23N_3            | IO_L23N_3            | IO_L23N_3            | IO_L23N_3            | U22                 | I/O  |
| 3    | IO_L23P_3/VREF_3     | IO_L23P_3/VREF_3     | IO_L23P_3/VREF_3     | IO_L23P_3/VREF_3     | IO_L23P_3/VREF_3     | U21                 | VREF |
| 3    | IO_L24N_3            | IO_L24N_3            | IO_L24N_3            | IO_L24N_3            | IO_L24N_3            | U24                 | I/O  |
| 3    | IO_L24P_3            | IO_L24P_3            | IO_L24P_3            | IO_L24P_3            | IO_L24P_3            | U23                 | I/O  |
| 3    | IO_L26N_3            | IO_L26N_3            | IO_L26N_3            | IO_L26N_3            | IO_L26N_3            | U26                 | I/O  |
| 3    | IO_L26P_3            | IO_L26P_3            | IO_L26P_3            | IO_L26P_3            | IO_L26P_3            | U25                 | I/O  |
| 3    | IO_L27N_3            | IO_L27N_3            | IO_L27N_3            | IO_L27N_3            | IO_L27N_3            | T20                 | I/O  |
| 3    | IO_L27P_3            | IO_L27P_3            | IO_L27P_3            | IO_L27P_3            | IO_L27P_3            | T19                 | I/O  |
| 3    | IO_L28N_3            | IO_L28N_3            | IO_L28N_3            | IO_L28N_3            | IO_L28N_3            | T22                 | I/O  |
| 3    | IO_L28P_3            | IO_L28P_3            | IO_L28P_3            | IO_L28P_3            | IO_L28P_3            | T21                 | I/O  |
| 3    | IO_L29N_3            | IO_L29N_3            | IO_L29N_3            | IO_L29N_3            | IO_L29N_3            | T26                 | I/O  |
| 3    | IO_L29P_3            | IO_L29P_3            | IO_L29P_3            | IO_L29P_3            | IO_L29P_3            | T25                 | I/O  |
| 3    | IO_L31N_3            | IO_L31N_3            | IO_L31N_3            | IO_L31N_3            | IO_L31N_3            | R20                 | I/O  |
| 3    | IO_L31P_3            | IO_L31P_3            | IO_L31P_3            | IO_L31P_3            | IO_L31P_3            | R19                 | I/O  |
| 3    | IO_L32N_3            | IO_L32N_3            | IO_L32N_3            | IO_L32N_3            | IO_L32N_3            | R22                 | I/O  |
| 3    | IO_L32P_3            | IO_L32P_3            | IO_L32P_3            | IO_L32P_3            | IO_L32P_3            | R21                 | I/O  |
| 3    | IO_L33N_3            | IO_L33N_3            | IO_L33N_3            | IO_L33N_3            | IO_L33N_3            | R24                 | I/O  |
| 3    | IO_L33P_3            | IO_L33P_3            | IO_L33P_3            | IO_L33P_3            | IO_L33P_3            | T23                 | I/O  |
| 3    | IO_L34N_3            | IO_L34N_3            | IO_L34N_3            | IO_L34N_3            | IO_L34N_3            | R26                 | I/O  |
| 3    | IO_L34P_3/VREF_3     | IO_L34P_3/VREF_3     | IO_L34P_3/VREF_3     | IO_L34P_3/VREF_3     | IO_L34P_3/VREF_3     | R25                 | VREF |
| 3    | IO_L35N_3            | IO_L35N_3            | IO_L35N_3            | IO_L35N_3            | IO_L35N_3            | P20                 | I/O  |
| 3    | IO_L35P_3            | IO_L35P_3            | IO_L35P_3            | IO_L35P_3            | IO_L35P_3            | P19                 | I/O  |
| 3    | IO_L38N_3            | IO_L38N_3            | IO_L38N_3            | IO_L38N_3            | IO_L38N_3            | P22                 | I/O  |
| 3    | IO_L38P_3            | IO_L38P_3            | IO_L38P_3            | IO_L38P_3            | IO_L38P_3            | P21                 | I/O  |
| 3    | IO_L39N_3            | IO_L39N_3            | IO_L39N_3            | IO_L39N_3            | IO_L39N_3            | P24                 | I/O  |
| 3    | IO_L39P_3            | IO_L39P_3            | IO_L39P_3            | IO_L39P_3            | IO_L39P_3            | P23                 | I/O  |
| 3    | IO_L40N_3/VREF_3     | IO_L40N_3/VREF_3     | IO_L40N_3/VREF_3     | IO_L40N_3/VREF_3     | IO_L40N_3/VREF_3     | P26                 | VREF |
| 3    | IO_L40P_3            | IO_L40P_3            | IO_L40P_3            | IO_L40P_3            | IO_L40P_3            | P25                 | I/O  |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | P17                 | VCCO |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | P18                 | VCCO |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | R18                 | VCCO |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | T18                 | VCCO |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | T24                 | VCCO |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | U19                 | VCCO |
| 3    | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | VCCO_3               | V19                 | VCCO |



Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------|
| 3    | VCCO_3            | VCCO_3            | VCCO_3            | VCCO_3            | VCCO_3            | Y24              | VCCO |
| 4    | IO                | IO                | IO                | IO                | IO                | AA20             | I/O  |
| 4    | IO                | IO                | IO                | IO                | IO                | AD15             | I/O  |
| 4    | N.C. (◆)          | IO                | IO                | IO                | IO                | AD19             | I/O  |
| 4    | IO                | IO                | IO                | IO                | IO                | AD23             | I/O  |
| 4    | IO                | IO                | IO                | IO                | IO                | AF21             | I/O  |
| 4    | IO                | IO                | IO                | IO                | IO                | AF22             | I/O  |
| 4    | IO                | IO                | IO                | IO                | IO                | W15              | I/O  |
| 4    | IO                | IO                | IO                | IO                | IO                | W16              | I/O  |
| 4    | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | AB14             | VREF |
| 4    | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | AD25             | VREF |
| 4    | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | IO/VREF_4         | Y17              | VREF |
| 4    | IO_L01N_4/VRP_4   | IO_L01N_4/VRP_4   | IO_L01N_4/VRP_4   | IO_L01N_4/VRP_4   | IO_L01N_4/VRP_4   | AB22             | DCI  |
| 4    | IO_L01P_4/VRN_4   | IO_L01P_4/VRN_4   | IO_L01P_4/VRN_4   | IO_L01P_4/VRN_4   | IO_L01P_4/VRN_4   | AC22             | DCI  |
| 4    | IO_L04N_4         | IO_L04N_4         | IO_L04N_4         | IO_L04N_4         | IO_L04N_4         | AE24             | I/O  |
| 4    | IO_L04P_4         | IO_L04P_4         | IO_L04P_4         | IO_L04P_4         | IO_L04P_4         | AF24             | I/O  |
| 4    | IO_L05N_4         | IO_L05N_4         | IO_L05N_4         | IO_L05N_4         | IO_L05N_4         | AE23             | I/O  |
| 4    | IO_L05P_4         | IO_L05P_4         | IO_L05P_4         | IO_L05P_4         | IO_L05P_4         | AF23             | I/O  |
| 4    | IO_L06N_4/VREF_4  | IO_L06N_4/VREF_4  | IO_L06N_4/VREF_4  | IO_L06N_4/VREF_4  | IO_L06N_4/VREF_4  | AD22             | VREF |
| 4    | IO_L06P_4         | IO_L06P_4         | IO_L06P_4         | IO_L06P_4         | IO_L06P_4         | AE22             | I/O  |
| 4    | IO_L07N_4         | IO_L07N_4         | IO_L07N_4         | IO_L07N_4         | IO_L07N_4         | AB21             | I/O  |
| 4    | IO_L07P_4         | IO_L07P_4         | IO_L07P_4         | IO_L07P_4         | IO_L07P_4         | AC21             | I/O  |
| 4    | IO_L08N_4         | IO_L08N_4         | IO_L08N_4         | IO_L08N_4         | IO_L08N_4         | AD21             | I/O  |
| 4    | IO_L08P_4         | IO_L08P_4         | IO_L08P_4         | IO_L08P_4         | IO_L08P_4         | AE21             | I/O  |
| 4    | IO_L09N_4         | IO_L09N_4         | IO_L09N_4         | IO_L09N_4         | IO_L09N_4         | AB20             | I/O  |
| 4    | IO_L09P_4         | IO_L09P_4         | IO_L09P_4         | IO_L09P_4         | IO_L09P_4         | AC20             | I/O  |
| 4    | IO_L10N_4         | IO_L10N_4         | IO_L10N_4         | IO_L10N_4         | IO_L10N_4         | AE20             | I/O  |
| 4    | IO_L10P_4         | IO_L10P_4         | IO_L10P_4         | IO_L10P_4         | IO_L10P_4         | AF20             | I/O  |
| 4    | N.C. (◆)          | IO_L11N_4         | IO_L11N_4         | IO_L11N_4         | IO_L11N_4         | Y19              | I/O  |
| 4    | N.C. (◆)          | IO_L11P_4         | IO_L11P_4         | IO_L11P_4         | IO_L11P_4         | AA19             | I/O  |
| 4    | N.C. (◆)          | IO_L12N_4         | IO_L12N_4         | IO_L12N_4         | IO_L12N_4         | AB19             | I/O  |
| 4    | N.C. (◆)          | IO_L12P_4         | IO_L12P_4         | IO_L12P_4         | IO_L12P_4         | AC19             | I/O  |
| 4    | IO_L15N_4         | IO_L15N_4         | IO_L15N_4         | IO_L15N_4         | IO_L15N_4         | AE19             | I/O  |
| 4    | IO_L15P_4         | IO_L15P_4         | IO_L15P_4         | IO_L15P_4         | IO_L15P_4         | AF19             | I/O  |
| 4    | IO_L16N_4         | IO_L16N_4         | IO_L16N_4         | IO_L16N_4         | IO_L16N_4         | Y18              | I/O  |
| 4    | IO_L16P_4         | IO_L16P_4         | IO_L16P_4         | IO_L16P_4         | IO_L16P_4         | AA18             | I/O  |
| 4    | N.C. (◆)          | IO_L17N_4         | IO_L17N_4         | IO_L17N_4         | IO_L17N_4         | AB18             | I/O  |
| 4    | N.C. (◆)          | IO_L17P_4         | IO_L17P_4         | IO_L17P_4         | IO_L17P_4         | AC18             | I/O  |
| 4    | N.C. (◆)          | IO_L18N_4         | IO_L18N_4         | IO_L18N_4         | IO_L18N_4         | AD18             | I/O  |
| 4    | N.C. (◆)          | IO_L18P_4         | IO_L18P_4         | IO_L18P_4         | IO_L18P_4         | AE18             | I/O  |
| 4    | IO_L19N_4         | IO_L19N_4         | IO_L19N_4         | IO_L19N_4         | IO_L19N_4         | AC17             | I/O  |
| 4    | IO_L19P_4         | IO_L19P_4         | IO_L19P_4         | IO_L19P_4         | IO_L19P_4         | AA17             | I/O  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name   | XC3S1500 Pin Name   | XC3S2000 Pin Name   | XC3S4000 Pin Name   | XC3S5000 Pin Name        | FG676 Pin Number | Type |
|------|---------------------|---------------------|---------------------|---------------------|--------------------------|------------------|------|
| 4    | IO_L22N_4/VREF_4    | IO_L22N_4/VREF_4    | IO_L22N_4/VREF_4    | IO_L22N_4/VREF_4    | IO_L22N_4/VREF_4         | AD17             | VREF |
| 4    | IO_L22P_4           | IO_L22P_4           | IO_L22P_4           | IO_L22P_4           | IO_L22P_4                | AB17             | I/O  |
| 4    | N.C. (◆)            | IO_L23N_4           | IO_L23N_4           | IO_L23N_4           | IO_L23N_4                | AE17             | I/O  |
| 4    | N.C. (◆)            | IO_L23P_4           | IO_L23P_4           | IO_L23P_4           | IO_L23P_4                | AF17             | I/O  |
| 4    | IO_L24N_4           | IO_L24N_4           | IO_L24N_4           | IO_L24N_4           | IO_L24N_4                | Y16              | I/O  |
| 4    | IO_L24P_4           | IO_L24P_4           | IO_L24P_4           | IO_L24P_4           | IO_L24P_4                | AA16             | I/O  |
| 4    | IO_L25N_4           | IO_L25N_4           | IO_L25N_4           | IO_L25N_4           | IO_L25N_4                | AB16             | I/O  |
| 4    | IO_L25P_4           | IO_L25P_4           | IO_L25P_4           | IO_L25P_4           | IO_L25P_4                | AC16             | I/O  |
| 4    | N.C. (◆)            | IO_L26N_4           | IO_L26N_4           | IO_L26N_4           | IO_L26N_4                | AE16             | I/O  |
| 4    | N.C. (◆)            | IO_L26P_4/VREF_4    | IO_L26P_4/VREF_4    | IO_L26P_4/VREF_4    | IO_L26P_4/VREF_4         | AF16             | VREF |
| 4    | IO_L27N_4/DIN/D0    | IO_L27N_4/DIN/D0    | IO_L27N_4/DIN/D0    | IO_L27N_4/DIN/D0    | IO_L27N_4/DIN/D0         | Y15              | DUAL |
| 4    | IO_L27P_4/D1        | IO_L27P_4/D1        | IO_L27P_4/D1        | IO_L27P_4/D1        | IO_L27P_4/D1             | W14              | DUAL |
| 4    | IO_L28N_4           | IO_L28N_4           | IO_L28N_4           | IO_L28N_4           | IO_L28N_4                | AA15             | I/O  |
| 4    | IO_L28P_4           | IO_L28P_4           | IO_L28P_4           | IO_L28P_4           | IO_L28P_4                | AB15             | I/O  |
| 4    | IO_L29N_4           | IO_L29N_4           | IO_L29N_4           | IO_L29N_4           | IO_L29N_4                | AE15             | I/O  |
| 4    | IO_L29P_4           | IO_L29P_4           | IO_L29P_4           | IO_L29P_4           | IO_L29P_4                | AF15             | I/O  |
| 4    | IO_L30N_4/D2        | IO_L30N_4/D2        | IO_L30N_4/D2        | IO_L30N_4/D2        | IO_L30N_4/D2             | Y14              | DUAL |
| 4    | IO_L30P_4/D3        | IO_L30P_4/D3        | IO_L30P_4/D3        | IO_L30P_4/D3        | IO_L30P_4/D3             | AA14             | DUAL |
| 4    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B         | AC14             | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY      | AD14             | DUAL |
| 4    | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1          | AE14             | GCLK |
| 4    | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0          | AF14             | GCLK |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | AD16             | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | AD20             | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | U14              | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | V14              | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | V15              | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | V16              | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | W17              | VCCO |
| 4    | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4              | VCCO_4                   | W18              | VCCO |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | AA7              | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | AA13             | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO_L17P_5 <sup>(3)</sup> | AB9              | I/O  |
| 5    | N.C. (◆)            | IO                  | IO                  | IO                  | IO_L17N_5 <sup>(3)</sup> | AC9              | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | AC11             | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | AD10             | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | AD12             | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | AF4              | I/O  |
| 5    | IO                  | IO                  | IO                  | IO                  | IO                       | Y8               | I/O  |
| 5    | IO/VREF_5           | IO/VREF_5           | IO/VREF_5           | IO/VREF_5           | IO/VREF_5                | AF5              | VREF |
| 5    | IO/VREF_5           | IO/VREF_5           | IO/VREF_5           | IO/VREF_5           | IO/VREF_5                | AF13             | VREF |
| 5    | IO_L01N_5/RDWR_B    | IO_L01N_5/RDWR_B    | IO_L01N_5/RDWR_B    | IO_L01N_5/RDWR_B    | IO_L01N_5/RDWR_B         | AC5              | DUAL |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000<br>Pin Name | XC3S1500<br>Pin Name | XC3S2000<br>Pin Name | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG676 Pin<br>Number | Type |
|------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|------|
| 5    | IO_L01P_5/CS_B       | IO_L01P_5/CS_B       | IO_L01P_5/CS_B       | IO_L01P_5/CS_B       | IO_L01P_5/CS_B       | AB5                 | DUAL |
| 5    | IO_L04N_5            | IO_L04N_5            | IO_L04N_5            | IO_L04N_5            | IO_L04N_5            | AE4                 | I/O  |
| 5    | IO_L04P_5            | IO_L04P_5            | IO_L04P_5            | IO_L04P_5            | IO_L04P_5            | AD4                 | I/O  |
| 5    | IO_L05N_5            | IO_L05N_5            | IO_L05N_5            | IO_L05N_5            | IO_L05N_5            | AB6                 | I/O  |
| 5    | IO_L05P_5            | IO_L05P_5            | IO_L05P_5            | IO_L05P_5            | IO_L05P_5            | AA6                 | I/O  |
| 5    | IO_L06N_5            | IO_L06N_5            | IO_L06N_5            | IO_L06N_5            | IO_L06N_5            | AE5                 | I/O  |
| 5    | IO_L06P_5            | IO_L06P_5            | IO_L06P_5            | IO_L06P_5            | IO_L06P_5            | AD5                 | I/O  |
| 5    | IO_L07N_5            | IO_L07N_5            | IO_L07N_5            | IO_L07N_5            | IO_L07N_5            | AD6                 | I/O  |
| 5    | IO_L07P_5            | IO_L07P_5            | IO_L07P_5            | IO_L07P_5            | IO_L07P_5            | AC6                 | I/O  |
| 5    | IO_L08N_5            | IO_L08N_5            | IO_L08N_5            | IO_L08N_5            | IO_L08N_5            | AF6                 | I/O  |
| 5    | IO_L08P_5            | IO_L08P_5            | IO_L08P_5            | IO_L08P_5            | IO_L08P_5            | AE6                 | I/O  |
| 5    | IO_L09N_5            | IO_L09N_5            | IO_L09N_5            | IO_L09N_5            | IO_L09N_5            | AC7                 | I/O  |
| 5    | IO_L09P_5            | IO_L09P_5            | IO_L09P_5            | IO_L09P_5            | IO_L09P_5            | AB7                 | I/O  |
| 5    | IO_L10N_5/VRP_5      | IO_L10N_5/VRP_5      | IO_L10N_5/VRP_5      | IO_L10N_5/VRP_5      | IO_L10N_5/VRP_5      | AF7                 | DCI  |
| 5    | IO_L10P_5/VRN_5      | IO_L10P_5/VRN_5      | IO_L10P_5/VRN_5      | IO_L10P_5/VRN_5      | IO_L10P_5/VRN_5      | AE7                 | DCI  |
| 5    | N.C. (◆)             | IO_L11N_5/VREF_5     | IO_L11N_5/VREF_5     | IO_L11N_5/VREF_5     | IO_L11N_5/VREF_5     | AB8                 | VREF |
| 5    | N.C. (◆)             | IO_L11P_5            | IO_L11P_5            | IO_L11P_5            | IO_L11P_5            | AA8                 | I/O  |
| 5    | N.C. (◆)             | IO_L12N_5            | IO_L12N_5            | IO_L12N_5            | IO_L12N_5            | AD8                 | I/O  |
| 5    | N.C. (◆)             | IO_L12P_5            | IO_L12P_5            | IO_L12P_5            | IO_L12P_5            | AC8                 | I/O  |
| 5    | IO_L15N_5            | IO_L15N_5            | IO_L15N_5            | IO_L15N_5            | IO_L15N_5            | AF8                 | I/O  |
| 5    | IO_L15P_5            | IO_L15P_5            | IO_L15P_5            | IO_L15P_5            | IO_L15P_5            | AE8                 | I/O  |
| 5    | IO_L16N_5            | IO_L16N_5            | IO_L16N_5            | IO_L16N_5            | IO_L16N_5            | AA9                 | I/O  |
| 5    | IO_L16P_5            | IO_L16P_5            | IO_L16P_5            | IO_L16P_5            | IO_L16P_5            | Y9                  | I/O  |
| 5    | N.C. (◆)             | IO_L18N_5            | IO_L18N_5            | IO_L18N_5            | IO_L18N_5            | AE9                 | I/O  |
| 5    | N.C. (◆)             | IO_L18P_5            | IO_L18P_5            | IO_L18P_5            | IO_L18P_5            | AD9                 | I/O  |
| 5    | IO_L19N_5            | IO_L19N_5            | IO_L19N_5            | IO_L19N_5            | IO_L19N_5            | AA10                | I/O  |
| 5    | IO_L19P_5/VREF_5     | IO_L19P_5/VREF_5     | IO_L19P_5/VREF_5     | IO_L19P_5/VREF_5     | IO_L19P_5/VREF_5     | Y10                 | VREF |
| 5    | IO_L22N_5            | IO_L22N_5            | IO_L22N_5            | IO_L22N_5            | IO_L22N_5            | AC10                | I/O  |
| 5    | IO_L22P_5            | IO_L22P_5            | IO_L22P_5            | IO_L22P_5            | IO_L22P_5            | AB10                | I/O  |
| 5    | N.C. (◆)             | IO_L23N_5            | IO_L23N_5            | IO_L23N_5            | IO_L23N_5            | AF10                | I/O  |
| 5    | N.C. (◆)             | IO_L23P_5            | IO_L23P_5            | IO_L23P_5            | IO_L23P_5            | AE10                | I/O  |
| 5    | IO_L24N_5            | IO_L24N_5            | IO_L24N_5            | IO_L24N_5            | IO_L24N_5            | Y11                 | I/O  |
| 5    | IO_L24P_5            | IO_L24P_5            | IO_L24P_5            | IO_L24P_5            | IO_L24P_5            | W11                 | I/O  |
| 5    | IO_L25N_5            | IO_L25N_5            | IO_L25N_5            | IO_L25N_5            | IO_L25N_5            | AB11                | I/O  |
| 5    | IO_L25P_5            | IO_L25P_5            | IO_L25P_5            | IO_L25P_5            | IO_L25P_5            | AA11                | I/O  |
| 5    | N.C. (◆)             | IO_L26N_5            | IO_L26N_5            | IO_L26N_5            | IO_L26N_5            | AF11                | I/O  |
| 5    | N.C. (◆)             | IO_L26P_5            | IO_L26P_5            | IO_L26P_5            | IO_L26P_5            | AE11                | I/O  |
| 5    | IO_L27N_5/VREF_5     | IO_L27N_5/VREF_5     | IO_L27N_5/VREF_5     | IO_L27N_5/VREF_5     | IO_L27N_5/VREF_5     | Y12                 | VREF |
| 5    | IO_L27P_5            | IO_L27P_5            | IO_L27P_5            | IO_L27P_5            | IO_L27P_5            | W12                 | I/O  |
| 5    | IO_L28N_5/D6         | IO_L28N_5/D6         | IO_L28N_5/D6         | IO_L28N_5/D6         | IO_L28N_5/D6         | AB12                | DUAL |
| 5    | IO_L28P_5/D7         | IO_L28P_5/D7         | IO_L28P_5/D7         | IO_L28P_5/D7         | IO_L28P_5/D7         | AA12                | DUAL |
| 5    | IO_L29N_5            | IO_L29N_5            | IO_L29N_5            | IO_L29N_5            | IO_L29N_5            | AF12                | I/O  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------|
| 5    | IO_L29P_5/VREF_5  | IO_L29P_5/VREF_5  | IO_L29P_5/VREF_5  | IO_L29P_5/VREF_5  | IO_L29P_5/VREF_5  | AE12             | VREF |
| 5    | IO_L30N_5         | IO_L30N_5         | IO_L30N_5         | IO_L30N_5         | IO_L30N_5         | Y13              | I/O  |
| 5    | IO_L30P_5         | IO_L30P_5         | IO_L30P_5         | IO_L30P_5         | IO_L30P_5         | W13              | I/O  |
| 5    | IO_L31N_5/D4      | IO_L31N_5/D4      | IO_L31N_5/D4      | IO_L31N_5/D4      | IO_L31N_5/D4      | AC13             | DUAL |
| 5    | IO_L31P_5/D5      | IO_L31P_5/D5      | IO_L31P_5/D5      | IO_L31P_5/D5      | IO_L31P_5/D5      | AB13             | DUAL |
| 5    | IO_L32N_5/GCLK3   | IO_L32N_5/GCLK3   | IO_L32N_5/GCLK3   | IO_L32N_5/GCLK3   | IO_L32N_5/GCLK3   | AE13             | GCLK |
| 5    | IO_L32P_5/GCLK2   | IO_L32P_5/GCLK2   | IO_L32P_5/GCLK2   | IO_L32P_5/GCLK2   | IO_L32P_5/GCLK2   | AD13             | GCLK |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | AD7              | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | AD11             | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | U13              | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | V11              | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | V12              | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | V13              | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | W9               | VCCO |
| 5    | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5            | W10              | VCCO |
| 6    | N.C. (◆)          | N.C. (■)          | IO                | IO                | IO                | AA5              | I/O  |
| 6    | IO_L01N_6/VRP_6   | IO_L01N_6/VRP_6   | IO_L01N_6/VRP_6   | IO_L01N_6/VRP_6   | IO_L01N_6/VRP_6   | AD2              | DCI  |
| 6    | IO_L01P_6/VRN_6   | IO_L01P_6/VRN_6   | IO_L01P_6/VRN_6   | IO_L01P_6/VRN_6   | IO_L01P_6/VRN_6   | AD1              | DCI  |
| 6    | IO_L02N_6         | IO_L02N_6         | IO_L02N_6         | IO_L02N_6         | IO_L02N_6         | AB4              | I/O  |
| 6    | IO_L02P_6         | IO_L02P_6         | IO_L02P_6         | IO_L02P_6         | IO_L02P_6         | AB3              | I/O  |
| 6    | IO_L03N_6/VREF_6  | IO_L03N_6/VREF_6  | IO_L03N_6/VREF_6  | IO_L03N_6/VREF_6  | IO_L03N_6/VREF_6  | AC2              | VREF |
| 6    | IO_L03P_6         | IO_L03P_6         | IO_L03P_6         | IO_L03P_6         | IO_L03P_6         | AC1              | I/O  |
| 6    | N.C. (◆)          | IO_L05N_6         | IO_L05N_6         | IO_L05N_6         | IO_L05N_6         | AB2              | I/O  |
| 6    | N.C. (◆)          | IO_L05P_6         | IO_L05P_6         | IO_L05P_6         | IO_L05P_6         | AB1              | I/O  |
| 6    | N.C. (◆)          | IO_L06N_6         | IO_L06N_6         | IO_L06N_6         | IO_L06N_6         | Y7               | I/O  |
| 6    | N.C. (◆)          | IO_L06P_6         | IO_L06P_6         | IO_L06P_6         | IO_L06P_6         | Y6               | I/O  |
| 6    | N.C. (◆)          | IO_L07N_6         | IO_L07N_6         | IO_L07N_6         | IO_L07N_6         | AA4              | I/O  |
| 6    | N.C. (◆)          | IO_L07P_6         | IO_L07P_6         | IO_L07P_6         | IO_L07P_6         | AA3              | I/O  |
| 6    | N.C. (◆)          | IO_L08N_6         | IO_L08N_6         | IO_L08N_6         | IO_L08N_6         | Y5               | I/O  |
| 6    | N.C. (◆)          | IO_L08P_6         | IO_L08P_6         | IO_L08P_6         | IO_L08P_6         | Y4               | I/O  |
| 6    | N.C. (◆)          | IO_L09N_6/VREF_6  | IO_L09N_6/VREF_6  | IO_L09N_6/VREF_6  | IO_L09N_6/VREF_6  | AA2              | VREF |
| 6    | N.C. (◆)          | IO_L09P_6         | IO_L09P_6         | IO_L09P_6         | IO_L09P_6         | AA1              | I/O  |
| 6    | N.C. (◆)          | IO_L10N_6         | IO_L10N_6         | IO_L10N_6         | IO_L10N_6         | Y2               | I/O  |
| 6    | N.C. (◆)          | IO_L10P_6         | IO_L10P_6         | IO_L10P_6         | IO_L10P_6         | Y1               | I/O  |
| 6    | IO_L14N_6         | IO_L14N_6         | IO_L14N_6         | IO_L14N_6         | IO_L14N_6         | W7               | I/O  |
| 6    | IO_L14P_6         | IO_L14P_6         | IO_L14P_6         | IO_L14P_6         | IO_L14P_6         | W6               | I/O  |
| 6    | IO_L16N_6         | IO_L16N_6         | IO_L16N_6         | IO_L16N_6         | IO_L16N_6         | V6               | I/O  |
| 6    | IO_L16P_6         | IO_L16P_6         | IO_L16P_6         | IO_L16P_6         | IO_L16P_6         | W5               | I/O  |
| 6    | IO_L17N_6         | IO_L17N_6         | IO_L17N_6         | IO_L17N_6         | IO_L17N_6         | W4               | I/O  |
| 6    | IO_L17P_6/VREF_6  | IO_L17P_6/VREF_6  | IO_L17P_6/VREF_6  | IO_L17P_6/VREF_6  | IO_L17P_6/VREF_6  | W3               | VREF |
| 6    | IO_L19N_6         | IO_L19N_6         | IO_L19N_6         | IO_L19N_6         | IO_L19N_6         | W2               | I/O  |
| 6    | IO_L19P_6         | IO_L19P_6         | IO_L19P_6         | IO_L19P_6         | IO_L19P_6         | W1               | I/O  |

**Table 103: FG676 Package Pinout (Cont'd)**

| Bank | XC3S1000<br>Pin Name | XC3S1500<br>Pin Name | XC3S2000<br>Pin Name | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG676 Pin<br>Number | Type |
|------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|------|
| 6    | IO_L20N_6            | IO_L20N_6            | IO_L20N_6            | IO_L20N_6            | IO_L20N_6            | V7                  | I/O  |
| 6    | IO_L20P_6            | IO_L20P_6            | IO_L20P_6            | IO_L20P_6            | IO_L20P_6            | U7                  | I/O  |
| 6    | IO_L21N_6            | IO_L21N_6            | IO_L21N_6            | IO_L21N_6            | IO_L21N_6            | V5                  | I/O  |
| 6    | IO_L21P_6            | IO_L21P_6            | IO_L21P_6            | IO_L21P_6            | IO_L21P_6            | V4                  | I/O  |
| 6    | IO_L22N_6            | IO_L22N_6            | IO_L22N_6            | IO_L22N_6            | IO_L22N_6            | V3                  | I/O  |
| 6    | IO_L22P_6            | IO_L22P_6            | IO_L22P_6            | IO_L22P_6            | IO_L22P_6            | V2                  | I/O  |
| 6    | IO_L23N_6            | IO_L23N_6            | IO_L23N_6            | IO_L23N_6            | IO_L23N_6            | U6                  | I/O  |
| 6    | IO_L23P_6            | IO_L23P_6            | IO_L23P_6            | IO_L23P_6            | IO_L23P_6            | U5                  | I/O  |
| 6    | IO_L24N_6/VREF_6     | IO_L24N_6/VREF_6     | IO_L24N_6/VREF_6     | IO_L24N_6/VREF_6     | IO_L24N_6/VREF_6     | U4                  | VREF |
| 6    | IO_L24P_6            | IO_L24P_6            | IO_L24P_6            | IO_L24P_6            | IO_L24P_6            | U3                  | I/O  |
| 6    | IO_L26N_6            | IO_L26N_6            | IO_L26N_6            | IO_L26N_6            | IO_L26N_6            | U2                  | I/O  |
| 6    | IO_L26P_6            | IO_L26P_6            | IO_L26P_6            | IO_L26P_6            | IO_L26P_6            | U1                  | I/O  |
| 6    | IO_L27N_6            | IO_L27N_6            | IO_L27N_6            | IO_L27N_6            | IO_L27N_6            | T8                  | I/O  |
| 6    | IO_L27P_6            | IO_L27P_6            | IO_L27P_6            | IO_L27P_6            | IO_L27P_6            | T7                  | I/O  |
| 6    | IO_L28N_6            | IO_L28N_6            | IO_L28N_6            | IO_L28N_6            | IO_L28N_6            | T6                  | I/O  |
| 6    | IO_L28P_6            | IO_L28P_6            | IO_L28P_6            | IO_L28P_6            | IO_L28P_6            | T5                  | I/O  |
| 6    | IO_L29N_6            | IO_L29N_6            | IO_L29N_6            | IO_L29N_6            | IO_L29N_6            | T2                  | I/O  |
| 6    | IO_L29P_6            | IO_L29P_6            | IO_L29P_6            | IO_L29P_6            | IO_L29P_6            | T1                  | I/O  |
| 6    | IO_L31N_6            | IO_L31N_6            | IO_L31N_6            | IO_L31N_6            | IO_L31N_6            | R8                  | I/O  |
| 6    | IO_L31P_6            | IO_L31P_6            | IO_L31P_6            | IO_L31P_6            | IO_L31P_6            | R7                  | I/O  |
| 6    | IO_L32N_6            | IO_L32N_6            | IO_L32N_6            | IO_L32N_6            | IO_L32N_6            | R6                  | I/O  |
| 6    | IO_L32P_6            | IO_L32P_6            | IO_L32P_6            | IO_L32P_6            | IO_L32P_6            | R5                  | I/O  |
| 6    | IO_L33N_6            | IO_L33N_6            | IO_L33N_6            | IO_L33N_6            | IO_L33N_6            | T4                  | I/O  |
| 6    | IO_L33P_6            | IO_L33P_6            | IO_L33P_6            | IO_L33P_6            | IO_L33P_6            | R3                  | I/O  |
| 6    | IO_L34N_6/VREF_6     | IO_L34N_6/VREF_6     | IO_L34N_6/VREF_6     | IO_L34N_6/VREF_6     | IO_L34N_6/VREF_6     | R2                  | VREF |
| 6    | IO_L34P_6            | IO_L34P_6            | IO_L34P_6            | IO_L34P_6            | IO_L34P_6            | R1                  | I/O  |
| 6    | IO_L35N_6            | IO_L35N_6            | IO_L35N_6            | IO_L35N_6            | IO_L35N_6            | P8                  | I/O  |
| 6    | IO_L35P_6            | IO_L35P_6            | IO_L35P_6            | IO_L35P_6            | IO_L35P_6            | P7                  | I/O  |
| 6    | IO_L38N_6            | IO_L38N_6            | IO_L38N_6            | IO_L38N_6            | IO_L38N_6            | P6                  | I/O  |
| 6    | IO_L38P_6            | IO_L38P_6            | IO_L38P_6            | IO_L38P_6            | IO_L38P_6            | P5                  | I/O  |
| 6    | IO_L39N_6            | IO_L39N_6            | IO_L39N_6            | IO_L39N_6            | IO_L39N_6            | P4                  | I/O  |
| 6    | IO_L39P_6            | IO_L39P_6            | IO_L39P_6            | IO_L39P_6            | IO_L39P_6            | P3                  | I/O  |
| 6    | IO_L40N_6            | IO_L40N_6            | IO_L40N_6            | IO_L40N_6            | IO_L40N_6            | P2                  | I/O  |
| 6    | IO_L40P_6/VREF_6     | IO_L40P_6/VREF_6     | IO_L40P_6/VREF_6     | IO_L40P_6/VREF_6     | IO_L40P_6/VREF_6     | P1                  | VREF |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | P9                  | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | P10                 | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | R9                  | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | T3                  | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | T9                  | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | U8                  | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | V8                  | VCCO |
| 6    | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | VCCO_6               | Y3                  | VCCO |
| 7    | IO_L01N_7/VRP_7      | IO_L01N_7/VRP_7      | IO_L01N_7/VRP_7      | IO_L01N_7/VRP_7      | IO_L01N_7/VRP_7      | F5                  | DCI  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------|
| 7    | IO_L01P_7/VRN_7   | IO_L01P_7/VRN_7   | IO_L01P_7/VRN_7   | IO_L01P_7/VRN_7   | IO_L01P_7/VRN_7   | F6               | DCI  |
| 7    | IO_L02N_7         | IO_L02N_7         | IO_L02N_7         | IO_L02N_7         | IO_L02N_7         | E3               | I/O  |
| 7    | IO_L02P_7         | IO_L02P_7         | IO_L02P_7         | IO_L02P_7         | IO_L02P_7         | E4               | I/O  |
| 7    | IO_L03N_7/VREF_7  | IO_L03N_7/VREF_7  | IO_L03N_7/VREF_7  | IO_L03N_7/VREF_7  | IO_L03N_7/VREF_7  | D1               | VREF |
| 7    | IO_L03P_7         | IO_L03P_7         | IO_L03P_7         | IO_L03P_7         | IO_L03P_7         | D2               | I/O  |
| 7    | N.C. (◆)          | IO_L05N_7         | IO_L05N_7         | IO_L05N_7         | IO_L05N_7         | G6               | I/O  |
| 7    | N.C. (◆)          | IO_L05P_7         | IO_L05P_7         | IO_L05P_7         | IO_L05P_7         | G7               | I/O  |
| 7    | N.C. (◆)          | IO_L06N_7         | IO_L06N_7         | IO_L06N_7         | IO_L06N_7         | E1               | I/O  |
| 7    | N.C. (◆)          | IO_L06P_7         | IO_L06P_7         | IO_L06P_7         | IO_L06P_7         | E2               | I/O  |
| 7    | N.C. (◆)          | IO_L07N_7         | IO_L07N_7         | IO_L07N_7         | IO_L07N_7         | F3               | I/O  |
| 7    | N.C. (◆)          | IO_L07P_7         | IO_L07P_7         | IO_L07P_7         | IO_L07P_7         | F4               | I/O  |
| 7    | N.C. (◆)          | IO_L08N_7         | IO_L08N_7         | IO_L08N_7         | IO_L08N_7         | G4               | I/O  |
| 7    | N.C. (◆)          | IO_L08P_7         | IO_L08P_7         | IO_L08P_7         | IO_L08P_7         | G5               | I/O  |
| 7    | N.C. (◆)          | IO_L09N_7         | IO_L09N_7         | IO_L09N_7         | IO_L09N_7         | F1               | I/O  |
| 7    | N.C. (◆)          | IO_L09P_7         | IO_L09P_7         | IO_L09P_7         | IO_L09P_7         | F2               | I/O  |
| 7    | N.C. (◆)          | IO_L10N_7         | IO_L10N_7         | IO_L10N_7         | IO_L10N_7         | H6               | I/O  |
| 7    | N.C. (◆)          | IO_L10P_7/VREF_7  | IO_L10P_7/VREF_7  | IO_L10P_7/VREF_7  | IO_L10P_7/VREF_7  | H7               | VREF |
| 7    | IO_L14N_7         | IO_L14N_7         | IO_L14N_7         | IO_L14N_7         | IO_L14N_7         | G1               | I/O  |
| 7    | IO_L14P_7         | IO_L14P_7         | IO_L14P_7         | IO_L14P_7         | IO_L14P_7         | G2               | I/O  |
| 7    | IO_L16N_7         | IO_L16N_7         | IO_L16N_7         | IO_L16N_7         | IO_L16N_7         | J6               | I/O  |
| 7    | IO_L16P_7/VREF_7  | IO_L16P_7/VREF_7  | IO_L16P_7/VREF_7  | IO_L16P_7/VREF_7  | IO_L16P_7/VREF_7  | H5               | VREF |
| 7    | IO_L17N_7         | IO_L17N_7         | IO_L17N_7         | IO_L17N_7         | IO_L17N_7         | H3               | I/O  |
| 7    | IO_L17P_7         | IO_L17P_7         | IO_L17P_7         | IO_L17P_7         | IO_L17P_7         | H4               | I/O  |
| 7    | IO_L19N_7/VREF_7  | IO_L19N_7/VREF_7  | IO_L19N_7/VREF_7  | IO_L19N_7/VREF_7  | IO_L19N_7/VREF_7  | H1               | VREF |
| 7    | IO_L19P_7         | IO_L19P_7         | IO_L19P_7         | IO_L19P_7         | IO_L19P_7         | H2               | I/O  |
| 7    | IO_L20N_7         | IO_L20N_7         | IO_L20N_7         | IO_L20N_7         | IO_L20N_7         | K7               | I/O  |
| 7    | IO_L20P_7         | IO_L20P_7         | IO_L20P_7         | IO_L20P_7         | IO_L20P_7         | J7               | I/O  |
| 7    | IO_L21N_7         | IO_L21N_7         | IO_L21N_7         | IO_L21N_7         | IO_L21N_7         | J4               | I/O  |
| 7    | IO_L21P_7         | IO_L21P_7         | IO_L21P_7         | IO_L21P_7         | IO_L21P_7         | J5               | I/O  |
| 7    | IO_L22N_7         | IO_L22N_7         | IO_L22N_7         | IO_L22N_7         | IO_L22N_7         | J2               | I/O  |
| 7    | IO_L22P_7         | IO_L22P_7         | IO_L22P_7         | IO_L22P_7         | IO_L22P_7         | J3               | I/O  |
| 7    | IO_L23N_7         | IO_L23N_7         | IO_L23N_7         | IO_L23N_7         | IO_L23N_7         | K5               | I/O  |
| 7    | IO_L23P_7         | IO_L23P_7         | IO_L23P_7         | IO_L23P_7         | IO_L23P_7         | K6               | I/O  |
| 7    | IO_L24N_7         | IO_L24N_7         | IO_L24N_7         | IO_L24N_7         | IO_L24N_7         | K3               | I/O  |
| 7    | IO_L24P_7         | IO_L24P_7         | IO_L24P_7         | IO_L24P_7         | IO_L24P_7         | K4               | I/O  |
| 7    | IO_L26N_7         | IO_L26N_7         | IO_L26N_7         | IO_L26N_7         | IO_L26N_7         | K1               | I/O  |
| 7    | IO_L26P_7         | IO_L26P_7         | IO_L26P_7         | IO_L26P_7         | IO_L26P_7         | K2               | I/O  |
| 7    | IO_L27N_7         | IO_L27N_7         | IO_L27N_7         | IO_L27N_7         | IO_L27N_7         | L7               | I/O  |
| 7    | IO_L27P_7/VREF_7  | IO_L27P_7/VREF_7  | IO_L27P_7/VREF_7  | IO_L27P_7/VREF_7  | IO_L27P_7/VREF_7  | L8               | VREF |
| 7    | IO_L28N_7         | IO_L28N_7         | IO_L28N_7         | IO_L28N_7         | IO_L28N_7         | L5               | I/O  |
| 7    | IO_L28P_7         | IO_L28P_7         | IO_L28P_7         | IO_L28P_7         | IO_L28P_7         | L6               | I/O  |
| 7    | IO_L29N_7         | IO_L29N_7         | IO_L29N_7         | IO_L29N_7         | IO_L29N_7         | L1               | I/O  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------|
| 7    | IO_L29P_7         | IO_L29P_7         | IO_L29P_7         | IO_L29P_7         | IO_L29P_7         | L2               | I/O  |
| 7    | IO_L31N_7         | IO_L31N_7         | IO_L31N_7         | IO_L31N_7         | IO_L31N_7         | M7               | I/O  |
| 7    | IO_L31P_7         | IO_L31P_7         | IO_L31P_7         | IO_L31P_7         | IO_L31P_7         | M8               | I/O  |
| 7    | IO_L32N_7         | IO_L32N_7         | IO_L32N_7         | IO_L32N_7         | IO_L32N_7         | M6               | I/O  |
| 7    | IO_L32P_7         | IO_L32P_7         | IO_L32P_7         | IO_L32P_7         | IO_L32P_7         | M5               | I/O  |
| 7    | IO_L33N_7         | IO_L33N_7         | IO_L33N_7         | IO_L33N_7         | IO_L33N_7         | M3               | I/O  |
| 7    | IO_L33P_7         | IO_L33P_7         | IO_L33P_7         | IO_L33P_7         | IO_L33P_7         | L4               | I/O  |
| 7    | IO_L34N_7         | IO_L34N_7         | IO_L34N_7         | IO_L34N_7         | IO_L34N_7         | M1               | I/O  |
| 7    | IO_L34P_7         | IO_L34P_7         | IO_L34P_7         | IO_L34P_7         | IO_L34P_7         | M2               | I/O  |
| 7    | IO_L35N_7         | IO_L35N_7         | IO_L35N_7         | IO_L35N_7         | IO_L35N_7         | N7               | I/O  |
| 7    | IO_L35P_7         | IO_L35P_7         | IO_L35P_7         | IO_L35P_7         | IO_L35P_7         | N8               | I/O  |
| 7    | IO_L38N_7         | IO_L38N_7         | IO_L38N_7         | IO_L38N_7         | IO_L38N_7         | N5               | I/O  |
| 7    | IO_L38P_7         | IO_L38P_7         | IO_L38P_7         | IO_L38P_7         | IO_L38P_7         | N6               | I/O  |
| 7    | IO_L39N_7         | IO_L39N_7         | IO_L39N_7         | IO_L39N_7         | IO_L39N_7         | N3               | I/O  |
| 7    | IO_L39P_7         | IO_L39P_7         | IO_L39P_7         | IO_L39P_7         | IO_L39P_7         | N4               | I/O  |
| 7    | IO_L40N_7/VREF_7  | IO_L40N_7/VREF_7  | IO_L40N_7/VREF_7  | IO_L40N_7/VREF_7  | IO_L40N_7/VREF_7  | N1               | VREF |
| 7    | IO_L40P_7         | IO_L40P_7         | IO_L40P_7         | IO_L40P_7         | IO_L40P_7         | N2               | I/O  |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | G3               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | J8               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | K8               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | L3               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | L9               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | M9               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | N9               | VCCO |
| 7    | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | VCCO_7            | N10              | VCCO |
| N/A  | GND               | GND               | GND               | GND               | GND               | A1               | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | A26              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AC4              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AC12             | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AC15             | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AC23             | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AD3              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AD24             | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AE2              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AE25             | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AF1              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | AF26             | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | B2               | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | B25              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | C3               | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | C24              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | D4               | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | D12              | GND  |

Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------|
| N/A  | GND               | GND               | GND               | GND               | GND               | D15              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | D23              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | K11              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | K12              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | K15              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | K16              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L10              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L11              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L12              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L13              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L14              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L15              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L16              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | L17              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M4               | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M10              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M11              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M12              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M13              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M14              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M15              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M16              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M17              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | M23              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | N11              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | N12              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | N13              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | N14              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | N15              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | N16              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | P11              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | P12              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | P13              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | P14              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | P15              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | P16              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R4               | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R10              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R11              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R12              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R13              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R14              | GND  |
| N/A  | GND               | GND               | GND               | GND               | GND               | R15              | GND  |



Table 103: FG676 Package Pinout (Cont'd)

| Bank | XC3S1000 Pin Name | XC3S1500 Pin Name | XC3S2000 Pin Name | XC3S4000 Pin Name | XC3S5000 Pin Name | FG676 Pin Number | Type   |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|--------|
| N/A  | GND               | GND               | GND               | GND               | GND               | R16              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | R17              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | R23              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T10              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T11              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T12              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T13              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T14              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T15              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T16              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | T17              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | U11              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | U12              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | U15              | GND    |
| N/A  | GND               | GND               | GND               | GND               | GND               | U16              | GND    |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | A2               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | A9               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | A18              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | A25              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | AE1              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | AE26             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | AF2              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | AF9              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | AF18             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | AF25             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | B1               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | B26              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | J1               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | J26              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | V1               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | VCCAUX            | V26              | VCCAUX |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | H8               | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | H19              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | J9               | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | J10              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | J17              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | J18              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | K9               | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | K10              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | K17              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | K18              | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | U9               | VCCINT |
| N/A  | VCCINT            | VCCINT            | VCCINT            | VCCINT            | VCCINT            | U10              | VCCINT |

Table 103: FG676 Package Pinout (Cont'd)

| Bank       | XC3S1000<br>Pin Name | XC3S1500<br>Pin Name | XC3S2000<br>Pin Name | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG676 Pin<br>Number | Type   |
|------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|--------|
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | U17                 | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | U18                 | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | V9                  | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | V10                 | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | V17                 | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | V18                 | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | W8                  | VCCINT |
| N/A        | VCCINT               | VCCINT               | VCCINT               | VCCINT               | VCCINT               | W19                 | VCCINT |
| VCC<br>AUX | CCLK                 | CCLK                 | CCLK                 | CCLK                 | CCLK                 | AD26                | CONFIG |
| VCC<br>AUX | DONE                 | DONE                 | DONE                 | DONE                 | DONE                 | AC24                | CONFIG |
| VCC<br>AUX | HSWAP_EN             | HSWAP_EN             | HSWAP_EN             | HSWAP_EN             | HSWAP_EN             | C2                  | CONFIG |
| VCC<br>AUX | M0                   | M0                   | M0                   | M0                   | M0                   | AE3                 | CONFIG |
| VCC<br>AUX | M1                   | M1                   | M1                   | M1                   | M1                   | AC3                 | CONFIG |
| VCC<br>AUX | M2                   | M2                   | M2                   | M2                   | M2                   | AF3                 | CONFIG |
| VCC<br>AUX | PROG_B               | PROG_B               | PROG_B               | PROG_B               | PROG_B               | D3                  | CONFIG |
| VCC<br>AUX | TCK                  | TCK                  | TCK                  | TCK                  | TCK                  | B24                 | JTAG   |
| VCC<br>AUX | TDI                  | TDI                  | TDI                  | TDI                  | TDI                  | C1                  | JTAG   |
| VCC<br>AUX | TDO                  | TDO                  | TDO                  | TDO                  | TDO                  | D24                 | JTAG   |
| VCC<br>AUX | TMS                  | TMS                  | TMS                  | TMS                  | TMS                  | A24                 | JTAG   |

**Notes:**

- XC3S1500 balls D25 and F25 are not VREF pins although they are designated as such. If a design uses an IOSTANDARD requiring VREF in bank 2 then apply the workaround in [Answer Record 20519](#).
- XC3S4000 is pin compatible with XC3S2000 but uses alternate differential pair labeling on six package balls (H20, H21, H22, H23, H24, J21).
- XC3S5000 is pin compatible with XC3S4000 but uses alternate differential pair functionality on fifteen package balls (A3, A8, B8, B18, C4, C8, C18, D8, D18, E8, E18, H23, H24, AB9, and AC9).

## User I/Os by Bank

Table 104 indicates how the available user-I/O pins are distributed between the eight I/O banks for the XC3S1000 in the FG676 package. Similarly, Table 105 shows how the available user-I/O pins are distributed between the eight I/O banks for the XC3S1500 in the FG676 package. Finally, Table 106 shows the same information for the XC3S2000, XC3S4000, and XC3S5000 in the FG676 package.

Table 104: User I/Os Per Bank for XC3S1000 in FG676 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 49          | 40                            | 0    | 2   | 5    | 2    |
|        | 1        | 50          | 41                            | 0    | 2   | 5    | 2    |
| Right  | 2        | 48          | 41                            | 0    | 2   | 5    | 0    |
|        | 3        | 48          | 41                            | 0    | 2   | 5    | 0    |
| Bottom | 4        | 50          | 35                            | 6    | 2   | 5    | 2    |
|        | 5        | 50          | 35                            | 6    | 2   | 5    | 2    |
| Left   | 6        | 48          | 41                            | 0    | 2   | 5    | 0    |
|        | 7        | 48          | 41                            | 0    | 2   | 5    | 0    |

Table 105: User I/Os Per Bank for XC3S1500 in FG676 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 62          | 52                            | 0    | 2   | 6    | 2    |
|        | 1        | 61          | 51                            | 0    | 2   | 6    | 2    |
| Right  | 2        | 60          | 52                            | 0    | 2   | 6    | 0    |
|        | 3        | 60          | 52                            | 0    | 2   | 6    | 0    |
| Bottom | 4        | 63          | 47                            | 6    | 2   | 6    | 2    |
|        | 5        | 61          | 45                            | 6    | 2   | 6    | 2    |
| Left   | 6        | 60          | 52                            | 0    | 2   | 6    | 0    |
|        | 7        | 60          | 52                            | 0    | 2   | 6    | 0    |

Table 106: User I/Os Per Bank for XC3S2000, XC3S4000, and XC3S5000 in FG676 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 62          | 52                            | 0    | 2   | 6    | 2    |
|        | 1        | 61          | 51                            | 0    | 2   | 6    | 2    |
| Right  | 2        | 61          | 53                            | 0    | 2   | 6    | 0    |
|        | 3        | 60          | 52                            | 0    | 2   | 6    | 0    |
| Bottom | 4        | 63          | 47                            | 6    | 2   | 6    | 2    |
|        | 5        | 61          | 45                            | 6    | 2   | 6    | 2    |
| Left   | 6        | 61          | 53                            | 0    | 2   | 6    | 0    |
|        | 7        | 60          | 52                            | 0    | 2   | 6    | 0    |

FG676 Footprint

Left Half of Package (Top View)

XC3S1000

(391 max. user I/O)

315 I/O: Unrestricted, general-purpose user I/O

40 VREF: User I/O or input voltage reference for bank

98 N.C.: Unconnected pins for XC3S1000 (◆)

XC3S1500

(487 max user I/O)

403 I/O: Unrestricted, general-purpose user I/O

48 VREF: User I/O or input voltage reference for bank

2 N.C.: Unconnected pins for XC3S1500 (■)

XC3S2000, XC3S4000, XC3S5000 (489 max user I/O)

405 I/O: Unrestricted, general-purpose user I/O

48 VREF: User I/O or input voltage reference for bank

0 N.C.: No unconnected pins

All devices

12 DUAL: Configuration pin, then possible user I/O

8 GCLK: User I/O or global clock buffer input

16 DCI: User I/O or reference resistor input for bank

7 CONFIG: Dedicated configuration pins

4 JTAG: Dedicated JTAG port pins

20 VCCINT: Internal core voltage supply (+1.2V)

64 VCCO: Output voltage supply for bank

16 VCCAUX: Auxiliary voltage supply (+2.5V)

76 GND: Ground

|        |   | Bank 0            |                   |                   |                   |                   |                  |                   |                   |                   |                   |                   |                   |                   |                  |
|--------|---|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|
|        |   | 1                 | 2                 | 3                 | 4                 | 5                 | 6                | 7                 | 8                 | 9                 | 10                | 11                | 12                | 13                |                  |
| Bank 7 | A | GND               | VCCAUX            | I/O               | I/O L05P_0 VREF_0 | I/O               | I/O              | I/O L10P_0        | I/O L15P_0        | VCCAUX            | I/O L23P_0        | I/O L26P_0 VREF_0 | I/O L29P_0        | I/O L32P_0 GCLK6  |                  |
|        | B | VCCAUX            | GND               | I/O VREF_0        | I/O L05N_0        | I/O L06P_0        | I/O L08P_0       | I/O L10N_0        | I/O L15N_0        | I/O L18P_0        | I/O L23N_0        | I/O L26N_0        | I/O L29N_0        | I/O L32N_0 GCLK7  |                  |
|        | C | TDI               | HSWAP_EN          | GND               | I/O               | I/O L06N_0        | I/O L08N_0       | VCCO_0            | I/O               | I/O L18N_0        | I/O L22P_0        | VCCO_0            | I/O               | I/O L31P_0 VREF_0 |                  |
|        | D | I/O L03N_7 VREF_7 | I/O L03P_7        | PROG_B            | GND               | I/O L01P_0 VRN_0  | I/O L07P_0       | I/O L09P_0        | I/O               | I/O L12P_0        | I/O L17P_0        | I/O L22N_0        | I/O L25P_0        | GND               | I/O L31N_0       |
|        | E | I/O L06N_7        | I/O L06P_7        | I/O L02N_7        | I/O L02P_7        | I/O L01N_0 VRP_0  | I/O L07N_0       | I/O L09N_0        | I/O               | I/O L12N_0        | I/O L17N_0        | I/O L19P_0        | I/O L25N_0        | I/O L28P_0        | I/O              |
|        | F | I/O L09N_7        | I/O L09P_7        | I/O L07N_7        | I/O L07P_7        | I/O L01N_7 VRP_7  | I/O L01P_7 VRN_7 | I/O VREF_0        | I/O               | I/O L11P_0        | I/O L16P_0        | I/O L19N_0        | I/O L24P_0        | I/O L28N_0        | I/O L30P_0       |
|        | G | I/O L14N_7        | I/O L14P_7        | VCCO_7            | I/O L08N_7        | I/O L08P_7        | I/O L05N_7       | I/O L05P_7        | I/O L11N_0        | I/O L16N_0        | I/O VREF_0        | I/O L24N_0        | I/O L27N_0        | I/O L30N_0        | I/O              |
|        | H | I/O L19N_7 VREF_7 | I/O L19P_7        | I/O L17N_7        | I/O L17P_7        | I/O L16P_7 VREF_7 | I/O L10N_7       | I/O L10P_7 VREF_7 | VCCINT            | VCCO_0            | VCCO_0            | I/O               | I/O               | I/O L27P_0        | I/O              |
|        | J | VCCAUX            | I/O L22N_7        | I/O L22P_7        | I/O L21N_7        | I/O L21P_7        | I/O L16N_7       | I/O L20P_7        | VCCO_7            | VCCINT            | VCCINT            | VCCO_0            | VCCO_0            | VCCO_0            | VCCO_0           |
|        | K | I/O L26N_7        | I/O L26P_7        | I/O L24N_7        | I/O L24P_7        | I/O L23N_7        | I/O L23P_7       | I/O L20N_7        | VCCO_7            | VCCINT            | VCCINT            | GND               | GND               | VCCO_0            | VCCO_0           |
|        | L | I/O L29N_7        | I/O L29P_7        | VCCO_7            | I/O L33P_7        | I/O L28N_7        | I/O L28P_7       | I/O L27N_7        | I/O L27P_7 VREF_7 | VCCO_7            | GND               | GND               | GND               | GND               | GND              |
|        | M | I/O L34N_7        | I/O L34P_7        | I/O L33N_7        | GND               | I/O L32P_7        | I/O L32N_7       | I/O L31N_7        | I/O L31P_7        | VCCO_7            | GND               | GND               | GND               | GND               | GND              |
|        | N | I/O L40N_7 VREF_7 | I/O L40P_7        | I/O L39N_7        | I/O L39P_7        | I/O L38N_7        | I/O L38P_7       | I/O L35N_7        | I/O L35P_7        | VCCO_7            | VCCO_7            | GND               | GND               | GND               | GND              |
| Bank 6 | P | I/O L40P_6 VREF_6 | I/O L40N_6        | I/O L39P_6        | I/O L39N_6        | I/O L38P_6        | I/O L38N_6       | I/O L35P_6        | I/O L35N_6        | VCCO_6            | VCCO_6            | GND               | GND               | GND               |                  |
|        | R | I/O L34P_6        | I/O L34N_6 VREF_6 | I/O L33P_6        | GND               | I/O L32P_6        | I/O L32N_6       | I/O L31P_6        | I/O L31N_6        | VCCO_6            | GND               | GND               | GND               | GND               |                  |
|        | T | I/O L29P_6        | I/O L29N_6        | VCCO_6            | I/O L33N_6        | I/O L28P_6        | I/O L28N_6       | I/O L27P_6        | I/O L27N_6        | VCCO_6            | GND               | GND               | GND               | GND               |                  |
|        | U | I/O L26P_6        | I/O L26N_6        | I/O L24P_6        | I/O L24N_6 VREF_6 | I/O L23P_6        | I/O L23N_6       | I/O L20P_6        | VCCO_6            | VCCINT            | VCCINT            | GND               | GND               | VCCO_5            | VCCO_5           |
|        | V | VCCAUX            | I/O L22P_6        | I/O L22N_6        | I/O L21P_6        | I/O L21N_6        | I/O L16N_6       | I/O L20N_6        | VCCO_6            | VCCINT            | VCCINT            | VCCO_5            | VCCO_5            | VCCO_5            | VCCO_5           |
|        | W | I/O L19P_6        | I/O L19N_6        | I/O L17P_6 VREF_6 | I/O L17N_6        | I/O L16P_6        | I/O L14P_6       | I/O L14N_6        | VCCINT            | VCCO_5            | VCCO_5            | I/O L24P_5        | I/O L27P_5        | I/O L30P_5        | I/O              |
|        | Y | I/O L10P_6        | I/O L10N_6        | VCCO_6            | I/O L08P_6        | I/O L08N_6        | I/O L06P_6       | I/O L06N_6        | I/O               | I/O L16P_5        | I/O L19P_5 VREF_5 | I/O L24N_5        | I/O L27N_5 VREF_5 | I/O L30N_5        | I/O              |
|        | A | I/O L09P_6        | I/O L09N_6 VREF_6 | I/O L07P_6        | I/O L07N_6        | I/O               | I/O L05P_5       | I/O               | I/O L11P_5        | I/O L16N_5        | I/O L19N_5        | I/O L25P_5        | I/O L28P_5 D7     | I/O               | I/O              |
|        | A | I/O L05P_6        | I/O L05N_6        | I/O L02P_6        | I/O L02N_6        | I/O L01P_5 CS_B   | I/O L05N_5       | I/O L09P_5        | I/O               | I/O L11N_5 VREF_5 | I/O               | I/O L22P_5        | I/O L25N_5        | I/O L28N_5 D6     | I/O L31P_5 D5    |
|        | A | I/O L03P_6        | I/O L03N_6 VREF_6 | M1                | GND               | I/O L01N_5 RDWR_B | I/O L07P_5       | I/O L09N_5        | I/O L12P_5        | I/O               | I/O L22N_5        | I/O               | GND               | I/O L31N_5 D4     | I/O              |
|        | A | I/O L01P_6 VRN_6  | I/O L01N_6 VRP_6  | GND               | I/O L04P_5        | I/O L06P_5        | I/O L07N_5       | VCCO_5            | I/O L12N_5        | I/O L18P_5        | I/O               | VCCO_5            | I/O               | I/O L32P_5 GCLK2  | I/O              |
|        | A | VCCAUX            | GND               | M0                | I/O L04N_5        | I/O L06N_5        | I/O L08P_5       | I/O L10P_5 VRN_5  | I/O L15P_5        | I/O L18N_5        | I/O L23P_5        | I/O               | I/O L26P_5        | I/O L29P_5 VREF_5 | I/O L32N_5 GCLK3 |
|        | A | GND               | VCCAUX            | M2                | I/O               | I/O VREF_5        | I/O L08N_5       | I/O L10N_5 VRP_5  | I/O L15N_5        | VCCAUX            | I/O L23N_5        | I/O L26N_5        | I/O L29N_5        | I/O VREF_5        | I/O              |

Figure 53: FG676 Package Footprint (Top View)



## FG900: 900-lead Fine-pitch Ball Grid Array

The 900-lead fine-pitch ball grid array package, FG900, supports three different Spartan-3 devices, including the XC3S2000, the XC3S4000, and the XC3S5000. The footprints for the XC3S4000 and XC3S5000 are identical, as shown in [Table 107](#) and [Figure 55](#). The XC3S2000, however, has fewer I/O pins which consequently results in 68 unconnected pins on the FG900 package, labeled as “N.C.” In [Table 107](#) and [Figure 55](#), these unconnected pins are indicated with a black diamond symbol (◆).

All the package pins appear in [Table 107](#) and are sorted by bank number, 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.

If there is a difference between the XC3S2000 pinout and the pinout for the XC3S4000 and XC3S5000, then that difference is highlighted in [Table 107](#). If the table entry is shaded, then there is an unconnected pin on the XC3S2000 that maps to a user-I/O pin on the XC3S4000 and XC3S5000.

An electronic version of this package pinout table and footprint diagram is available for download from the Xilinx website at [http://www.xilinx.com/support/documentation/data\\_sheets/s3\\_pin.zip](http://www.xilinx.com/support/documentation/data_sheets/s3_pin.zip).

### Pinout Table

Table 107: FG900 Package Pinout

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 0    | IO                | IO                          | E15              | I/O  |
| 0    | IO                | IO                          | K15              | I/O  |
| 0    | IO                | IO                          | D13              | I/O  |
| 0    | IO                | IO                          | K13              | I/O  |
| 0    | IO                | IO                          | G8               | I/O  |
| 0    | IO/VREF_0         | IO/VREF_0                   | F9               | VREF |
| 0    | IO/VREF_0         | IO/VREF_0                   | C4               | VREF |
| 0    | IO_L01N_0/VRP_0   | IO_L01N_0/VRP_0             | B4               | DCI  |
| 0    | IO_L01P_0/VRN_0   | IO_L01P_0/VRN_0             | A4               | DCI  |
| 0    | IO_L02N_0         | IO_L02N_0                   | B5               | I/O  |
| 0    | IO_L02P_0         | IO_L02P_0                   | A5               | I/O  |
| 0    | IO_L03N_0         | IO_L03N_0                   | D5               | I/O  |
| 0    | IO_L03P_0         | IO_L03P_0                   | E6               | I/O  |
| 0    | IO_L04N_0         | IO_L04N_0                   | C6               | I/O  |
| 0    | IO_L04P_0         | IO_L04P_0                   | B6               | I/O  |
| 0    | IO_L05N_0         | IO_L05N_0                   | F6               | I/O  |
| 0    | IO_L05P_0/VREF_0  | IO_L05P_0/VREF_0            | F7               | VREF |
| 0    | IO_L06N_0         | IO_L06N_0                   | D7               | I/O  |
| 0    | IO_L06P_0         | IO_L06P_0                   | C7               | I/O  |
| 0    | IO_L07N_0         | IO_L07N_0                   | F8               | I/O  |
| 0    | IO_L07P_0         | IO_L07P_0                   | E8               | I/O  |
| 0    | IO_L08N_0         | IO_L08N_0                   | D8               | I/O  |
| 0    | IO_L08P_0         | IO_L08P_0                   | C8               | I/O  |
| 0    | IO_L09N_0         | IO_L09N_0                   | B8               | I/O  |
| 0    | IO_L09P_0         | IO_L09P_0                   | A8               | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 0    | IO_L10N_0         | IO_L10N_0                   | J9               | I/O  |
| 0    | IO_L10P_0         | IO_L10P_0                   | H9               | I/O  |
| 0    | IO_L11N_0         | IO_L11N_0                   | G10              | I/O  |
| 0    | IO_L11P_0         | IO_L11P_0                   | F10              | I/O  |
| 0    | IO_L12N_0         | IO_L12N_0                   | C10              | I/O  |
| 0    | IO_L12P_0         | IO_L12P_0                   | B10              | I/O  |
| 0    | IO_L13N_0         | IO_L13N_0                   | J10              | I/O  |
| 0    | IO_L13P_0         | IO_L13P_0                   | K11              | I/O  |
| 0    | IO_L14N_0         | IO_L14N_0                   | H11              | I/O  |
| 0    | IO_L14P_0         | IO_L14P_0                   | G11              | I/O  |
| 0    | IO_L15N_0         | IO_L15N_0                   | F11              | I/O  |
| 0    | IO_L15P_0         | IO_L15P_0                   | E11              | I/O  |
| 0    | IO_L16N_0         | IO_L16N_0                   | D11              | I/O  |
| 0    | IO_L16P_0         | IO_L16P_0                   | C11              | I/O  |
| 0    | IO_L17N_0         | IO_L17N_0                   | B11              | I/O  |
| 0    | IO_L17P_0         | IO_L17P_0                   | A11              | I/O  |
| 0    | IO_L18N_0         | IO_L18N_0                   | K12              | I/O  |
| 0    | IO_L18P_0         | IO_L18P_0                   | J12              | I/O  |
| 0    | IO_L19N_0         | IO_L19N_0                   | H12              | I/O  |
| 0    | IO_L19P_0         | IO_L19P_0                   | G12              | I/O  |
| 0    | IO_L20N_0         | IO_L20N_0                   | F12              | I/O  |
| 0    | IO_L20P_0         | IO_L20P_0                   | E12              | I/O  |
| 0    | IO_L21N_0         | IO_L21N_0                   | D12              | I/O  |
| 0    | IO_L21P_0         | IO_L21P_0                   | C12              | I/O  |
| 0    | IO_L22N_0         | IO_L22N_0                   | B12              | I/O  |
| 0    | IO_L22P_0         | IO_L22P_0                   | A12              | I/O  |
| 0    | IO_L23N_0         | IO_L23N_0                   | J13              | I/O  |
| 0    | IO_L23P_0         | IO_L23P_0                   | H13              | I/O  |
| 0    | IO_L24N_0         | IO_L24N_0                   | F13              | I/O  |
| 0    | IO_L24P_0         | IO_L24P_0                   | E13              | I/O  |
| 0    | IO_L25N_0         | IO_L25N_0                   | B13              | I/O  |
| 0    | IO_L25P_0         | IO_L25P_0                   | A13              | I/O  |
| 0    | IO_L26N_0         | IO_L26N_0                   | K14              | I/O  |
| 0    | IO_L26P_0/VREF_0  | IO_L26P_0/VREF_0            | J14              | VREF |
| 0    | IO_L27N_0         | IO_L27N_0                   | G14              | I/O  |
| 0    | IO_L27P_0         | IO_L27P_0                   | F14              | I/O  |
| 0    | IO_L28N_0         | IO_L28N_0                   | C14              | I/O  |
| 0    | IO_L28P_0         | IO_L28P_0                   | B14              | I/O  |
| 0    | IO_L29N_0         | IO_L29N_0                   | J15              | I/O  |
| 0    | IO_L29P_0         | IO_L29P_0                   | H15              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 0    | IO_L30N_0         | IO_L30N_0                   | G15              | I/O  |
| 0    | IO_L30P_0         | IO_L30P_0                   | F15              | I/O  |
| 0    | IO_L31N_0         | IO_L31N_0                   | D15              | I/O  |
| 0    | IO_L31P_0/VREF_0  | IO_L31P_0/VREF_0            | C15              | VREF |
| 0    | IO_L32N_0/GCLK7   | IO_L32N_0/GCLK7             | B15              | GCLK |
| 0    | IO_L32P_0/GCLK6   | IO_L32P_0/GCLK6             | A15              | GCLK |
| 0    | N.C. (◆)          | IO_L35N_0                   | B7               | I/O  |
| 0    | N.C. (◆)          | IO_L35P_0                   | A7               | I/O  |
| 0    | N.C. (◆)          | IO_L36N_0                   | G7               | I/O  |
| 0    | N.C. (◆)          | IO_L36P_0                   | H8               | I/O  |
| 0    | N.C. (◆)          | IO_L37N_0                   | E9               | I/O  |
| 0    | N.C. (◆)          | IO_L37P_0                   | D9               | I/O  |
| 0    | N.C. (◆)          | IO_L38N_0                   | B9               | I/O  |
| 0    | N.C. (◆)          | IO_L38P_0                   | A9               | I/O  |
| 0    | VCCO_0            | VCCO_0                      | C5               | VCCO |
| 0    | VCCO_0            | VCCO_0                      | E7               | VCCO |
| 0    | VCCO_0            | VCCO_0                      | C9               | VCCO |
| 0    | VCCO_0            | VCCO_0                      | G9               | VCCO |
| 0    | VCCO_0            | VCCO_0                      | J11              | VCCO |
| 0    | VCCO_0            | VCCO_0                      | L12              | VCCO |
| 0    | VCCO_0            | VCCO_0                      | C13              | VCCO |
| 0    | VCCO_0            | VCCO_0                      | G13              | VCCO |
| 0    | VCCO_0            | VCCO_0                      | L13              | VCCO |
| 0    | VCCO_0            | VCCO_0                      | L14              | VCCO |
| 1    | IO                | IO                          | E25              | I/O  |
| 1    | IO                | IO                          | J21              | I/O  |
| 1    | IO                | IO                          | K20              | I/O  |
| 1    | IO                | IO                          | F18              | I/O  |
| 1    | IO                | IO                          | F16              | I/O  |
| 1    | IO                | IO                          | A16              | I/O  |
| 1    | IO/VREF_1         | IO/VREF_1                   | J17              | VREF |
| 1    | IO_L01N_1/VRP_1   | IO_L01N_1/VRP_1             | A27              | DCI  |
| 1    | IO_L01P_1/VRN_1   | IO_L01P_1/VRN_1             | B27              | DCI  |
| 1    | IO_L02N_1         | IO_L02N_1                   | D26              | I/O  |
| 1    | IO_L02P_1         | IO_L02P_1                   | C27              | I/O  |
| 1    | IO_L03N_1         | IO_L03N_1                   | A26              | I/O  |
| 1    | IO_L03P_1         | IO_L03P_1                   | B26              | I/O  |
| 1    | IO_L04N_1         | IO_L04N_1                   | B25              | I/O  |
| 1    | IO_L04P_1         | IO_L04P_1                   | C25              | I/O  |
| 1    | IO_L05N_1         | IO_L05N_1                   | F24              | I/O  |



Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 1    | IO_L05P_1         | IO_L05P_1                   | F25              | I/O  |
| 1    | IO_L06N_1/VREF_1  | IO_L06N_1/VREF_1            | C24              | VREF |
| 1    | IO_L06P_1         | IO_L06P_1                   | D24              | I/O  |
| 1    | IO_L07N_1         | IO_L07N_1                   | A24              | I/O  |
| 1    | IO_L07P_1         | IO_L07P_1                   | B24              | I/O  |
| 1    | IO_L08N_1         | IO_L08N_1                   | H23              | I/O  |
| 1    | IO_L08P_1         | IO_L08P_1                   | G24              | I/O  |
| 1    | IO_L09N_1         | IO_L09N_1                   | F23              | I/O  |
| 1    | IO_L09P_1         | IO_L09P_1                   | G23              | I/O  |
| 1    | IO_L10N_1/VREF_1  | IO_L10N_1/VREF_1            | C23              | VREF |
| 1    | IO_L10P_1         | IO_L10P_1                   | D23              | I/O  |
| 1    | IO_L11N_1         | IO_L11N_1                   | A23              | I/O  |
| 1    | IO_L11P_1         | IO_L11P_1                   | B23              | I/O  |
| 1    | IO_L12N_1         | IO_L12N_1                   | H22              | I/O  |
| 1    | IO_L12P_1         | IO_L12P_1                   | J22              | I/O  |
| 1    | IO_L13N_1         | IO_L13N_1                   | F22              | I/O  |
| 1    | IO_L13P_1         | IO_L13P_1                   | E23              | I/O  |
| 1    | IO_L14N_1         | IO_L14N_1                   | D22              | I/O  |
| 1    | IO_L14P_1         | IO_L14P_1                   | E22              | I/O  |
| 1    | IO_L15N_1         | IO_L15N_1                   | A22              | I/O  |
| 1    | IO_L15P_1         | IO_L15P_1                   | B22              | I/O  |
| 1    | IO_L16N_1         | IO_L16N_1                   | F21              | I/O  |
| 1    | IO_L16P_1         | IO_L16P_1                   | G21              | I/O  |
| 1    | IO_L17N_1/VREF_1  | IO_L17N_1/VREF_1            | B21              | VREF |
| 1    | IO_L17P_1         | IO_L17P_1                   | C21              | I/O  |
| 1    | IO_L18N_1         | IO_L18N_1                   | G20              | I/O  |
| 1    | IO_L18P_1         | IO_L18P_1                   | H20              | I/O  |
| 1    | IO_L19N_1         | IO_L19N_1                   | E20              | I/O  |
| 1    | IO_L19P_1         | IO_L19P_1                   | F20              | I/O  |
| 1    | IO_L20N_1         | IO_L20N_1                   | C20              | I/O  |
| 1    | IO_L20P_1         | IO_L20P_1                   | D20              | I/O  |
| 1    | IO_L21N_1         | IO_L21N_1                   | A20              | I/O  |
| 1    | IO_L21P_1         | IO_L21P_1                   | B20              | I/O  |
| 1    | IO_L22N_1         | IO_L22N_1                   | J19              | I/O  |
| 1    | IO_L22P_1         | IO_L22P_1                   | K19              | I/O  |
| 1    | IO_L23N_1         | IO_L23N_1                   | G19              | I/O  |
| 1    | IO_L23P_1         | IO_L23P_1                   | H19              | I/O  |
| 1    | IO_L24N_1         | IO_L24N_1                   | E19              | I/O  |
| 1    | IO_L24P_1         | IO_L24P_1                   | F19              | I/O  |
| 1    | IO_L25N_1         | IO_L25N_1                   | C19              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 1    | IO_L25P_1         | IO_L25P_1                   | D19              | I/O  |
| 1    | IO_L26N_1         | IO_L26N_1                   | A19              | I/O  |
| 1    | IO_L26P_1         | IO_L26P_1                   | B19              | I/O  |
| 1    | IO_L27N_1         | IO_L27N_1                   | F17              | I/O  |
| 1    | IO_L27P_1         | IO_L27P_1                   | G17              | I/O  |
| 1    | IO_L28N_1         | IO_L28N_1                   | B17              | I/O  |
| 1    | IO_L28P_1         | IO_L28P_1                   | C17              | I/O  |
| 1    | IO_L29N_1         | IO_L29N_1                   | J16              | I/O  |
| 1    | IO_L29P_1         | IO_L29P_1                   | K16              | I/O  |
| 1    | IO_L30N_1         | IO_L30N_1                   | G16              | I/O  |
| 1    | IO_L30P_1         | IO_L30P_1                   | H16              | I/O  |
| 1    | IO_L31N_1/VREF_1  | IO_L31N_1/VREF_1            | D16              | VREF |
| 1    | IO_L31P_1         | IO_L31P_1                   | E16              | I/O  |
| 1    | IO_L32N_1/GCLK5   | IO_L32N_1/GCLK5             | B16              | GCLK |
| 1    | IO_L32P_1/GCLK4   | IO_L32P_1/GCLK4             | C16              | GCLK |
| 1    | N.C. (◆)          | IO_L37N_1                   | H18              | I/O  |
| 1    | N.C. (◆)          | IO_L37P_1                   | J18              | I/O  |
| 1    | N.C. (◆)          | IO_L38N_1                   | D18              | I/O  |
| 1    | N.C. (◆)          | IO_L38P_1                   | E18              | I/O  |
| 1    | N.C. (◆)          | IO_L39N_1                   | A18              | I/O  |
| 1    | N.C. (◆)          | IO_L39P_1                   | B18              | I/O  |
| 1    | N.C. (◆)          | IO_L40N_1                   | K17              | I/O  |
| 1    | N.C. (◆)          | IO_L40P_1                   | K18              | I/O  |
| 1    | VCCO_1            | VCCO_1                      | L17              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | C18              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | G18              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | L18              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | L19              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | J20              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | C22              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | G22              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | E24              | VCCO |
| 1    | VCCO_1            | VCCO_1                      | C26              | VCCO |
| 2    | IO                | IO                          | J25              | I/O  |
| 2    | IO_L01N_2/VRP_2   | IO_L01N_2/VRP_2             | C29              | DCI  |
| 2    | IO_L01P_2/VRN_2   | IO_L01P_2/VRN_2             | C30              | DCI  |
| 2    | IO_L02N_2         | IO_L02N_2                   | D27              | I/O  |
| 2    | IO_L02P_2         | IO_L02P_2                   | D28              | I/O  |
| 2    | IO_L03N_2/VREF_2  | IO_L03N_2/VREF_2            | D29              | VREF |
| 2    | IO_L03P_2         | IO_L03P_2                   | D30              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 2    | IO_L04N_2         | IO_L04N_2                   | E29              | I/O  |
| 2    | IO_L04P_2         | IO_L04P_2                   | E30              | I/O  |
| 2    | IO_L05N_2         | IO_L05N_2                   | F28              | I/O  |
| 2    | IO_L05P_2         | IO_L05P_2                   | F29              | I/O  |
| 2    | IO_L06N_2         | IO_L06N_2                   | G27              | I/O  |
| 2    | IO_L06P_2         | IO_L06P_2                   | G28              | I/O  |
| 2    | IO_L07N_2         | IO_L07N_2                   | G29              | I/O  |
| 2    | IO_L07P_2         | IO_L07P_2                   | G30              | I/O  |
| 2    | IO_L08N_2         | IO_L08N_2                   | G25              | I/O  |
| 2    | IO_L08P_2         | IO_L08P_2                   | H24              | I/O  |
| 2    | IO_L09N_2/VREF_2  | IO_L09N_2/VREF_2            | H25              | VREF |
| 2    | IO_L09P_2         | IO_L09P_2                   | H26              | I/O  |
| 2    | IO_L10N_2         | IO_L10N_2                   | H27              | I/O  |
| 2    | IO_L10P_2         | IO_L10P_2                   | H28              | I/O  |
| 2    | IO_L12N_2         | IO_L12N_2                   | H29              | I/O  |
| 2    | IO_L12P_2         | IO_L12P_2                   | H30              | I/O  |
| 2    | IO_L13N_2         | IO_L13N_2                   | J26              | I/O  |
| 2    | IO_L13P_2/VREF_2  | IO_L13P_2/VREF_2            | J27              | VREF |
| 2    | IO_L14N_2         | IO_L14N_2                   | J29              | I/O  |
| 2    | IO_L14P_2         | IO_L14P_2                   | J30              | I/O  |
| 2    | IO_L15N_2         | IO_L15N_2                   | J23              | I/O  |
| 2    | IO_L15P_2         | IO_L15P_2                   | K22              | I/O  |
| 2    | IO_L16N_2         | IO_L16N_2                   | K24              | I/O  |
| 2    | IO_L16P_2         | IO_L16P_2                   | K25              | I/O  |
| 2    | IO_L19N_2         | IO_L19N_2                   | L25              | I/O  |
| 2    | IO_L19P_2         | IO_L19P_2                   | L26              | I/O  |
| 2    | IO_L20N_2         | IO_L20N_2                   | L27              | I/O  |
| 2    | IO_L20P_2         | IO_L20P_2                   | L28              | I/O  |
| 2    | IO_L21N_2         | IO_L21N_2                   | L29              | I/O  |
| 2    | IO_L21P_2         | IO_L21P_2                   | L30              | I/O  |
| 2    | IO_L22N_2         | IO_L22N_2                   | M22              | I/O  |
| 2    | IO_L22P_2         | IO_L22P_2                   | M23              | I/O  |
| 2    | IO_L23N_2/VREF_2  | IO_L23N_2/VREF_2            | M24              | VREF |
| 2    | IO_L23P_2         | IO_L23P_2                   | M25              | I/O  |
| 2    | IO_L24N_2         | IO_L24N_2                   | M27              | I/O  |
| 2    | IO_L24P_2         | IO_L24P_2                   | M28              | I/O  |
| 2    | IO_L26N_2         | IO_L26N_2                   | M21              | I/O  |
| 2    | IO_L26P_2         | IO_L26P_2                   | N21              | I/O  |
| 2    | IO_L27N_2         | IO_L27N_2                   | N22              | I/O  |
| 2    | IO_L27P_2         | IO_L27P_2                   | N23              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 2    | IO_L28N_2         | IO_L28N_2                   | M26              | I/O  |
| 2    | IO_L28P_2         | IO_L28P_2                   | N25              | I/O  |
| 2    | IO_L29N_2         | IO_L29N_2                   | N26              | I/O  |
| 2    | IO_L29P_2         | IO_L29P_2                   | N27              | I/O  |
| 2    | IO_L31N_2         | IO_L31N_2                   | N29              | I/O  |
| 2    | IO_L31P_2         | IO_L31P_2                   | N30              | I/O  |
| 2    | IO_L32N_2         | IO_L32N_2                   | P21              | I/O  |
| 2    | IO_L32P_2         | IO_L32P_2                   | P22              | I/O  |
| 2    | IO_L33N_2         | IO_L33N_2                   | P24              | I/O  |
| 2    | IO_L33P_2         | IO_L33P_2                   | P25              | I/O  |
| 2    | IO_L34N_2/VREF_2  | IO_L34N_2/VREF_2            | P28              | VREF |
| 2    | IO_L34P_2         | IO_L34P_2                   | P29              | I/O  |
| 2    | IO_L35N_2         | IO_L35N_2                   | R21              | I/O  |
| 2    | IO_L35P_2         | IO_L35P_2                   | R22              | I/O  |
| 2    | IO_L37N_2         | IO_L37N_2                   | R23              | I/O  |
| 2    | IO_L37P_2         | IO_L37P_2                   | R24              | I/O  |
| 2    | IO_L38N_2         | IO_L38N_2                   | R25              | I/O  |
| 2    | IO_L38P_2         | IO_L38P_2                   | R26              | I/O  |
| 2    | IO_L39N_2         | IO_L39N_2                   | R27              | I/O  |
| 2    | IO_L39P_2         | IO_L39P_2                   | R28              | I/O  |
| 2    | IO_L40N_2         | IO_L40N_2                   | R29              | I/O  |
| 2    | IO_L40P_2/VREF_2  | IO_L40P_2/VREF_2            | R30              | VREF |
| 2    | N.C. (◆)          | IO_L41N_2                   | E27              | I/O  |
| 2    | N.C. (◆)          | IO_L41P_2                   | F26              | I/O  |
| 2    | N.C. (◆)          | IO_L45N_2                   | K28              | I/O  |
| 2    | N.C. (◆)          | IO_L45P_2                   | K29              | I/O  |
| 2    | N.C. (◆)          | IO_L46N_2                   | K21              | I/O  |
| 2    | N.C. (◆)          | IO_L46P_2                   | L21              | I/O  |
| 2    | N.C. (◆)          | IO_L47N_2                   | L23              | I/O  |
| 2    | N.C. (◆)          | IO_L47P_2                   | L24              | I/O  |
| 2    | N.C. (◆)          | IO_L50N_2                   | M29              | I/O  |
| 2    | N.C. (◆)          | IO_L50P_2                   | M30              | I/O  |
| 2    | VCCO_2            | VCCO_2                      | M20              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | N20              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | P20              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | L22              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | J24              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | N24              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | G26              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | E28              | VCCO |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 2    | VCCO_2            | VCCO_2                      | J28              | VCCO |
| 2    | VCCO_2            | VCCO_2                      | N28              | VCCO |
| 3    | IO                | IO                          | AB25             | I/O  |
| 3    | IO_L01N_3/VRP_3   | IO_L01N_3/VRP_3             | AH30             | DCI  |
| 3    | IO_L01P_3/VRN_3   | IO_L01P_3/VRN_3             | AH29             | DCI  |
| 3    | IO_L02N_3/VREF_3  | IO_L02N_3/VREF_3            | AG28             | VREF |
| 3    | IO_L02P_3         | IO_L02P_3                   | AG27             | I/O  |
| 3    | IO_L03N_3         | IO_L03N_3                   | AG30             | I/O  |
| 3    | IO_L03P_3         | IO_L03P_3                   | AG29             | I/O  |
| 3    | IO_L04N_3         | IO_L04N_3                   | AF30             | I/O  |
| 3    | IO_L04P_3         | IO_L04P_3                   | AF29             | I/O  |
| 3    | IO_L05N_3         | IO_L05N_3                   | AE26             | I/O  |
| 3    | IO_L05P_3         | IO_L05P_3                   | AF27             | I/O  |
| 3    | IO_L06N_3         | IO_L06N_3                   | AE29             | I/O  |
| 3    | IO_L06P_3         | IO_L06P_3                   | AE28             | I/O  |
| 3    | IO_L07N_3         | IO_L07N_3                   | AD28             | I/O  |
| 3    | IO_L07P_3         | IO_L07P_3                   | AD27             | I/O  |
| 3    | IO_L08N_3         | IO_L08N_3                   | AD30             | I/O  |
| 3    | IO_L08P_3         | IO_L08P_3                   | AD29             | I/O  |
| 3    | IO_L09N_3         | IO_L09N_3                   | AC24             | I/O  |
| 3    | IO_L09P_3/VREF_3  | IO_L09P_3/VREF_3            | AD25             | VREF |
| 3    | IO_L10N_3         | IO_L10N_3                   | AC26             | I/O  |
| 3    | IO_L10P_3         | IO_L10P_3                   | AC25             | I/O  |
| 3    | IO_L11N_3         | IO_L11N_3                   | AC28             | I/O  |
| 3    | IO_L11P_3         | IO_L11P_3                   | AC27             | I/O  |
| 3    | IO_L13N_3/VREF_3  | IO_L13N_3/VREF_3            | AC30             | VREF |
| 3    | IO_L13P_3         | IO_L13P_3                   | AC29             | I/O  |
| 3    | IO_L14N_3         | IO_L14N_3                   | AB27             | I/O  |
| 3    | IO_L14P_3         | IO_L14P_3                   | AB26             | I/O  |
| 3    | IO_L15N_3         | IO_L15N_3                   | AB30             | I/O  |
| 3    | IO_L15P_3         | IO_L15P_3                   | AB29             | I/O  |
| 3    | IO_L16N_3         | IO_L16N_3                   | AA22             | I/O  |
| 3    | IO_L16P_3         | IO_L16P_3                   | AB23             | I/O  |
| 3    | IO_L17N_3         | IO_L17N_3                   | AA25             | I/O  |
| 3    | IO_L17P_3/VREF_3  | IO_L17P_3/VREF_3            | AA24             | VREF |
| 3    | IO_L19N_3         | IO_L19N_3                   | AA29             | I/O  |
| 3    | IO_L19P_3         | IO_L19P_3                   | AA28             | I/O  |
| 3    | IO_L20N_3         | IO_L20N_3                   | Y21              | I/O  |
| 3    | IO_L20P_3         | IO_L20P_3                   | AA21             | I/O  |
| 3    | IO_L21N_3         | IO_L21N_3                   | Y24              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 3    | IO_L21P_3         | IO_L21P_3                   | Y23              | I/O  |
| 3    | IO_L22N_3         | IO_L22N_3                   | Y26              | I/O  |
| 3    | IO_L22P_3         | IO_L22P_3                   | Y25              | I/O  |
| 3    | IO_L23N_3         | IO_L23N_3                   | Y28              | I/O  |
| 3    | IO_L23P_3/VREF_3  | IO_L23P_3/VREF_3            | Y27              | VREF |
| 3    | IO_L24N_3         | IO_L24N_3                   | Y30              | I/O  |
| 3    | IO_L24P_3         | IO_L24P_3                   | Y29              | I/O  |
| 3    | IO_L26N_3         | IO_L26N_3                   | W30              | I/O  |
| 3    | IO_L26P_3         | IO_L26P_3                   | W29              | I/O  |
| 3    | IO_L27N_3         | IO_L27N_3                   | V21              | I/O  |
| 3    | IO_L27P_3         | IO_L27P_3                   | W21              | I/O  |
| 3    | IO_L28N_3         | IO_L28N_3                   | V23              | I/O  |
| 3    | IO_L28P_3         | IO_L28P_3                   | V22              | I/O  |
| 3    | IO_L29N_3         | IO_L29N_3                   | V25              | I/O  |
| 3    | IO_L29P_3         | IO_L29P_3                   | W26              | I/O  |
| 3    | IO_L31N_3         | IO_L31N_3                   | V30              | I/O  |
| 3    | IO_L31P_3         | IO_L31P_3                   | V29              | I/O  |
| 3    | IO_L32N_3         | IO_L32N_3                   | U22              | I/O  |
| 3    | IO_L32P_3         | IO_L32P_3                   | U21              | I/O  |
| 3    | IO_L33N_3         | IO_L33N_3                   | U25              | I/O  |
| 3    | IO_L33P_3         | IO_L33P_3                   | U24              | I/O  |
| 3    | IO_L34N_3         | IO_L34N_3                   | U29              | I/O  |
| 3    | IO_L34P_3/VREF_3  | IO_L34P_3/VREF_3            | U28              | VREF |
| 3    | IO_L35N_3         | IO_L35N_3                   | T22              | I/O  |
| 3    | IO_L35P_3         | IO_L35P_3                   | T21              | I/O  |
| 3    | IO_L37N_3         | IO_L37N_3                   | T24              | I/O  |
| 3    | IO_L37P_3         | IO_L37P_3                   | T23              | I/O  |
| 3    | IO_L38N_3         | IO_L38N_3                   | T26              | I/O  |
| 3    | IO_L38P_3         | IO_L38P_3                   | T25              | I/O  |
| 3    | IO_L39N_3         | IO_L39N_3                   | T28              | I/O  |
| 3    | IO_L39P_3         | IO_L39P_3                   | T27              | I/O  |
| 3    | IO_L40N_3/VREF_3  | IO_L40N_3/VREF_3            | T30              | VREF |
| 3    | IO_L40P_3         | IO_L40P_3                   | T29              | I/O  |
| 3    | N.C. (◆)          | IO_L46N_3                   | W23              | I/O  |
| 3    | N.C. (◆)          | IO_L46P_3                   | W22              | I/O  |
| 3    | N.C. (◆)          | IO_L47N_3                   | W25              | I/O  |
| 3    | N.C. (◆)          | IO_L47P_3                   | W24              | I/O  |
| 3    | N.C. (◆)          | IO_L48N_3                   | W28              | I/O  |
| 3    | N.C. (◆)          | IO_L48P_3                   | W27              | I/O  |
| 3    | N.C. (◆)          | IO_L50N_3                   | V27              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 3    | N.C. (◆)          | IO_L50P_3                   | V26              | I/O  |
| 3    | VCCO_3            | VCCO_3                      | U20              | VCCO |
| 3    | VCCO_3            | VCCO_3                      | V20              | VCCO |
| 3    | VCCO_3            | VCCO_3                      | W20              | VCCO |
| 3    | VCCO_3            | VCCO_3                      | Y22              | VCCO |
| 3    | VCCO_3            | VCCO_3                      | V24              | VCCO |
| 3    | VCCO_3            | VCCO_3                      | AB24             | VCCO |
| 3    | VCCO_3            | VCCO_3                      | AD26             | VCCO |
| 3    | VCCO_3            | VCCO_3                      | V28              | VCCO |
| 3    | VCCO_3            | VCCO_3                      | AB28             | VCCO |
| 3    | VCCO_3            | VCCO_3                      | AF28             | VCCO |
| 4    | IO                | IO                          | AA16             | I/O  |
| 4    | IO                | IO                          | AG18             | I/O  |
| 4    | IO                | IO                          | AA18             | I/O  |
| 4    | IO                | IO                          | AE22             | I/O  |
| 4    | IO                | IO                          | AD23             | I/O  |
| 4    | IO                | IO                          | AH27             | I/O  |
| 4    | IO/VREF_4         | IO/VREF_4                   | AF16             | VREF |
| 4    | IO/VREF_4         | IO/VREF_4                   | AK28             | VREF |
| 4    | IO_L01N_4/VRP_4   | IO_L01N_4/VRP_4             | AJ27             | DCI  |
| 4    | IO_L01P_4/VRN_4   | IO_L01P_4/VRN_4             | AK27             | DCI  |
| 4    | IO_L02N_4         | IO_L02N_4                   | AJ26             | I/O  |
| 4    | IO_L02P_4         | IO_L02P_4                   | AK26             | I/O  |
| 4    | IO_L03N_4         | IO_L03N_4                   | AG26             | I/O  |
| 4    | IO_L03P_4         | IO_L03P_4                   | AF25             | I/O  |
| 4    | IO_L04N_4         | IO_L04N_4                   | AD24             | I/O  |
| 4    | IO_L04P_4         | IO_L04P_4                   | AC23             | I/O  |
| 4    | IO_L05N_4         | IO_L05N_4                   | AE23             | I/O  |
| 4    | IO_L05P_4         | IO_L05P_4                   | AF23             | I/O  |
| 4    | IO_L06N_4/VREF_4  | IO_L06N_4/VREF_4            | AG23             | VREF |
| 4    | IO_L06P_4         | IO_L06P_4                   | AH23             | I/O  |
| 4    | IO_L07N_4         | IO_L07N_4                   | AJ23             | I/O  |
| 4    | IO_L07P_4         | IO_L07P_4                   | AK23             | I/O  |
| 4    | IO_L08N_4         | IO_L08N_4                   | AB22             | I/O  |
| 4    | IO_L08P_4         | IO_L08P_4                   | AC22             | I/O  |
| 4    | IO_L09N_4         | IO_L09N_4                   | AF22             | I/O  |
| 4    | IO_L09P_4         | IO_L09P_4                   | AG22             | I/O  |
| 4    | IO_L10N_4         | IO_L10N_4                   | AJ22             | I/O  |
| 4    | IO_L10P_4         | IO_L10P_4                   | AK22             | I/O  |
| 4    | IO_L11N_4         | IO_L11N_4                   | AD21             | I/O  |

**Table 107: FG900 Package Pinout (Cont'd)**

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 4    | IO_L11P_4         | IO_L11P_4                   | AE21             | I/O  |
| 4    | IO_L12N_4         | IO_L12N_4                   | AH21             | I/O  |
| 4    | IO_L12P_4         | IO_L12P_4                   | AJ21             | I/O  |
| 4    | IO_L13N_4         | IO_L13N_4                   | AB21             | I/O  |
| 4    | IO_L13P_4         | IO_L13P_4                   | AA20             | I/O  |
| 4    | IO_L14N_4         | IO_L14N_4                   | AC20             | I/O  |
| 4    | IO_L14P_4         | IO_L14P_4                   | AD20             | I/O  |
| 4    | IO_L15N_4         | IO_L15N_4                   | AE20             | I/O  |
| 4    | IO_L15P_4         | IO_L15P_4                   | AF20             | I/O  |
| 4    | IO_L16N_4         | IO_L16N_4                   | AG20             | I/O  |
| 4    | IO_L16P_4         | IO_L16P_4                   | AH20             | I/O  |
| 4    | IO_L17N_4         | IO_L17N_4                   | AJ20             | I/O  |
| 4    | IO_L17P_4         | IO_L17P_4                   | AK20             | I/O  |
| 4    | IO_L18N_4         | IO_L18N_4                   | AA19             | I/O  |
| 4    | IO_L18P_4         | IO_L18P_4                   | AB19             | I/O  |
| 4    | IO_L19N_4         | IO_L19N_4                   | AC19             | I/O  |
| 4    | IO_L19P_4         | IO_L19P_4                   | AD19             | I/O  |
| 4    | IO_L20N_4         | IO_L20N_4                   | AE19             | I/O  |
| 4    | IO_L20P_4         | IO_L20P_4                   | AF19             | I/O  |
| 4    | IO_L21N_4         | IO_L21N_4                   | AG19             | I/O  |
| 4    | IO_L21P_4         | IO_L21P_4                   | AH19             | I/O  |
| 4    | IO_L22N_4/VREF_4  | IO_L22N_4/VREF_4            | AJ19             | VREF |
| 4    | IO_L22P_4         | IO_L22P_4                   | AK19             | I/O  |
| 4    | IO_L23N_4         | IO_L23N_4                   | AB18             | I/O  |
| 4    | IO_L23P_4         | IO_L23P_4                   | AC18             | I/O  |
| 4    | IO_L24N_4         | IO_L24N_4                   | AE18             | I/O  |
| 4    | IO_L24P_4         | IO_L24P_4                   | AF18             | I/O  |
| 4    | IO_L25N_4         | IO_L25N_4                   | AJ18             | I/O  |
| 4    | IO_L25P_4         | IO_L25P_4                   | AK18             | I/O  |
| 4    | IO_L26N_4         | IO_L26N_4                   | AA17             | I/O  |
| 4    | IO_L26P_4/VREF_4  | IO_L26P_4/VREF_4            | AB17             | VREF |
| 4    | IO_L27N_4/DIN/D0  | IO_L27N_4/DIN/D0            | AD17             | DUAL |
| 4    | IO_L27P_4/D1      | IO_L27P_4/D1                | AE17             | DUAL |
| 4    | IO_L28N_4         | IO_L28N_4                   | AH17             | I/O  |
| 4    | IO_L28P_4         | IO_L28P_4                   | AJ17             | I/O  |
| 4    | IO_L29N_4         | IO_L29N_4                   | AB16             | I/O  |
| 4    | IO_L29P_4         | IO_L29P_4                   | AC16             | I/O  |
| 4    | IO_L30N_4/D2      | IO_L30N_4/D2                | AD16             | DUAL |
| 4    | IO_L30P_4/D3      | IO_L30P_4/D3                | AE16             | DUAL |
| 4    | IO_L31N_4/INIT_B  | IO_L31N_4/INIT_B            | AG16             | DUAL |



Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name    | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|----------------------|-----------------------------|------------------|------|
| 4    | IO_L31P_4/DOOUT/BUSY | IO_L31P_4/DOOUT/BUSY        | AH16             | DUAL |
| 4    | IO_L32N_4/GCLK1      | IO_L32N_4/GCLK1             | AJ16             | GCLK |
| 4    | IO_L32P_4/GCLK0      | IO_L32P_4/GCLK0             | AK16             | GCLK |
| 4    | N.C. (◆)             | IO_L33N_4                   | AH25             | I/O  |
| 4    | N.C. (◆)             | IO_L33P_4                   | AJ25             | I/O  |
| 4    | N.C. (◆)             | IO_L34N_4                   | AE25             | I/O  |
| 4    | N.C. (◆)             | IO_L34P_4                   | AE24             | I/O  |
| 4    | N.C. (◆)             | IO_L35N_4                   | AG24             | I/O  |
| 4    | N.C. (◆)             | IO_L35P_4                   | AH24             | I/O  |
| 4    | N.C. (◆)             | IO_L38N_4                   | AJ24             | I/O  |
| 4    | N.C. (◆)             | IO_L38P_4                   | AK24             | I/O  |
| 4    | VCCO_4               | VCCO_4                      | Y17              | VCCO |
| 4    | VCCO_4               | VCCO_4                      | Y18              | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AD18             | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AH18             | VCCO |
| 4    | VCCO_4               | VCCO_4                      | Y19              | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AB20             | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AD22             | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AH22             | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AF24             | VCCO |
| 4    | VCCO_4               | VCCO_4                      | AH26             | VCCO |
| 5    | IO                   | IO                          | AE6              | I/O  |
| 5    | IO                   | IO                          | AB10             | I/O  |
| 5    | IO                   | IO                          | AA11             | I/O  |
| 5    | IO                   | IO                          | AA15             | I/O  |
| 5    | IO                   | IO                          | AE15             | I/O  |
| 5    | IO/VREF_5            | IO/VREF_5                   | AH4              | VREF |
| 5    | IO/VREF_5            | IO/VREF_5                   | AK15             | VREF |
| 5    | IO_L01N_5/RDWR_B     | IO_L01N_5/RDWR_B            | AK4              | DUAL |
| 5    | IO_L01P_5/CS_B       | IO_L01P_5/CS_B              | AJ4              | DUAL |
| 5    | IO_L02N_5            | IO_L02N_5                   | AK5              | I/O  |
| 5    | IO_L02P_5            | IO_L02P_5                   | AJ5              | I/O  |
| 5    | IO_L03N_5            | IO_L03N_5                   | AF6              | I/O  |
| 5    | IO_L03P_5            | IO_L03P_5                   | AG5              | I/O  |
| 5    | IO_L04N_5            | IO_L04N_5                   | AJ6              | I/O  |
| 5    | IO_L04P_5            | IO_L04P_5                   | AH6              | I/O  |
| 5    | IO_L05N_5            | IO_L05N_5                   | AE7              | I/O  |
| 5    | IO_L05P_5            | IO_L05P_5                   | AD7              | I/O  |
| 5    | IO_L06N_5            | IO_L06N_5                   | AH7              | I/O  |
| 5    | IO_L06P_5            | IO_L06P_5                   | AG7              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 5    | IO_L07N_5         | IO_L07N_5                   | AK8              | I/O  |
| 5    | IO_L07P_5         | IO_L07P_5                   | AJ8              | I/O  |
| 5    | IO_L08N_5         | IO_L08N_5                   | AC9              | I/O  |
| 5    | IO_L08P_5         | IO_L08P_5                   | AB9              | I/O  |
| 5    | IO_L09N_5         | IO_L09N_5                   | AG9              | I/O  |
| 5    | IO_L09P_5         | IO_L09P_5                   | AF9              | I/O  |
| 5    | IO_L10N_5/VRP_5   | IO_L10N_5/VRP_5             | AK9              | DCI  |
| 5    | IO_L10P_5/VRN_5   | IO_L10P_5/VRN_5             | AJ9              | DCI  |
| 5    | IO_L11N_5/VREF_5  | IO_L11N_5/VREF_5            | AE10             | VREF |
| 5    | IO_L11P_5         | IO_L11P_5                   | AE9              | I/O  |
| 5    | IO_L12N_5         | IO_L12N_5                   | AJ10             | I/O  |
| 5    | IO_L12P_5         | IO_L12P_5                   | AH10             | I/O  |
| 5    | IO_L13N_5         | IO_L13N_5                   | AD11             | I/O  |
| 5    | IO_L13P_5         | IO_L13P_5                   | AD10             | I/O  |
| 5    | IO_L14N_5         | IO_L14N_5                   | AF11             | I/O  |
| 5    | IO_L14P_5         | IO_L14P_5                   | AE11             | I/O  |
| 5    | IO_L15N_5         | IO_L15N_5                   | AH11             | I/O  |
| 5    | IO_L15P_5         | IO_L15P_5                   | AG11             | I/O  |
| 5    | IO_L16N_5         | IO_L16N_5                   | AK11             | I/O  |
| 5    | IO_L16P_5         | IO_L16P_5                   | AJ11             | I/O  |
| 5    | IO_L17N_5         | IO_L17N_5                   | AB12             | I/O  |
| 5    | IO_L17P_5         | IO_L17P_5                   | AC11             | I/O  |
| 5    | IO_L18N_5         | IO_L18N_5                   | AD12             | I/O  |
| 5    | IO_L18P_5         | IO_L18P_5                   | AC12             | I/O  |
| 5    | IO_L19N_5         | IO_L19N_5                   | AF12             | I/O  |
| 5    | IO_L19P_5/VREF_5  | IO_L19P_5/VREF_5            | AE12             | VREF |
| 5    | IO_L20N_5         | IO_L20N_5                   | AH12             | I/O  |
| 5    | IO_L20P_5         | IO_L20P_5                   | AG12             | I/O  |
| 5    | IO_L21N_5         | IO_L21N_5                   | AK12             | I/O  |
| 5    | IO_L21P_5         | IO_L21P_5                   | AJ12             | I/O  |
| 5    | IO_L22N_5         | IO_L22N_5                   | AA13             | I/O  |
| 5    | IO_L22P_5         | IO_L22P_5                   | AA12             | I/O  |
| 5    | IO_L23N_5         | IO_L23N_5                   | AC13             | I/O  |
| 5    | IO_L23P_5         | IO_L23P_5                   | AB13             | I/O  |
| 5    | IO_L24N_5         | IO_L24N_5                   | AG13             | I/O  |
| 5    | IO_L24P_5         | IO_L24P_5                   | AF13             | I/O  |
| 5    | IO_L25N_5         | IO_L25N_5                   | AK13             | I/O  |
| 5    | IO_L25P_5         | IO_L25P_5                   | AJ13             | I/O  |
| 5    | IO_L26N_5         | IO_L26N_5                   | AB14             | I/O  |
| 5    | IO_L26P_5         | IO_L26P_5                   | AA14             | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 5    | IO_L27N_5/VREF_5  | IO_L27N_5/VREF_5            | AE14             | VREF |
| 5    | IO_L27P_5         | IO_L27P_5                   | AE13             | I/O  |
| 5    | IO_L28N_5/D6      | IO_L28N_5/D6                | AJ14             | DUAL |
| 5    | IO_L28P_5/D7      | IO_L28P_5/D7                | AH14             | DUAL |
| 5    | IO_L29N_5         | IO_L29N_5                   | AC15             | I/O  |
| 5    | IO_L29P_5/VREF_5  | IO_L29P_5/VREF_5            | AB15             | VREF |
| 5    | IO_L30N_5         | IO_L30N_5                   | AD15             | I/O  |
| 5    | IO_L30P_5         | IO_L30P_5                   | AD14             | I/O  |
| 5    | IO_L31N_5/D4      | IO_L31N_5/D4                | AG15             | DUAL |
| 5    | IO_L31P_5/D5      | IO_L31P_5/D5                | AF15             | DUAL |
| 5    | IO_L32N_5/GCLK3   | IO_L32N_5/GCLK3             | AJ15             | GCLK |
| 5    | IO_L32P_5/GCLK2   | IO_L32P_5/GCLK2             | AH15             | GCLK |
| 5    | N.C. (◆)          | IO_L35N_5                   | AK7              | I/O  |
| 5    | N.C. (◆)          | IO_L35P_5                   | AJ7              | I/O  |
| 5    | N.C. (◆)          | IO_L36N_5                   | AD8              | I/O  |
| 5    | N.C. (◆)          | IO_L36P_5                   | AC8              | I/O  |
| 5    | N.C. (◆)          | IO_L37N_5                   | AF8              | I/O  |
| 5    | N.C. (◆)          | IO_L37P_5                   | AE8              | I/O  |
| 5    | N.C. (◆)          | IO_L38N_5                   | AH8              | I/O  |
| 5    | N.C. (◆)          | IO_L38P_5                   | AG8              | I/O  |
| 5    | VCCO_5            | VCCO_5                      | AH5              | VCCO |
| 5    | VCCO_5            | VCCO_5                      | AF7              | VCCO |
| 5    | VCCO_5            | VCCO_5                      | AD9              | VCCO |
| 5    | VCCO_5            | VCCO_5                      | AH9              | VCCO |
| 5    | VCCO_5            | VCCO_5                      | AB11             | VCCO |
| 5    | VCCO_5            | VCCO_5                      | Y12              | VCCO |
| 5    | VCCO_5            | VCCO_5                      | Y13              | VCCO |
| 5    | VCCO_5            | VCCO_5                      | AD13             | VCCO |
| 5    | VCCO_5            | VCCO_5                      | AH13             | VCCO |
| 5    | VCCO_5            | VCCO_5                      | Y14              | VCCO |
| 6    | IO                | IO                          | AB6              | I/O  |
| 6    | IO_L01N_6/VRP_6   | IO_L01N_6/VRP_6             | AH2              | DCI  |
| 6    | IO_L01P_6/VRN_6   | IO_L01P_6/VRN_6             | AH1              | DCI  |
| 6    | IO_L02N_6         | IO_L02N_6                   | AG4              | I/O  |
| 6    | IO_L02P_6         | IO_L02P_6                   | AG3              | I/O  |
| 6    | IO_L03N_6/VREF_6  | IO_L03N_6/VREF_6            | AG2              | VREF |
| 6    | IO_L03P_6         | IO_L03P_6                   | AG1              | I/O  |
| 6    | IO_L04N_6         | IO_L04N_6                   | AF2              | I/O  |
| 6    | IO_L04P_6         | IO_L04P_6                   | AF1              | I/O  |
| 6    | IO_L05N_6         | IO_L05N_6                   | AF4              | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 6    | IO_L05P_6         | IO_L05P_6                   | AE5              | I/O  |
| 6    | IO_L06N_6         | IO_L06N_6                   | AE3              | I/O  |
| 6    | IO_L06P_6         | IO_L06P_6                   | AE2              | I/O  |
| 6    | IO_L07N_6         | IO_L07N_6                   | AD4              | I/O  |
| 6    | IO_L07P_6         | IO_L07P_6                   | AD3              | I/O  |
| 6    | IO_L08N_6         | IO_L08N_6                   | AD2              | I/O  |
| 6    | IO_L08P_6         | IO_L08P_6                   | AD1              | I/O  |
| 6    | IO_L09N_6/VREF_6  | IO_L09N_6/VREF_6            | AD6              | VREF |
| 6    | IO_L09P_6         | IO_L09P_6                   | AC7              | I/O  |
| 6    | IO_L10N_6         | IO_L10N_6                   | AC6              | I/O  |
| 6    | IO_L10P_6         | IO_L10P_6                   | AC5              | I/O  |
| 6    | IO_L11N_6         | IO_L11N_6                   | AC4              | I/O  |
| 6    | IO_L11P_6         | IO_L11P_6                   | AC3              | I/O  |
| 6    | IO_L13N_6         | IO_L13N_6                   | AC2              | I/O  |
| 6    | IO_L13P_6/VREF_6  | IO_L13P_6/VREF_6            | AC1              | VREF |
| 6    | IO_L14N_6         | IO_L14N_6                   | AB5              | I/O  |
| 6    | IO_L14P_6         | IO_L14P_6                   | AB4              | I/O  |
| 6    | IO_L15N_6         | IO_L15N_6                   | AB2              | I/O  |
| 6    | IO_L15P_6         | IO_L15P_6                   | AB1              | I/O  |
| 6    | IO_L16N_6         | IO_L16N_6                   | AB8              | I/O  |
| 6    | IO_L16P_6         | IO_L16P_6                   | AA9              | I/O  |
| 6    | IO_L17N_6         | IO_L17N_6                   | AA7              | I/O  |
| 6    | IO_L17P_6/VREF_6  | IO_L17P_6/VREF_6            | AA6              | VREF |
| 6    | IO_L19N_6         | IO_L19N_6                   | AA3              | I/O  |
| 6    | IO_L19P_6         | IO_L19P_6                   | AA2              | I/O  |
| 6    | IO_L20N_6         | IO_L20N_6                   | AA10             | I/O  |
| 6    | IO_L20P_6         | IO_L20P_6                   | Y10              | I/O  |
| 6    | IO_L21N_6         | IO_L21N_6                   | Y8               | I/O  |
| 6    | IO_L21P_6         | IO_L21P_6                   | Y7               | I/O  |
| 6    | IO_L22N_6         | IO_L22N_6                   | Y6               | I/O  |
| 6    | IO_L22P_6         | IO_L22P_6                   | Y5               | I/O  |
| 6    | IO_L24N_6/VREF_6  | IO_L24N_6/VREF_6            | Y2               | VREF |
| 6    | IO_L24P_6         | IO_L24P_6                   | Y1               | I/O  |
| 6    | N.C. (◆)          | IO_L25N_6                   | W9               | I/O  |
| 6    | N.C. (◆)          | IO_L25P_6                   | W8               | I/O  |
| 6    | IO_L26N_6         | IO_L26N_6                   | W7               | I/O  |
| 6    | IO_L26P_6         | IO_L26P_6                   | W6               | I/O  |
| 6    | IO_L27N_6         | IO_L27N_6                   | W4               | I/O  |
| 6    | IO_L27P_6         | IO_L27P_6                   | W3               | I/O  |
| 6    | IO_L28N_6         | IO_L28N_6                   | W2               | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 6    | IO_L28P_6         | IO_L28P_6                   | W1               | I/O  |
| 6    | IO_L29N_6         | IO_L29N_6                   | W10              | I/O  |
| 6    | IO_L29P_6         | IO_L29P_6                   | V10              | I/O  |
| 6    | N.C. (◆)          | IO_L30N_6                   | V9               | I/O  |
| 6    | N.C. (◆)          | IO_L30P_6                   | V8               | I/O  |
| 6    | IO_L31N_6         | IO_L31N_6                   | W5               | I/O  |
| 6    | IO_L31P_6         | IO_L31P_6                   | V6               | I/O  |
| 6    | IO_L32N_6         | IO_L32N_6                   | V5               | I/O  |
| 6    | IO_L32P_6         | IO_L32P_6                   | V4               | I/O  |
| 6    | IO_L33N_6         | IO_L33N_6                   | V2               | I/O  |
| 6    | IO_L33P_6         | IO_L33P_6                   | V1               | I/O  |
| 6    | IO_L34N_6/VREF_6  | IO_L34N_6/VREF_6            | U10              | VREF |
| 6    | IO_L34P_6         | IO_L34P_6                   | U9               | I/O  |
| 6    | IO_L35N_6         | IO_L35N_6                   | U7               | I/O  |
| 6    | IO_L35P_6         | IO_L35P_6                   | U6               | I/O  |
| 6    | N.C. (◆)          | IO_L36N_6                   | U3               | I/O  |
| 6    | N.C. (◆)          | IO_L36P_6                   | U2               | I/O  |
| 6    | IO_L37N_6         | IO_L37N_6                   | T10              | I/O  |
| 6    | IO_L37P_6         | IO_L37P_6                   | T9               | I/O  |
| 6    | IO_L38N_6         | IO_L38N_6                   | T6               | I/O  |
| 6    | IO_L38P_6         | IO_L38P_6                   | T5               | I/O  |
| 6    | IO_L39N_6         | IO_L39N_6                   | T4               | I/O  |
| 6    | IO_L39P_6         | IO_L39P_6                   | T3               | I/O  |
| 6    | IO_L40N_6         | IO_L40N_6                   | T2               | I/O  |
| 6    | IO_L40P_6/VREF_6  | IO_L40P_6/VREF_6            | T1               | VREF |
| 6    | N.C. (◆)          | IO_L45N_6                   | Y4               | I/O  |
| 6    | N.C. (◆)          | IO_L45P_6                   | Y3               | I/O  |
| 6    | N.C. (◆)          | IO_L52N_6                   | T8               | I/O  |
| 6    | N.C. (◆)          | IO_L52P_6                   | T7               | I/O  |
| 6    | VCCO_6            | VCCO_6                      | V3               | VCCO |
| 6    | VCCO_6            | VCCO_6                      | AB3              | VCCO |
| 6    | VCCO_6            | VCCO_6                      | AF3              | VCCO |
| 6    | VCCO_6            | VCCO_6                      | AD5              | VCCO |
| 6    | VCCO_6            | VCCO_6                      | V7               | VCCO |
| 6    | VCCO_6            | VCCO_6                      | AB7              | VCCO |
| 6    | VCCO_6            | VCCO_6                      | Y9               | VCCO |
| 6    | VCCO_6            | VCCO_6                      | U11              | VCCO |
| 6    | VCCO_6            | VCCO_6                      | V11              | VCCO |
| 6    | VCCO_6            | VCCO_6                      | W11              | VCCO |
| 7    | IO                | IO                          | J6               | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 7    | IO_L01N_7/VRP_7   | IO_L01N_7/VRP_7             | C1               | DCI  |
| 7    | IO_L01P_7/VRN_7   | IO_L01P_7/VRN_7             | C2               | DCI  |
| 7    | IO_L02N_7         | IO_L02N_7                   | D3               | I/O  |
| 7    | IO_L02P_7         | IO_L02P_7                   | D4               | I/O  |
| 7    | IO_L03N_7/VREF_7  | IO_L03N_7/VREF_7            | D1               | VREF |
| 7    | IO_L03P_7         | IO_L03P_7                   | D2               | I/O  |
| 7    | IO_L04N_7         | IO_L04N_7                   | E1               | I/O  |
| 7    | IO_L04P_7         | IO_L04P_7                   | E2               | I/O  |
| 7    | IO_L05N_7         | IO_L05N_7                   | F5               | I/O  |
| 7    | IO_L05P_7         | IO_L05P_7                   | E4               | I/O  |
| 7    | IO_L06N_7         | IO_L06N_7                   | F2               | I/O  |
| 7    | IO_L06P_7         | IO_L06P_7                   | F3               | I/O  |
| 7    | IO_L07N_7         | IO_L07N_7                   | G3               | I/O  |
| 7    | IO_L07P_7         | IO_L07P_7                   | G4               | I/O  |
| 7    | IO_L08N_7         | IO_L08N_7                   | G1               | I/O  |
| 7    | IO_L08P_7         | IO_L08P_7                   | G2               | I/O  |
| 7    | IO_L09N_7         | IO_L09N_7                   | H7               | I/O  |
| 7    | IO_L09P_7         | IO_L09P_7                   | G6               | I/O  |
| 7    | IO_L10N_7         | IO_L10N_7                   | H5               | I/O  |
| 7    | IO_L10P_7/VREF_7  | IO_L10P_7/VREF_7            | H6               | VREF |
| 7    | IO_L11N_7         | IO_L11N_7                   | H3               | I/O  |
| 7    | IO_L11P_7         | IO_L11P_7                   | H4               | I/O  |
| 7    | IO_L13N_7         | IO_L13N_7                   | H1               | I/O  |
| 7    | IO_L13P_7         | IO_L13P_7                   | H2               | I/O  |
| 7    | IO_L14N_7         | IO_L14N_7                   | J4               | I/O  |
| 7    | IO_L14P_7         | IO_L14P_7                   | J5               | I/O  |
| 7    | IO_L15N_7         | IO_L15N_7                   | J1               | I/O  |
| 7    | IO_L15P_7         | IO_L15P_7                   | J2               | I/O  |
| 7    | IO_L16N_7         | IO_L16N_7                   | K9               | I/O  |
| 7    | IO_L16P_7/VREF_7  | IO_L16P_7/VREF_7            | J8               | VREF |
| 7    | IO_L17N_7         | IO_L17N_7                   | K6               | I/O  |
| 7    | IO_L17P_7         | IO_L17P_7                   | K7               | I/O  |
| 7    | IO_L19N_7/VREF_7  | IO_L19N_7/VREF_7            | K2               | VREF |
| 7    | IO_L19P_7         | IO_L19P_7                   | K3               | I/O  |
| 7    | IO_L20N_7         | IO_L20N_7                   | L10              | I/O  |
| 7    | IO_L20P_7         | IO_L20P_7                   | K10              | I/O  |
| 7    | IO_L21N_7         | IO_L21N_7                   | L7               | I/O  |
| 7    | IO_L21P_7         | IO_L21P_7                   | L8               | I/O  |
| 7    | IO_L22N_7         | IO_L22N_7                   | L5               | I/O  |
| 7    | IO_L22P_7         | IO_L22P_7                   | L6               | I/O  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 7    | IO_L23N_7         | IO_L23N_7                   | L3               | I/O  |
| 7    | IO_L23P_7         | IO_L23P_7                   | L4               | I/O  |
| 7    | IO_L24N_7         | IO_L24N_7                   | L1               | I/O  |
| 7    | IO_L24P_7         | IO_L24P_7                   | L2               | I/O  |
| 7    | N.C. (◆)          | IO_L25N_7                   | M6               | I/O  |
| 7    | N.C. (◆)          | IO_L25P_7                   | M7               | I/O  |
| 7    | IO_L26N_7         | IO_L26N_7                   | M3               | I/O  |
| 7    | IO_L26P_7         | IO_L26P_7                   | M4               | I/O  |
| 7    | IO_L27N_7         | IO_L27N_7                   | M1               | I/O  |
| 7    | IO_L27P_7/VREF_7  | IO_L27P_7/VREF_7            | M2               | VREF |
| 7    | IO_L28N_7         | IO_L28N_7                   | N10              | I/O  |
| 7    | IO_L28P_7         | IO_L28P_7                   | M10              | I/O  |
| 7    | IO_L29N_7         | IO_L29N_7                   | N8               | I/O  |
| 7    | IO_L29P_7         | IO_L29P_7                   | N9               | I/O  |
| 7    | IO_L31N_7         | IO_L31N_7                   | N1               | I/O  |
| 7    | IO_L31P_7         | IO_L31P_7                   | N2               | I/O  |
| 7    | IO_L32N_7         | IO_L32N_7                   | P9               | I/O  |
| 7    | IO_L32P_7         | IO_L32P_7                   | P10              | I/O  |
| 7    | IO_L33N_7         | IO_L33N_7                   | P6               | I/O  |
| 7    | IO_L33P_7         | IO_L33P_7                   | P7               | I/O  |
| 7    | IO_L34N_7         | IO_L34N_7                   | P2               | I/O  |
| 7    | IO_L34P_7         | IO_L34P_7                   | P3               | I/O  |
| 7    | IO_L35N_7         | IO_L35N_7                   | R9               | I/O  |
| 7    | IO_L35P_7         | IO_L35P_7                   | R10              | I/O  |
| 7    | IO_L37N_7         | IO_L37N_7                   | R7               | I/O  |
| 7    | IO_L37P_7/VREF_7  | IO_L37P_7/VREF_7            | R8               | VREF |
| 7    | IO_L38N_7         | IO_L38N_7                   | R5               | I/O  |
| 7    | IO_L38P_7         | IO_L38P_7                   | R6               | I/O  |
| 7    | IO_L39N_7         | IO_L39N_7                   | R3               | I/O  |
| 7    | IO_L39P_7         | IO_L39P_7                   | R4               | I/O  |
| 7    | IO_L40N_7/VREF_7  | IO_L40N_7/VREF_7            | R1               | VREF |
| 7    | IO_L40P_7         | IO_L40P_7                   | R2               | I/O  |
| 7    | N.C. (◆)          | IO_L46N_7                   | M8               | I/O  |
| 7    | N.C. (◆)          | IO_L46P_7                   | M9               | I/O  |
| 7    | N.C. (◆)          | IO_L49N_7                   | N6               | I/O  |
| 7    | N.C. (◆)          | IO_L49P_7                   | M5               | I/O  |
| 7    | N.C. (◆)          | IO_L50N_7                   | N4               | I/O  |
| 7    | N.C. (◆)          | IO_L50P_7                   | N5               | I/O  |
| 7    | VCCO_7            | VCCO_7                      | E3               | VCCO |
| 7    | VCCO_7            | VCCO_7                      | J3               | VCCO |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type |
|------|-------------------|-----------------------------|------------------|------|
| 7    | VCCO_7            | VCCO_7                      | N3               | VCCO |
| 7    | VCCO_7            | VCCO_7                      | G5               | VCCO |
| 7    | VCCO_7            | VCCO_7                      | J7               | VCCO |
| 7    | VCCO_7            | VCCO_7                      | N7               | VCCO |
| 7    | VCCO_7            | VCCO_7                      | L9               | VCCO |
| 7    | VCCO_7            | VCCO_7                      | M11              | VCCO |
| 7    | VCCO_7            | VCCO_7                      | N11              | VCCO |
| 7    | VCCO_7            | VCCO_7                      | P11              | VCCO |
| N/A  | GND               | GND                         | A1               | GND  |
| N/A  | GND               | GND                         | B1               | GND  |
| N/A  | GND               | GND                         | F1               | GND  |
| N/A  | GND               | GND                         | K1               | GND  |
| N/A  | GND               | GND                         | P1               | GND  |
| N/A  | GND               | GND                         | U1               | GND  |
| N/A  | GND               | GND                         | AA1              | GND  |
| N/A  | GND               | GND                         | AE1              | GND  |
| N/A  | GND               | GND                         | AJ1              | GND  |
| N/A  | GND               | GND                         | AK1              | GND  |
| N/A  | GND               | GND                         | A2               | GND  |
| N/A  | GND               | GND                         | B2               | GND  |
| N/A  | GND               | GND                         | AJ2              | GND  |
| N/A  | GND               | GND                         | E5               | GND  |
| N/A  | GND               | GND                         | K5               | GND  |
| N/A  | GND               | GND                         | P5               | GND  |
| N/A  | GND               | GND                         | U5               | GND  |
| N/A  | GND               | GND                         | AA5              | GND  |
| N/A  | GND               | GND                         | AF5              | GND  |
| N/A  | GND               | GND                         | A6               | GND  |
| N/A  | GND               | GND                         | AK6              | GND  |
| N/A  | GND               | GND                         | K8               | GND  |
| N/A  | GND               | GND                         | P8               | GND  |
| N/A  | GND               | GND                         | U8               | GND  |
| N/A  | GND               | GND                         | AA8              | GND  |
| N/A  | GND               | GND                         | A10              | GND  |
| N/A  | GND               | GND                         | E10              | GND  |
| N/A  | GND               | GND                         | H10              | GND  |
| N/A  | GND               | GND                         | AC10             | GND  |
| N/A  | GND               | GND                         | AF10             | GND  |
| N/A  | GND               | GND                         | AK10             | GND  |
| N/A  | GND               | GND                         | R12              | GND  |



Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000<br>Pin Name | XC3S4000, XC3S5000<br>Pin Name | FG900 Pin<br>Number | Type |
|------|----------------------|--------------------------------|---------------------|------|
| N/A  | GND                  | GND                            | T12                 | GND  |
| N/A  | GND                  | GND                            | N13                 | GND  |
| N/A  | GND                  | GND                            | P13                 | GND  |
| N/A  | GND                  | GND                            | R13                 | GND  |
| N/A  | GND                  | GND                            | T13                 | GND  |
| N/A  | GND                  | GND                            | U13                 | GND  |
| N/A  | GND                  | GND                            | V13                 | GND  |
| N/A  | GND                  | GND                            | A14                 | GND  |
| N/A  | GND                  | GND                            | E14                 | GND  |
| N/A  | GND                  | GND                            | H14                 | GND  |
| N/A  | GND                  | GND                            | N14                 | GND  |
| N/A  | GND                  | GND                            | P14                 | GND  |
| N/A  | GND                  | GND                            | R14                 | GND  |
| N/A  | GND                  | GND                            | T14                 | GND  |
| N/A  | GND                  | GND                            | U14                 | GND  |
| N/A  | GND                  | GND                            | V14                 | GND  |
| N/A  | GND                  | GND                            | AC14                | GND  |
| N/A  | GND                  | GND                            | AF14                | GND  |
| N/A  | GND                  | GND                            | AK14                | GND  |
| N/A  | GND                  | GND                            | M15                 | GND  |
| N/A  | GND                  | GND                            | N15                 | GND  |
| N/A  | GND                  | GND                            | P15                 | GND  |
| N/A  | GND                  | GND                            | R15                 | GND  |
| N/A  | GND                  | GND                            | T15                 | GND  |
| N/A  | GND                  | GND                            | U15                 | GND  |
| N/A  | GND                  | GND                            | V15                 | GND  |
| N/A  | GND                  | GND                            | W15                 | GND  |
| N/A  | GND                  | GND                            | M16                 | GND  |
| N/A  | GND                  | GND                            | N16                 | GND  |
| N/A  | GND                  | GND                            | P16                 | GND  |
| N/A  | GND                  | GND                            | R16                 | GND  |
| N/A  | GND                  | GND                            | T16                 | GND  |
| N/A  | GND                  | GND                            | U16                 | GND  |
| N/A  | GND                  | GND                            | V16                 | GND  |
| N/A  | GND                  | GND                            | W16                 | GND  |
| N/A  | GND                  | GND                            | A17                 | GND  |
| N/A  | GND                  | GND                            | E17                 | GND  |
| N/A  | GND                  | GND                            | H17                 | GND  |
| N/A  | GND                  | GND                            | N17                 | GND  |
| N/A  | GND                  | GND                            | P17                 | GND  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000<br>Pin Name | XC3S4000, XC3S5000<br>Pin Name | FG900 Pin<br>Number | Type |
|------|----------------------|--------------------------------|---------------------|------|
| N/A  | GND                  | GND                            | R17                 | GND  |
| N/A  | GND                  | GND                            | T17                 | GND  |
| N/A  | GND                  | GND                            | U17                 | GND  |
| N/A  | GND                  | GND                            | V17                 | GND  |
| N/A  | GND                  | GND                            | AC17                | GND  |
| N/A  | GND                  | GND                            | AF17                | GND  |
| N/A  | GND                  | GND                            | AK17                | GND  |
| N/A  | GND                  | GND                            | N18                 | GND  |
| N/A  | GND                  | GND                            | P18                 | GND  |
| N/A  | GND                  | GND                            | R18                 | GND  |
| N/A  | GND                  | GND                            | T18                 | GND  |
| N/A  | GND                  | GND                            | U18                 | GND  |
| N/A  | GND                  | GND                            | V18                 | GND  |
| N/A  | GND                  | GND                            | R19                 | GND  |
| N/A  | GND                  | GND                            | T19                 | GND  |
| N/A  | GND                  | GND                            | A21                 | GND  |
| N/A  | GND                  | GND                            | E21                 | GND  |
| N/A  | GND                  | GND                            | H21                 | GND  |
| N/A  | GND                  | GND                            | AC21                | GND  |
| N/A  | GND                  | GND                            | AF21                | GND  |
| N/A  | GND                  | GND                            | AK21                | GND  |
| N/A  | GND                  | GND                            | K23                 | GND  |
| N/A  | GND                  | GND                            | P23                 | GND  |
| N/A  | GND                  | GND                            | U23                 | GND  |
| N/A  | GND                  | GND                            | AA23                | GND  |
| N/A  | GND                  | GND                            | A25                 | GND  |
| N/A  | GND                  | GND                            | AK25                | GND  |
| N/A  | GND                  | GND                            | E26                 | GND  |
| N/A  | GND                  | GND                            | K26                 | GND  |
| N/A  | GND                  | GND                            | P26                 | GND  |
| N/A  | GND                  | GND                            | U26                 | GND  |
| N/A  | GND                  | GND                            | AA26                | GND  |
| N/A  | GND                  | GND                            | AF26                | GND  |
| N/A  | GND                  | GND                            | A29                 | GND  |
| N/A  | GND                  | GND                            | B29                 | GND  |
| N/A  | GND                  | GND                            | AJ29                | GND  |
| N/A  | GND                  | GND                            | AK29                | GND  |
| N/A  | GND                  | GND                            | A30                 | GND  |
| N/A  | GND                  | GND                            | B30                 | GND  |
| N/A  | GND                  | GND                            | F30                 | GND  |

Table 107: FG900 Package Pinout (Cont'd)

| Bank | XC3S2000 Pin Name | XC3S4000, XC3S5000 Pin Name | FG900 Pin Number | Type   |
|------|-------------------|-----------------------------|------------------|--------|
| N/A  | GND               | GND                         | K30              | GND    |
| N/A  | GND               | GND                         | P30              | GND    |
| N/A  | GND               | GND                         | U30              | GND    |
| N/A  | GND               | GND                         | AA30             | GND    |
| N/A  | GND               | GND                         | AE30             | GND    |
| N/A  | GND               | GND                         | AJ30             | GND    |
| N/A  | GND               | GND                         | AK30             | GND    |
| N/A  | GND               | GND                         | AK2              | GND    |
| N/A  | VCCAUX            | VCCAUX                      | F4               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | K4               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | P4               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | U4               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AA4              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AE4              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | D6               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AG6              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | D10              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AG10             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | D14              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AG14             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | D17              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AG17             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | D21              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AG21             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | D25              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AG25             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | F27              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | K27              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | P27              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | U27              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AA27             | VCCAUX |
| N/A  | VCCAUX            | VCCAUX                      | AE27             | VCCAUX |
| N/A  | VCCINT            | VCCINT                      | L11              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | R11              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | T11              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | Y11              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | M12              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | N12              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | P12              | VCCINT |
| N/A  | VCCINT            | VCCINT                      | U12              | VCCINT |

Table 107: FG900 Package Pinout (Cont'd)

| Bank   | XC3S2000<br>Pin Name | XC3S4000, XC3S5000<br>Pin Name | FG900 Pin<br>Number | Type   |
|--------|----------------------|--------------------------------|---------------------|--------|
| N/A    | VCCINT               | VCCINT                         | V12                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | W12                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | M13                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | W13                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | M14                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | W14                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | L15                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | Y15                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | L16                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | Y16                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | M17                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | W17                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | M18                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | W18                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | M19                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | N19                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | P19                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | U19                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | V19                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | W19                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | L20                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | R20                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | T20                 | VCCINT |
| N/A    | VCCINT               | VCCINT                         | Y20                 | VCCINT |
| VCCAUX | CCLK                 | CCLK                           | AH28                | CONFIG |
| VCCAUX | DONE                 | DONE                           | AJ28                | CONFIG |
| VCCAUX | HSWAP_EN             | HSWAP_EN                       | A3                  | CONFIG |
| VCCAUX | M0                   | M0                             | AJ3                 | CONFIG |
| VCCAUX | M1                   | M1                             | AH3                 | CONFIG |
| VCCAUX | M2                   | M2                             | AK3                 | CONFIG |
| VCCAUX | PROG_B               | PROG_B                         | B3                  | CONFIG |
| VCCAUX | TCK                  | TCK                            | B28                 | JTAG   |
| VCCAUX | TDI                  | TDI                            | C3                  | JTAG   |
| VCCAUX | TDO                  | TDO                            | C28                 | JTAG   |
| VCCAUX | TMS                  | TMS                            | A28                 | JTAG   |

## User I/Os by Bank

Table 108 indicates how the available user-I/O pins are distributed between the eight I/O banks for the XC3S2000 in the FG900 package. Similarly, Table 109 shows how the available user-I/O pins are distributed between the eight I/O banks for the XC3S4000 and XC3S5000 in the FG900 package.

Table 108: User I/Os Per Bank for XC3S2000 in FG900 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 71          | 62                            | 0    | 2   | 5    | 2    |
|        | 1        | 71          | 62                            | 0    | 2   | 5    | 2    |
| Right  | 2        | 69          | 61                            | 0    | 2   | 6    | 0    |
|        | 3        | 71          | 62                            | 0    | 2   | 7    | 0    |
| Bottom | 4        | 72          | 57                            | 6    | 2   | 5    | 2    |
|        | 5        | 71          | 55                            | 6    | 2   | 6    | 2    |
| Left   | 6        | 69          | 60                            | 0    | 2   | 7    | 0    |
|        | 7        | 71          | 62                            | 0    | 2   | 7    | 0    |

Table 109: User I/Os Per Bank for XC3S4000 and XC3S5000 in FG900 Package

| Edge   | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------|----------|-------------|-------------------------------|------|-----|------|------|
|        |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top    | 0        | 79          | 70                            | 0    | 2   | 5    | 2    |
|        | 1        | 79          | 70                            | 0    | 2   | 5    | 2    |
| Right  | 2        | 79          | 71                            | 0    | 2   | 6    | 0    |
|        | 3        | 79          | 70                            | 0    | 2   | 7    | 0    |
| Bottom | 4        | 80          | 65                            | 6    | 2   | 5    | 2    |
|        | 5        | 79          | 63                            | 6    | 2   | 6    | 2    |
| Left   | 6        | 79          | 70                            | 0    | 2   | 7    | 0    |
|        | 7        | 79          | 70                            | 0    | 2   | 7    | 0    |

FG900 Footprint

Left Half of FG900 Package (Top View)

XC3S2000

(565 max. user I/O)

481 I/O: Unrestricted, general-purpose user I/O

48 VREF: User I/O or input voltage reference for bank

68 N.C.: Unconnected pins for XC3S2000 (◆)

XC3S4000, XC3S5000

(633 max user I/O)

549 I/O: Unrestricted, general-purpose user I/O

48 VREF: User I/O or input voltage reference for bank

0 N.C.: No unconnected pins in this package

All devices

12 DUAL: Configuration pin, then possible user I/O

8 GCLK: User I/O or global clock buffer input

16 DCI: User I/O or reference resistor input for bank

7 CONFIG: Dedicated configuration pins

4 JTAG: Dedicated JTAG port pins

32 VCCINT: Internal core voltage supply (+1.2V)

80 VCCO: Output voltage supply for bank

24 VCCAUX: Auxiliary voltage supply (+2.5V)

120 GND: Ground

|        |                   | Bank 0            |                   |            |                   |            |                   |                   |                   |                   |                   |            |                   |            |                   |                   |            |
|--------|-------------------|-------------------|-------------------|------------|-------------------|------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------|-------------------|------------|-------------------|-------------------|------------|
|        |                   | 1                 | 2                 | 3          | 4                 | 5          | 6                 | 7                 | 8                 | 9                 | 10                | 11         | 12                | 13         | 14                | 15                |            |
| Bank 7 | A                 | GND               | GND               | HSWAP_EN   | I/O L01P_0 VRN_0  | I/O L02P_0 | GND               | I/O L35P_0        | I/O L09P_0        | I/O L38P_0        | GND               | I/O L17P_0 | I/O L22P_0        | I/O L25P_0 | GND               | I/O L32P_0 GCLK6  |            |
|        | B                 | GND               | GND               | PROG_B     | I/O L01N_0 VRP_0  | I/O L02N_0 | I/O L04P_0        | I/O L35N_0        | I/O L09N_0        | I/O L38N_0        | I/O L12P_0        | I/O L17N_0 | I/O L22N_0        | I/O L25N_0 | I/O L28P_0        | I/O L32N_0 GCLK7  |            |
|        | C                 | I/O L01N_7 VRP_7  | I/O L01P_7 VRN_7  | TDI        | I/O VREF_0        | VCCO_0     | I/O L04N_0        | I/O L06P_0        | I/O L08P_0        | VCCO_0            | I/O L12N_0        | I/O L16P_0 | I/O L21P_0        | VCCO_0     | I/O L28N_0        | I/O L31P_0 VREF_0 |            |
|        | D                 | I/O L03N_7 VRP_7  | I/O L03P_7        | I/O L02N_7 | I/O L02P_7        | I/O L03N_0 | VCCAUX            | I/O L06N_0        | I/O L08N_0        | I/O L37P_0        | VCCAUX            | I/O L16N_0 | I/O L21N_0        | I/O        | VCCAUX            | I/O L31N_0        |            |
|        | E                 | I/O L04N_7        | I/O L04P_7        | VCCO_7     | I/O L05P_7        | GND        | I/O L03P_0        | VCCO_0            | I/O L07P_0        | I/O L37N_0        | GND               | I/O L15P_0 | I/O L20P_0        | I/O L24P_0 | GND               | I/O               |            |
|        | F                 | GND               | I/O L06N_7        | I/O L06P_7 | VCCAUX            | I/O L05N_7 | I/O L05N_0        | I/O L05P_0 VREF_0 | I/O L07N_0        | I/O VREF_0        | I/O L11P_0        | I/O L15N_0 | I/O L20N_0        | I/O L24N_0 | I/O L27P_0        | I/O L30P_0        |            |
|        | G                 | I/O L08N_7        | I/O L08P_7        | I/O L07N_7 | I/O L07P_7        | VCCO_7     | I/O L09P_7        | I/O L36N_0        | I/O L09P_0        | I/O               | VCCO_0            | I/O L11N_0 | I/O L14P_0        | I/O L19P_0 | VCCO_0            | I/O L27N_0        | I/O L30N_0 |
|        | H                 | I/O L13N_7        | I/O L13P_7        | I/O L11N_7 | I/O L11P_7        | I/O L10N_7 | I/O L10P_7 VREF_7 | I/O L09N_7        | I/O L36P_0        | I/O L10P_0        | GND               | I/O L14N_0 | I/O L19N_0        | I/O L23P_0 | GND               | I/O L29P_0        |            |
|        | J                 | I/O L15N_7        | I/O L15P_7        | VCCO_7     | I/O L14N_7        | I/O L14P_7 | I/O               | VCCO_7            | I/O L16P_7 VREF_7 | I/O L10N_0        | I/O L13N_0        | VCCO_0     | I/O L18P_0        | I/O L23N_0 | I/O L26P_0 VREF_0 | I/O L29N_0        |            |
|        | K                 | GND               | I/O L19N_7 VREF_7 | I/O L19P_7 | VCCAUX            | GND        | I/O L17N_7        | I/O L17P_7        | GND               | I/O L16N_7        | I/O L20P_7        | I/O L13P_0 | I/O L18N_0        | I/O        | I/O L26N_0        | I/O               |            |
|        | L                 | I/O L24N_7        | I/O L24P_7        | I/O L23N_7 | I/O L23P_7        | I/O L22N_7 | I/O L22P_7        | I/O L21N_7        | I/O L21P_7        | VCCO_7            | I/O L20N_7        | VCCINT     | VCCO_0            | VCCO_0     | VCCO_0            | VCCINT            |            |
|        | M                 | I/O L27N_7        | I/O L27P_7 VREF_7 | I/O L26N_7 | I/O L26P_7        | I/O L49P_7 | I/O L25N_7        | I/O L25P_7        | I/O L46P_7        | I/O L28P_7        | VCCO_7            | VCCINT     | VCCINT            | VCCINT     | VCCINT            | GND               |            |
|        | N                 | I/O L31N_7        | I/O L31P_7        | VCCO_7     | I/O L50N_7        | I/O L50P_7 | I/O L49N_7        | VCCO_7            | I/O L29N_7        | I/O L29P_7        | VCCO_7            | VCCINT     | GND               | GND        | GND               | GND               |            |
|        | P                 | GND               | I/O L34N_7        | I/O L34P_7 | VCCAUX            | GND        | I/O L33N_7        | I/O L33P_7        | GND               | I/O L32N_7        | I/O L32P_7        | VCCO_7     | VCCINT            | GND        | GND               | GND               |            |
|        | R                 | I/O L40N_7 VREF_7 | I/O L40P_7        | I/O L39N_7 | I/O L39P_7        | I/O L38N_7 | I/O L38P_7        | I/O L37N_7        | I/O L37P_7 VREF_7 | I/O L35N_7        | I/O L35P_7        | VCCINT     | GND               | GND        | GND               | GND               |            |
| T      | I/O L40P_6 VREF_6 | I/O L40N_6        | I/O L39P_6        | I/O L39N_6 | I/O L38P_6        | I/O L38N_6 | I/O L52P_6        | I/O L52N_6        | I/O L37P_6        | I/O L37N_6        | VCCINT            | GND        | GND               | GND        | GND               |                   |            |
| U      | GND               | I/O L36P_6        | I/O L36N_6        | VCCAUX     | GND               | I/O L35P_6 | I/O L35N_6        | GND               | I/O L34P_6        | I/O L34N_6 VREF_6 | VCCO_6            | VCCINT     | GND               | GND        | GND               |                   |            |
| V      | I/O L33P_6        | I/O L33N_6        | VCCO_6            | I/O L32P_6 | I/O L32N_6        | I/O L31P_6 | VCCO_6            | I/O L30P_6        | I/O L30N_6        | I/O L29P_6        | VCCO_6            | VCCINT     | GND               | GND        | GND               |                   |            |
| W      | I/O L28P_6        | I/O L28N_6        | I/O L27P_6        | I/O L27N_6 | I/O L31N_6        | I/O L26P_6 | I/O L26N_6        | I/O L25P_6        | I/O L25N_6        | I/O L29N_6        | VCCO_6            | VCCINT     | VCCINT            | VCCINT     | GND               |                   |            |
| Y      | I/O L24N_6 VREF_6 | I/O L24P_6        | I/O L45P_6        | I/O L45N_6 | I/O L22P_6        | I/O L22N_6 | I/O L21P_6        | I/O L21N_6        | VCCO_6            | I/O L20P_6        | VCCINT            | VCCO_5     | VCCO_5            | VCCO_5     | VCCINT            |                   |            |
| Bank 6 | A                 | GND               | I/O L19P_6        | I/O L19N_6 | VCCAUX            | GND        | I/O L17P_6 VREF_6 | I/O L17N_6        | GND               | I/O L16P_6        | I/O L20N_6        | I/O        | I/O L22P_5        | I/O L22N_5 | I/O L26P_5        | I/O               |            |
|        | B                 | I/O L15P_6        | I/O L15N_6        | VCCO_6     | I/O L14P_6        | I/O L14N_6 | I/O               | VCCO_6            | I/O L16N_6        | I/O L08P_5        | I/O               | VCCO_5     | I/O L17N_5        | I/O L23P_5 | I/O L26N_5        | I/O L29P_5 VREF_5 |            |
|        | C                 | I/O L13P_6 VREF_6 | I/O L13N_6        | I/O L11P_6 | I/O L11N_6        | I/O L10P_6 | I/O L10N_6        | I/O L09P_6        | I/O L36P_5        | I/O L08N_5        | GND               | I/O L17P_5 | I/O L18P_5        | I/O L23N_5 | GND               | I/O L29N_5        |            |
|        | D                 | I/O L08P_6        | I/O L08N_6        | I/O L07P_6 | I/O L07N_6        | VCCO_6     | I/O L09N_6 VREF_6 | I/O L05P_5        | I/O L36N_5        | VCCO_5            | I/O L13P_5        | I/O L13N_5 | I/O L18N_5        | VCCO_5     | I/O L30P_5        | I/O L30N_5        |            |
|        | A                 | GND               | I/O L06P_6        | I/O L06N_6 | VCCAUX            | I/O L05P_6 | I/O               | I/O L05N_5        | I/O L37P_5        | I/O L11P_5        | I/O L11N_5 VREF_5 | I/O L14P_5 | I/O L19P_5 VREF_5 | I/O L27P_5 | I/O L27N_5 VREF_5 | I/O               |            |
|        | F                 | I/O L04P_6        | I/O L04N_6        | VCCO_6     | I/O L05N_6        | GND        | I/O L03N_5        | VCCO_5            | I/O L37N_5        | I/O L09P_5        | GND               | I/O L14N_5 | I/O L19N_5        | I/O L24P_5 | GND               | I/O L31P_5 D5     |            |
|        | G                 | I/O L03P_6        | I/O L03N_6 VREF_6 | I/O L02P_6 | I/O L02N_6        | I/O L03P_5 | VCCAUX            | I/O L06P_5        | I/O L38P_5        | I/O L09N_5        | VCCAUX            | I/O L15P_5 | I/O L20P_5        | I/O L24N_5 | VCCAUX            | I/O L31N_5 D4     |            |
|        | H                 | I/O L01P_6 VRN_6  | I/O L01N_6 VRP_6  | M1         | I/O VREF_5        | VCCO_5     | I/O L04P_5        | I/O L06N_5        | I/O L38N_5        | VCCO_5            | I/O L12P_5        | I/O L15N_5 | I/O L20N_5        | VCCO_5     | I/O L28P_5 D7     | I/O L32P_5 GCLK2  |            |
|        | J                 | GND               | GND               | M0         | I/O L01P_5 CS_B   | I/O L02P_5 | I/O L04N_5        | I/O L06N_5        | I/O L07P_5        | I/O L10P_5 VRN_5  | I/O L12N_5        | I/O L16P_5 | I/O L21P_5        | I/O L25P_5 | I/O L28N_5 D6     | I/O L32N_5 GCLK3  |            |
|        | K                 | GND               | GND               | M2         | I/O L01N_5 RDWR_B | I/O L02N_5 | GND               | I/O L35N_5        | I/O L07N_5        | I/O L10N_5 VRP_5  | GND               | I/O L16N_5 | I/O L21N_5        | I/O L25N_5 | GND               | I/O VREF_5        |            |
|        |                   |                   | Bank 5            |            |                   |            |                   |                   |                   |                   |                   |            |                   |            |                   |                   |            |

Figure 55: FG900 Package Footprint (Top View)

DS099-4\_13a\_121103



## FG1156: 1156-lead Fine-pitch Ball Grid Array

**Note:** The FG(G)1156 package is discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

The 1,156-lead fine-pitch ball grid array package, FG1156, supports two different Spartan-3 devices, namely the XC3S4000 and the XC3S5000. The XC3S4000, however, has fewer I/O pins, which consequently results in 73 unconnected pins on the FG1156 package, labeled as “N.C.” In [Table 110](#) and [Figure 53](#), these unconnected pins are indicated with a black diamond symbol (◆).

The XC3S5000 has a single unconnected package pin, ball AK31, which is also unconnected for the XC3S4000.

All the package pins appear in [Table 110](#) and are sorted by bank number, 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.

On ball L29 in I/O Bank 2, the unconnected pin on the XC3S4000 maps to a VREF-type pin on the XC3S5000. If the other VREF\_2 pins all connect to a voltage reference to support a special I/O standard, then also connect the N.C. pin on the XC3S4000 to the same VREF\_2 voltage.

### Pinout Table

Table 110: FG1156 Package Pinout

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 0    | IO                | IO                | B9                | I/O  |
| 0    | IO                | IO                | E17               | I/O  |
| 0    | IO                | IO                | F6                | I/O  |
| 0    | IO                | IO                | F8                | I/O  |
| 0    | IO                | IO                | G12               | I/O  |
| 0    | IO                | IO                | H8                | I/O  |
| 0    | IO                | IO                | H9                | I/O  |
| 0    | IO                | IO                | J11               | I/O  |
| 0    | N.C. (◆)          | IO                | J9                | I/O  |
| 0    | N.C. (◆)          | IO                | K11               | I/O  |
| 0    | IO                | IO                | K13               | I/O  |
| 0    | IO                | IO                | K16               | I/O  |
| 0    | IO                | IO                | K17               | I/O  |
| 0    | IO                | IO                | L13               | I/O  |
| 0    | IO                | IO                | L16               | I/O  |
| 0    | IO                | IO                | L17               | I/O  |
| 0    | IO/VREF_0         | IO/VREF_0         | D5                | VREF |
| 0    | IO/VREF_0         | IO/VREF_0         | E10               | VREF |
| 0    | IO/VREF_0         | IO/VREF_0         | J14               | VREF |
| 0    | IO/VREF_0         | IO/VREF_0         | L15               | VREF |
| 0    | IO_L01N_0/VRP_0   | IO_L01N_0/VRP_0   | B3                | DCI  |
| 0    | IO_L01P_0/VRN_0   | IO_L01P_0/VRN_0   | A3                | DCI  |
| 0    | IO_L02N_0         | IO_L02N_0         | B4                | I/O  |
| 0    | IO_L02P_0         | IO_L02P_0         | A4                | I/O  |
| 0    | IO_L03N_0         | IO_L03N_0         | C5                | I/O  |



Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 0    | IO_L03P_0            | IO_L03P_0            | B5                   | I/O  |
| 0    | IO_L04N_0            | IO_L04N_0            | D6                   | I/O  |
| 0    | IO_L04P_0            | IO_L04P_0            | C6                   | I/O  |
| 0    | IO_L05N_0            | IO_L05N_0            | B6                   | I/O  |
| 0    | IO_L05P_0/VREF_0     | IO_L05P_0/VREF_0     | A6                   | VREF |
| 0    | IO_L06N_0            | IO_L06N_0            | F7                   | I/O  |
| 0    | IO_L06P_0            | IO_L06P_0            | E7                   | I/O  |
| 0    | IO_L07N_0            | IO_L07N_0            | G9                   | I/O  |
| 0    | IO_L07P_0            | IO_L07P_0            | F9                   | I/O  |
| 0    | IO_L08N_0            | IO_L08N_0            | D9                   | I/O  |
| 0    | IO_L08P_0            | IO_L08P_0            | C9                   | I/O  |
| 0    | IO_L09N_0            | IO_L09N_0            | J10                  | I/O  |
| 0    | IO_L09P_0            | IO_L09P_0            | H10                  | I/O  |
| 0    | IO_L10N_0            | IO_L10N_0            | G10                  | I/O  |
| 0    | IO_L10P_0            | IO_L10P_0            | F10                  | I/O  |
| 0    | IO_L11N_0            | IO_L11N_0            | L12                  | I/O  |
| 0    | IO_L11P_0            | IO_L11P_0            | K12                  | I/O  |
| 0    | IO_L12N_0            | IO_L12N_0            | J12                  | I/O  |
| 0    | IO_L12P_0            | IO_L12P_0            | H12                  | I/O  |
| 0    | IO_L13N_0            | IO_L13N_0            | F12                  | I/O  |
| 0    | IO_L13P_0            | IO_L13P_0            | E12                  | I/O  |
| 0    | IO_L14N_0            | IO_L14N_0            | D12                  | I/O  |
| 0    | IO_L14P_0            | IO_L14P_0            | C12                  | I/O  |
| 0    | IO_L15N_0            | IO_L15N_0            | B12                  | I/O  |
| 0    | IO_L15P_0            | IO_L15P_0            | A12                  | I/O  |
| 0    | IO_L16N_0            | IO_L16N_0            | H13                  | I/O  |
| 0    | IO_L16P_0            | IO_L16P_0            | G13                  | I/O  |
| 0    | IO_L17N_0            | IO_L17N_0            | D13                  | I/O  |
| 0    | IO_L17P_0            | IO_L17P_0            | C13                  | I/O  |
| 0    | IO_L18N_0            | IO_L18N_0            | L14                  | I/O  |
| 0    | IO_L18P_0            | IO_L18P_0            | K14                  | I/O  |
| 0    | IO_L19N_0            | IO_L19N_0            | H14                  | I/O  |
| 0    | IO_L19P_0            | IO_L19P_0            | G14                  | I/O  |
| 0    | IO_L20N_0            | IO_L20N_0            | F14                  | I/O  |
| 0    | IO_L20P_0            | IO_L20P_0            | E14                  | I/O  |
| 0    | IO_L21N_0            | IO_L21N_0            | D14                  | I/O  |
| 0    | IO_L21P_0            | IO_L21P_0            | C14                  | I/O  |
| 0    | IO_L22N_0            | IO_L22N_0            | B14                  | I/O  |
| 0    | IO_L22P_0            | IO_L22P_0            | A14                  | I/O  |
| 0    | IO_L23N_0            | IO_L23N_0            | K15                  | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 0    | IO_L23P_0            | IO_L23P_0            | J15                  | I/O  |
| 0    | IO_L24N_0            | IO_L24N_0            | G15                  | I/O  |
| 0    | IO_L24P_0            | IO_L24P_0            | F15                  | I/O  |
| 0    | IO_L25N_0            | IO_L25N_0            | D15                  | I/O  |
| 0    | IO_L25P_0            | IO_L25P_0            | C15                  | I/O  |
| 0    | IO_L26N_0            | IO_L26N_0            | B15                  | I/O  |
| 0    | IO_L26P_0/VREF_0     | IO_L26P_0/VREF_0     | A15                  | VREF |
| 0    | IO_L27N_0            | IO_L27N_0            | G16                  | I/O  |
| 0    | IO_L27P_0            | IO_L27P_0            | F16                  | I/O  |
| 0    | IO_L28N_0            | IO_L28N_0            | C16                  | I/O  |
| 0    | IO_L28P_0            | IO_L28P_0            | B16                  | I/O  |
| 0    | IO_L29N_0            | IO_L29N_0            | J17                  | I/O  |
| 0    | IO_L29P_0            | IO_L29P_0            | H17                  | I/O  |
| 0    | IO_L30N_0            | IO_L30N_0            | G17                  | I/O  |
| 0    | IO_L30P_0            | IO_L30P_0            | F17                  | I/O  |
| 0    | IO_L31N_0            | IO_L31N_0            | D17                  | I/O  |
| 0    | IO_L31P_0/VREF_0     | IO_L31P_0/VREF_0     | C17                  | VREF |
| 0    | IO_L32N_0/GCLK7      | IO_L32N_0/GCLK7      | B17                  | GCLK |
| 0    | IO_L32P_0/GCLK6      | IO_L32P_0/GCLK6      | A17                  | GCLK |
| 0    | N.C. (◆)             | IO_L33N_0            | D7                   | I/O  |
| 0    | N.C. (◆)             | IO_L33P_0            | C7                   | I/O  |
| 0    | N.C. (◆)             | IO_L34N_0            | B7                   | I/O  |
| 0    | N.C. (◆)             | IO_L34P_0            | A7                   | I/O  |
| 0    | IO_L35N_0            | IO_L35N_0            | E8                   | I/O  |
| 0    | IO_L35P_0            | IO_L35P_0            | D8                   | I/O  |
| 0    | IO_L36N_0            | IO_L36N_0            | B8                   | I/O  |
| 0    | IO_L36P_0            | IO_L36P_0            | A8                   | I/O  |
| 0    | IO_L37N_0            | IO_L37N_0            | D10                  | I/O  |
| 0    | IO_L37P_0            | IO_L37P_0            | C10                  | I/O  |
| 0    | IO_L38N_0            | IO_L38N_0            | B10                  | I/O  |
| 0    | IO_L38P_0            | IO_L38P_0            | A10                  | I/O  |
| 0    | N.C. (◆)             | IO_L39N_0            | G11                  | I/O  |
| 0    | N.C. (◆)             | IO_L39P_0            | F11                  | I/O  |
| 0    | N.C. (◆)             | IO_L40N_0            | B11                  | I/O  |
| 0    | N.C. (◆)             | IO_L40P_0            | A11                  | I/O  |
| 0    | VCCO_0               | VCCO_0               | B13                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | C4                   | VCCO |
| 0    | VCCO_0               | VCCO_0               | C8                   | VCCO |
| 0    | VCCO_0               | VCCO_0               | D11                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | D16                  | VCCO |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 0    | VCCO_0               | VCCO_0               | F13                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | G8                   | VCCO |
| 0    | VCCO_0               | VCCO_0               | H11                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | H15                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | M13                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | M14                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | M15                  | VCCO |
| 0    | VCCO_0               | VCCO_0               | M16                  | VCCO |
| 1    | IO                   | IO                   | B26                  | I/O  |
| 1    | IO                   | IO                   | A18                  | I/O  |
| 1    | IO                   | IO                   | C23                  | I/O  |
| 1    | IO                   | IO                   | E21                  | I/O  |
| 1    | IO                   | IO                   | E25                  | I/O  |
| 1    | IO                   | IO                   | F18                  | I/O  |
| 1    | IO                   | IO                   | F27                  | I/O  |
| 1    | IO                   | IO                   | F29                  | I/O  |
| 1    | IO                   | IO                   | H23                  | I/O  |
| 1    | IO                   | IO                   | H26                  | I/O  |
| 1    | N.C. (◆)             | IO                   | J26                  | I/O  |
| 1    | IO                   | IO                   | K19                  | I/O  |
| 1    | IO                   | IO                   | L19                  | I/O  |
| 1    | IO                   | IO                   | L20                  | I/O  |
| 1    | IO                   | IO                   | L21                  | I/O  |
| 1    | N.C. (◆)             | IO                   | L23                  | I/O  |
| 1    | IO                   | IO                   | L24                  | I/O  |
| 1    | IO/VREF_1            | IO/VREF_1            | D30                  | VREF |
| 1    | IO/VREF_1            | IO/VREF_1            | K21                  | VREF |
| 1    | IO/VREF_1            | IO/VREF_1            | L18                  | VREF |
| 1    | IO_L01N_1/VRP_1      | IO_L01N_1/VRP_1      | A32                  | DCI  |
| 1    | IO_L01P_1/VRN_1      | IO_L01P_1/VRN_1      | B32                  | DCI  |
| 1    | IO_L02N_1            | IO_L02N_1            | A31                  | I/O  |
| 1    | IO_L02P_1            | IO_L02P_1            | B31                  | I/O  |
| 1    | IO_L03N_1            | IO_L03N_1            | B30                  | I/O  |
| 1    | IO_L03P_1            | IO_L03P_1            | C30                  | I/O  |
| 1    | IO_L04N_1            | IO_L04N_1            | C29                  | I/O  |
| 1    | IO_L04P_1            | IO_L04P_1            | D29                  | I/O  |
| 1    | IO_L05N_1            | IO_L05N_1            | A29                  | I/O  |
| 1    | IO_L05P_1            | IO_L05P_1            | B29                  | I/O  |
| 1    | IO_L06N_1/VREF_1     | IO_L06N_1/VREF_1     | E28                  | VREF |
| 1    | IO_L06P_1            | IO_L06P_1            | F28                  | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 1    | IO_L07N_1            | IO_L07N_1            | D27                  | I/O  |
| 1    | IO_L07P_1            | IO_L07P_1            | E27                  | I/O  |
| 1    | IO_L08N_1            | IO_L08N_1            | A27                  | I/O  |
| 1    | IO_L08P_1            | IO_L08P_1            | B27                  | I/O  |
| 1    | IO_L09N_1            | IO_L09N_1            | F26                  | I/O  |
| 1    | IO_L09P_1            | IO_L09P_1            | G26                  | I/O  |
| 1    | IO_L10N_1/VREF_1     | IO_L10N_1/VREF_1     | C26                  | VREF |
| 1    | IO_L10P_1            | IO_L10P_1            | D26                  | I/O  |
| 1    | IO_L11N_1            | IO_L11N_1            | H25                  | I/O  |
| 1    | IO_L11P_1            | IO_L11P_1            | J25                  | I/O  |
| 1    | IO_L12N_1            | IO_L12N_1            | F25                  | I/O  |
| 1    | IO_L12P_1            | IO_L12P_1            | G25                  | I/O  |
| 1    | IO_L13N_1            | IO_L13N_1            | C25                  | I/O  |
| 1    | IO_L13P_1            | IO_L13P_1            | D25                  | I/O  |
| 1    | IO_L14N_1            | IO_L14N_1            | A25                  | I/O  |
| 1    | IO_L14P_1            | IO_L14P_1            | B25                  | I/O  |
| 1    | IO_L15N_1            | IO_L15N_1            | A24                  | I/O  |
| 1    | IO_L15P_1            | IO_L15P_1            | B24                  | I/O  |
| 1    | IO_L16N_1            | IO_L16N_1            | J23                  | I/O  |
| 1    | IO_L16P_1            | IO_L16P_1            | K23                  | I/O  |
| 1    | IO_L17N_1/VREF_1     | IO_L17N_1/VREF_1     | F23                  | VREF |
| 1    | IO_L17P_1            | IO_L17P_1            | G23                  | I/O  |
| 1    | IO_L18N_1            | IO_L18N_1            | D23                  | I/O  |
| 1    | IO_L18P_1            | IO_L18P_1            | E23                  | I/O  |
| 1    | IO_L19N_1            | IO_L19N_1            | A23                  | I/O  |
| 1    | IO_L19P_1            | IO_L19P_1            | B23                  | I/O  |
| 1    | IO_L20N_1            | IO_L20N_1            | K22                  | I/O  |
| 1    | IO_L20P_1            | IO_L20P_1            | L22                  | I/O  |
| 1    | IO_L21N_1            | IO_L21N_1            | G22                  | I/O  |
| 1    | IO_L21P_1            | IO_L21P_1            | H22                  | I/O  |
| 1    | IO_L22N_1            | IO_L22N_1            | C22                  | I/O  |
| 1    | IO_L22P_1            | IO_L22P_1            | D22                  | I/O  |
| 1    | IO_L23N_1            | IO_L23N_1            | H21                  | I/O  |
| 1    | IO_L23P_1            | IO_L23P_1            | J21                  | I/O  |
| 1    | IO_L24N_1            | IO_L24N_1            | F21                  | I/O  |
| 1    | IO_L24P_1            | IO_L24P_1            | G21                  | I/O  |
| 1    | IO_L25N_1            | IO_L25N_1            | C21                  | I/O  |
| 1    | IO_L25P_1            | IO_L25P_1            | D21                  | I/O  |
| 1    | IO_L26N_1            | IO_L26N_1            | A21                  | I/O  |
| 1    | IO_L26P_1            | IO_L26P_1            | B21                  | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 1    | IO_L27N_1            | IO_L27N_1            | F19                  | I/O  |
| 1    | IO_L27P_1            | IO_L27P_1            | G19                  | I/O  |
| 1    | IO_L28N_1            | IO_L28N_1            | B19                  | I/O  |
| 1    | IO_L28P_1            | IO_L28P_1            | C19                  | I/O  |
| 1    | IO_L29N_1            | IO_L29N_1            | J18                  | I/O  |
| 1    | IO_L29P_1            | IO_L29P_1            | K18                  | I/O  |
| 1    | IO_L30N_1            | IO_L30N_1            | G18                  | I/O  |
| 1    | IO_L30P_1            | IO_L30P_1            | H18                  | I/O  |
| 1    | IO_L31N_1/VREF_1     | IO_L31N_1/VREF_1     | D18                  | VREF |
| 1    | IO_L31P_1            | IO_L31P_1            | E18                  | I/O  |
| 1    | IO_L32N_1/GCLK5      | IO_L32N_1/GCLK5      | B18                  | GCLK |
| 1    | IO_L32P_1/GCLK4      | IO_L32P_1/GCLK4      | C18                  | GCLK |
| 1    | N.C. (◆)             | IO_L33N_1            | C28                  | I/O  |
| 1    | N.C. (◆)             | IO_L33P_1            | D28                  | I/O  |
| 1    | N.C. (◆)             | IO_L34N_1            | A28                  | I/O  |
| 1    | N.C. (◆)             | IO_L34P_1            | B28                  | I/O  |
| 1    | N.C. (◆)             | IO_L35N_1            | J24                  | I/O  |
| 1    | N.C. (◆)             | IO_L35P_1            | K24                  | I/O  |
| 1    | N.C. (◆)             | IO_L36N_1            | F24                  | I/O  |
| 1    | N.C. (◆)             | IO_L36P_1            | G24                  | I/O  |
| 1    | IO_L37N_1            | IO_L37N_1            | J20                  | I/O  |
| 1    | IO_L37P_1            | IO_L37P_1            | K20                  | I/O  |
| 1    | IO_L38N_1            | IO_L38N_1            | F20                  | I/O  |
| 1    | IO_L38P_1            | IO_L38P_1            | G20                  | I/O  |
| 1    | IO_L39N_1            | IO_L39N_1            | C20                  | I/O  |
| 1    | IO_L39P_1            | IO_L39P_1            | D20                  | I/O  |
| 1    | IO_L40N_1            | IO_L40N_1            | A20                  | I/O  |
| 1    | IO_L40P_1            | IO_L40P_1            | B20                  | I/O  |
| 1    | VCCO_1               | VCCO_1               | B22                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | C27                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | C31                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | D19                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | D24                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | F22                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | G27                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | H20                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | H24                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | M19                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | M20                  | VCCO |
| 1    | VCCO_1               | VCCO_1               | M21                  | VCCO |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 1    | VCCO_1               | VCCO_1               | M22                  | VCCO |
| 2    | IO                   | IO                   | G33                  | I/O  |
| 2    | IO                   | IO                   | G34                  | I/O  |
| 2    | IO                   | IO                   | U25                  | I/O  |
| 2    | IO                   | IO                   | U26                  | I/O  |
| 2    | IO_L01N_2/VRP_2      | IO_L01N_2/VRP_2      | C33                  | DCI  |
| 2    | IO_L01P_2/VRN_2      | IO_L01P_2/VRN_2      | C34                  | DCI  |
| 2    | IO_L02N_2            | IO_L02N_2            | D33                  | I/O  |
| 2    | IO_L02P_2            | IO_L02P_2            | D34                  | I/O  |
| 2    | IO_L03N_2/VREF_2     | IO_L03N_2/VREF_2     | E32                  | VREF |
| 2    | IO_L03P_2            | IO_L03P_2            | E33                  | I/O  |
| 2    | IO_L04N_2            | IO_L04N_2            | F31                  | I/O  |
| 2    | IO_L04P_2            | IO_L04P_2            | F32                  | I/O  |
| 2    | IO_L05N_2            | IO_L05N_2            | G29                  | I/O  |
| 2    | IO_L05P_2            | IO_L05P_2            | G30                  | I/O  |
| 2    | IO_L06N_2            | IO_L06N_2            | H29                  | I/O  |
| 2    | IO_L06P_2            | IO_L06P_2            | H30                  | I/O  |
| 2    | IO_L07N_2            | IO_L07N_2            | H33                  | I/O  |
| 2    | IO_L07P_2            | IO_L07P_2            | H34                  | I/O  |
| 2    | IO_L08N_2            | IO_L08N_2            | J28                  | I/O  |
| 2    | IO_L08P_2            | IO_L08P_2            | J29                  | I/O  |
| 2    | IO_L09N_2/VREF_2     | IO_L09N_2/VREF_2     | H31                  | VREF |
| 2    | IO_L09P_2            | IO_L09P_2            | J31                  | I/O  |
| 2    | IO_L10N_2            | IO_L10N_2            | J32                  | I/O  |
| 2    | IO_L10P_2            | IO_L10P_2            | J33                  | I/O  |
| 2    | IO_L11N_2            | IO_L11N_2            | J27                  | I/O  |
| 2    | IO_L11P_2            | IO_L11P_2            | K26                  | I/O  |
| 2    | IO_L12N_2            | IO_L12N_2            | K27                  | I/O  |
| 2    | IO_L12P_2            | IO_L12P_2            | K28                  | I/O  |
| 2    | IO_L13N_2            | IO_L13N_2            | K29                  | I/O  |
| 2    | IO_L13P_2/VREF_2     | IO_L13P_2/VREF_2     | K30                  | VREF |
| 2    | IO_L14N_2            | IO_L14N_2            | K31                  | I/O  |
| 2    | IO_L14P_2            | IO_L14P_2            | K32                  | I/O  |
| 2    | IO_L15N_2            | IO_L15N_2            | K33                  | I/O  |
| 2    | IO_L15P_2            | IO_L15P_2            | K34                  | I/O  |
| 2    | IO_L16N_2            | IO_L16N_2            | L25                  | I/O  |
| 2    | IO_L16P_2            | IO_L16P_2            | L26                  | I/O  |
| 2    | N.C. (◆)             | IO_L17N_2            | L28                  | I/O  |
| 2    | N.C. (◆)             | IO_L17P_2/<br>VREF_2 | L29                  | VREF |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 2    | IO_L19N_2            | IO_L19N_2            | M29                  | I/O  |
| 2    | IO_L19P_2            | IO_L19P_2            | M30                  | I/O  |
| 2    | IO_L20N_2            | IO_L20N_2            | M31                  | I/O  |
| 2    | IO_L20P_2            | IO_L20P_2            | M32                  | I/O  |
| 2    | IO_L21N_2            | IO_L21N_2            | M26                  | I/O  |
| 2    | IO_L21P_2            | IO_L21P_2            | N25                  | I/O  |
| 2    | IO_L22N_2            | IO_L22N_2            | N27                  | I/O  |
| 2    | IO_L22P_2            | IO_L22P_2            | N28                  | I/O  |
| 2    | IO_L23N_2/VREF_2     | IO_L23N_2/VREF_2     | N31                  | VREF |
| 2    | IO_L23P_2            | IO_L23P_2            | N32                  | I/O  |
| 2    | IO_L24N_2            | IO_L24N_2            | N24                  | I/O  |
| 2    | IO_L24P_2            | IO_L24P_2            | P24                  | I/O  |
| 2    | IO_L26N_2            | IO_L26N_2            | P29                  | I/O  |
| 2    | IO_L26P_2            | IO_L26P_2            | P30                  | I/O  |
| 2    | IO_L27N_2            | IO_L27N_2            | P31                  | I/O  |
| 2    | IO_L27P_2            | IO_L27P_2            | P32                  | I/O  |
| 2    | IO_L28N_2            | IO_L28N_2            | P33                  | I/O  |
| 2    | IO_L28P_2            | IO_L28P_2            | P34                  | I/O  |
| 2    | IO_L29N_2            | IO_L29N_2            | R24                  | I/O  |
| 2    | IO_L29P_2            | IO_L29P_2            | R25                  | I/O  |
| 2    | IO_L30N_2            | IO_L30N_2            | R28                  | I/O  |
| 2    | IO_L30P_2            | IO_L30P_2            | R29                  | I/O  |
| 2    | IO_L31N_2            | IO_L31N_2            | R31                  | I/O  |
| 2    | IO_L31P_2            | IO_L31P_2            | R32                  | I/O  |
| 2    | IO_L32N_2            | IO_L32N_2            | R33                  | I/O  |
| 2    | IO_L32P_2            | IO_L32P_2            | R34                  | I/O  |
| 2    | IO_L33N_2            | IO_L33N_2            | R26                  | I/O  |
| 2    | IO_L33P_2            | IO_L33P_2            | T25                  | I/O  |
| 2    | IO_L34N_2/VREF_2     | IO_L34N_2/VREF_2     | T28                  | VREF |
| 2    | IO_L34P_2            | IO_L34P_2            | T29                  | I/O  |
| 2    | IO_L35N_2            | IO_L35N_2            | T32                  | I/O  |
| 2    | IO_L35P_2            | IO_L35P_2            | T33                  | I/O  |
| 2    | IO_L37N_2            | IO_L37N_2            | U27                  | I/O  |
| 2    | IO_L37P_2            | IO_L37P_2            | U28                  | I/O  |
| 2    | IO_L38N_2            | IO_L38N_2            | U29                  | I/O  |
| 2    | IO_L38P_2            | IO_L38P_2            | U30                  | I/O  |
| 2    | IO_L39N_2            | IO_L39N_2            | U31                  | I/O  |
| 2    | IO_L39P_2            | IO_L39P_2            | U32                  | I/O  |
| 2    | IO_L40N_2            | IO_L40N_2            | U33                  | I/O  |
| 2    | IO_L40P_2/VREF_2     | IO_L40P_2/VREF_2     | U34                  | VREF |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 2    | IO_L41N_2         | IO_L41N_2         | F33               | I/O  |
| 2    | IO_L41P_2         | IO_L41P_2         | F34               | I/O  |
| 2    | N.C. (◆)          | IO_L42N_2         | G31               | I/O  |
| 2    | N.C. (◆)          | IO_L42P_2         | G32               | I/O  |
| 2    | IO_L45N_2         | IO_L45N_2         | L33               | I/O  |
| 2    | IO_L45P_2         | IO_L45P_2         | L34               | I/O  |
| 2    | IO_L46N_2         | IO_L46N_2         | M24               | I/O  |
| 2    | IO_L46P_2         | IO_L46P_2         | M25               | I/O  |
| 2    | IO_L47N_2         | IO_L47N_2         | M27               | I/O  |
| 2    | IO_L47P_2         | IO_L47P_2         | M28               | I/O  |
| 2    | IO_L48N_2         | IO_L48N_2         | M33               | I/O  |
| 2    | IO_L48P_2         | IO_L48P_2         | M34               | I/O  |
| 2    | N.C. (◆)          | IO_L49N_2         | P25               | I/O  |
| 2    | N.C. (◆)          | IO_L49P_2         | P26               | I/O  |
| 2    | IO_L50N_2         | IO_L50N_2         | P27               | I/O  |
| 2    | IO_L50P_2         | IO_L50P_2         | P28               | I/O  |
| 2    | N.C. (◆)          | IO_L51N_2         | T24               | I/O  |
| 2    | N.C. (◆)          | IO_L51P_2         | U24               | I/O  |
| 2    | VCCO_2            | VCCO_2            | D32               | VCCO |
| 2    | VCCO_2            | VCCO_2            | H28               | VCCO |
| 2    | VCCO_2            | VCCO_2            | H32               | VCCO |
| 2    | VCCO_2            | VCCO_2            | L27               | VCCO |
| 2    | VCCO_2            | VCCO_2            | L31               | VCCO |
| 2    | VCCO_2            | VCCO_2            | N23               | VCCO |
| 2    | VCCO_2            | VCCO_2            | N29               | VCCO |
| 2    | VCCO_2            | VCCO_2            | N33               | VCCO |
| 2    | VCCO_2            | VCCO_2            | P23               | VCCO |
| 2    | VCCO_2            | VCCO_2            | R23               | VCCO |
| 2    | VCCO_2            | VCCO_2            | R27               | VCCO |
| 2    | VCCO_2            | VCCO_2            | T23               | VCCO |
| 2    | VCCO_2            | VCCO_2            | T31               | VCCO |
| 3    | IO                | IO                | AH33              | I/O  |
| 3    | IO                | IO                | AH34              | I/O  |
| 3    | IO                | IO                | V25               | I/O  |
| 3    | IO                | IO                | V26               | I/O  |
| 3    | IO_L01N_3/VRP_3   | IO_L01N_3/VRP_3   | AM34              | DCI  |
| 3    | IO_L01P_3/VRN_3   | IO_L01P_3/VRN_3   | AM33              | DCI  |
| 3    | IO_L02N_3/VREF_3  | IO_L02N_3/VREF_3  | AL34              | VREF |
| 3    | IO_L02P_3         | IO_L02P_3         | AL33              | I/O  |
| 3    | IO_L03N_3         | IO_L03N_3         | AK33              | I/O  |



Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 3    | IO_L03P_3            | IO_L03P_3            | AK32                 | I/O  |
| 3    | IO_L04N_3            | IO_L04N_3            | AJ32                 | I/O  |
| 3    | IO_L04P_3            | IO_L04P_3            | AJ31                 | I/O  |
| 3    | IO_L05N_3            | IO_L05N_3            | AJ34                 | I/O  |
| 3    | IO_L05P_3            | IO_L05P_3            | AJ33                 | I/O  |
| 3    | IO_L06N_3            | IO_L06N_3            | AH30                 | I/O  |
| 3    | IO_L06P_3            | IO_L06P_3            | AH29                 | I/O  |
| 3    | IO_L07N_3            | IO_L07N_3            | AG30                 | I/O  |
| 3    | IO_L07P_3            | IO_L07P_3            | AG29                 | I/O  |
| 3    | IO_L08N_3            | IO_L08N_3            | AG34                 | I/O  |
| 3    | IO_L08P_3            | IO_L08P_3            | AG33                 | I/O  |
| 3    | IO_L09N_3            | IO_L09N_3            | AF29                 | I/O  |
| 3    | IO_L09P_3/VREF_3     | IO_L09P_3/VREF_3     | AF28                 | VREF |
| 3    | IO_L10N_3            | IO_L10N_3            | AF31                 | I/O  |
| 3    | IO_L10P_3            | IO_L10P_3            | AG31                 | I/O  |
| 3    | IO_L11N_3            | IO_L11N_3            | AF33                 | I/O  |
| 3    | IO_L11P_3            | IO_L11P_3            | AF32                 | I/O  |
| 3    | IO_L12N_3            | IO_L12N_3            | AE26                 | I/O  |
| 3    | IO_L12P_3            | IO_L12P_3            | AF27                 | I/O  |
| 3    | IO_L13N_3/VREF_3     | IO_L13N_3/VREF_3     | AE28                 | VREF |
| 3    | IO_L13P_3            | IO_L13P_3            | AE27                 | I/O  |
| 3    | IO_L14N_3            | IO_L14N_3            | AE30                 | I/O  |
| 3    | IO_L14P_3            | IO_L14P_3            | AE29                 | I/O  |
| 3    | IO_L15N_3            | IO_L15N_3            | AE32                 | I/O  |
| 3    | IO_L15P_3            | IO_L15P_3            | AE31                 | I/O  |
| 3    | IO_L16N_3            | IO_L16N_3            | AE34                 | I/O  |
| 3    | IO_L16P_3            | IO_L16P_3            | AE33                 | I/O  |
| 3    | IO_L17N_3            | IO_L17N_3            | AD26                 | I/O  |
| 3    | IO_L17P_3/VREF_3     | IO_L17P_3/VREF_3     | AD25                 | VREF |
| 3    | IO_L19N_3            | IO_L19N_3            | AD34                 | I/O  |
| 3    | IO_L19P_3            | IO_L19P_3            | AD33                 | I/O  |
| 3    | IO_L20N_3            | IO_L20N_3            | AC25                 | I/O  |
| 3    | IO_L20P_3            | IO_L20P_3            | AC24                 | I/O  |
| 3    | IO_L21N_3            | IO_L21N_3            | AC28                 | I/O  |
| 3    | IO_L21P_3            | IO_L21P_3            | AC27                 | I/O  |
| 3    | IO_L22N_3            | IO_L22N_3            | AC30                 | I/O  |
| 3    | IO_L22P_3            | IO_L22P_3            | AC29                 | I/O  |
| 3    | IO_L23N_3            | IO_L23N_3            | AC32                 | I/O  |
| 3    | IO_L23P_3/VREF_3     | IO_L23P_3/VREF_3     | AC31                 | VREF |
| 3    | IO_L24N_3            | IO_L24N_3            | AB25                 | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 3    | IO_L24P_3            | IO_L24P_3            | AC26                 | I/O  |
| 3    | IO_L26N_3            | IO_L26N_3            | AA28                 | I/O  |
| 3    | IO_L26P_3            | IO_L26P_3            | AA27                 | I/O  |
| 3    | IO_L27N_3            | IO_L27N_3            | AA30                 | I/O  |
| 3    | IO_L27P_3            | IO_L27P_3            | AA29                 | I/O  |
| 3    | IO_L28N_3            | IO_L28N_3            | AA32                 | I/O  |
| 3    | IO_L28P_3            | IO_L28P_3            | AA31                 | I/O  |
| 3    | IO_L29N_3            | IO_L29N_3            | AA34                 | I/O  |
| 3    | IO_L29P_3            | IO_L29P_3            | AA33                 | I/O  |
| 3    | IO_L30N_3            | IO_L30N_3            | Y29                  | I/O  |
| 3    | IO_L30P_3            | IO_L30P_3            | Y28                  | I/O  |
| 3    | IO_L31N_3            | IO_L31N_3            | Y32                  | I/O  |
| 3    | IO_L31P_3            | IO_L31P_3            | Y31                  | I/O  |
| 3    | IO_L32N_3            | IO_L32N_3            | Y34                  | I/O  |
| 3    | IO_L32P_3            | IO_L32P_3            | Y33                  | I/O  |
| 3    | IO_L33N_3            | IO_L33N_3            | W25                  | I/O  |
| 3    | IO_L33P_3            | IO_L33P_3            | Y26                  | I/O  |
| 3    | IO_L34N_3            | IO_L34N_3            | W29                  | I/O  |
| 3    | IO_L34P_3/VREF_3     | IO_L34P_3/VREF_3     | W28                  | VREF |
| 3    | IO_L35N_3            | IO_L35N_3            | W33                  | I/O  |
| 3    | IO_L35P_3            | IO_L35P_3            | W32                  | I/O  |
| 3    | IO_L37N_3            | IO_L37N_3            | V28                  | I/O  |
| 3    | IO_L37P_3            | IO_L37P_3            | V27                  | I/O  |
| 3    | IO_L38N_3            | IO_L38N_3            | V30                  | I/O  |
| 3    | IO_L38P_3            | IO_L38P_3            | V29                  | I/O  |
| 3    | IO_L39N_3            | IO_L39N_3            | V32                  | I/O  |
| 3    | IO_L39P_3            | IO_L39P_3            | V31                  | I/O  |
| 3    | IO_L40N_3/VREF_3     | IO_L40N_3/VREF_3     | V34                  | VREF |
| 3    | IO_L40P_3            | IO_L40P_3            | V33                  | I/O  |
| 3    | N.C. (◆)             | IO_L41N_3            | AH32                 | I/O  |
| 3    | N.C. (◆)             | IO_L41P_3            | AH31                 | I/O  |
| 3    | N.C. (◆)             | IO_L44N_3            | AD29                 | I/O  |
| 3    | N.C. (◆)             | IO_L44P_3            | AD28                 | I/O  |
| 3    | IO_L45N_3            | IO_L45N_3            | AC34                 | I/O  |
| 3    | IO_L45P_3            | IO_L45P_3            | AC33                 | I/O  |
| 3    | IO_L46N_3            | IO_L46N_3            | AB28                 | I/O  |
| 3    | IO_L46P_3            | IO_L46P_3            | AB27                 | I/O  |
| 3    | IO_L47N_3            | IO_L47N_3            | AB32                 | I/O  |
| 3    | IO_L47P_3            | IO_L47P_3            | AB31                 | I/O  |
| 3    | IO_L48N_3            | IO_L48N_3            | AA24                 | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 3    | IO_L48P_3         | IO_L48P_3         | AB24              | I/O  |
| 3    | N.C. (◆)          | IO_L49N_3         | AA26              | I/O  |
| 3    | N.C. (◆)          | IO_L49P_3         | AA25              | I/O  |
| 3    | IO_L50N_3         | IO_L50N_3         | Y25               | I/O  |
| 3    | IO_L50P_3         | IO_L50P_3         | Y24               | I/O  |
| 3    | N.C. (◆)          | IO_L51N_3         | V24               | I/O  |
| 3    | N.C. (◆)          | IO_L51P_3         | W24               | I/O  |
| 3    | VCCO_3            | VCCO_3            | AA23              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AB23              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AB29              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AB33              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AD27              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AD31              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AG28              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AG32              | VCCO |
| 3    | VCCO_3            | VCCO_3            | AL32              | VCCO |
| 3    | VCCO_3            | VCCO_3            | W23               | VCCO |
| 3    | VCCO_3            | VCCO_3            | W31               | VCCO |
| 3    | VCCO_3            | VCCO_3            | Y23               | VCCO |
| 3    | VCCO_3            | VCCO_3            | Y27               | VCCO |
| 4    | IO                | IO                | AD18              | I/O  |
| 4    | IO                | IO                | AD19              | I/O  |
| 4    | IO                | IO                | AD20              | I/O  |
| 4    | IO                | IO                | AD22              | I/O  |
| 4    | IO                | IO                | AE18              | I/O  |
| 4    | IO                | IO                | AE19              | I/O  |
| 4    | IO                | IO                | AE22              | I/O  |
| 4    | N.C. (◆)          | IO                | AE24              | I/O  |
| 4    | IO                | IO                | AF24              | I/O  |
| 4    | N.C. (◆)          | IO                | AF26              | I/O  |
| 4    | IO                | IO                | AG26              | I/O  |
| 4    | IO                | IO                | AG27              | I/O  |
| 4    | IO                | IO                | AJ27              | I/O  |
| 4    | IO                | IO                | AJ29              | I/O  |
| 4    | IO                | IO                | AK25              | I/O  |
| 4    | IO                | IO                | AN26              | I/O  |
| 4    | IO/VREF_4         | IO/VREF_4         | AF21              | VREF |
| 4    | IO/VREF_4         | IO/VREF_4         | AH23              | VREF |
| 4    | IO/VREF_4         | IO/VREF_4         | AK18              | VREF |
| 4    | IO/VREF_4         | IO/VREF_4         | AL30              | VREF |

**Table 110: FG1156 Package Pinout (Cont'd)**

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 4    | IO_L01N_4/VRP_4   | IO_L01N_4/VRP_4   | AN32              | DCI  |
| 4    | IO_L01P_4/VRN_4   | IO_L01P_4/VRN_4   | AP32              | DCI  |
| 4    | IO_L02N_4         | IO_L02N_4         | AN31              | I/O  |
| 4    | IO_L02P_4         | IO_L02P_4         | AP31              | I/O  |
| 4    | IO_L03N_4         | IO_L03N_4         | AM30              | I/O  |
| 4    | IO_L03P_4         | IO_L03P_4         | AN30              | I/O  |
| 4    | IO_L04N_4         | IO_L04N_4         | AN27              | I/O  |
| 4    | IO_L04P_4         | IO_L04P_4         | AP27              | I/O  |
| 4    | IO_L05N_4         | IO_L05N_4         | AH26              | I/O  |
| 4    | IO_L05P_4         | IO_L05P_4         | AJ26              | I/O  |
| 4    | IO_L06N_4/VREF_4  | IO_L06N_4/VREF_4  | AL26              | VREF |
| 4    | IO_L06P_4         | IO_L06P_4         | AM26              | I/O  |
| 4    | IO_L07N_4         | IO_L07N_4         | AF25              | I/O  |
| 4    | IO_L07P_4         | IO_L07P_4         | AG25              | I/O  |
| 4    | IO_L08N_4         | IO_L08N_4         | AH25              | I/O  |
| 4    | IO_L08P_4         | IO_L08P_4         | AJ25              | I/O  |
| 4    | IO_L09N_4         | IO_L09N_4         | AL25              | I/O  |
| 4    | IO_L09P_4         | IO_L09P_4         | AM25              | I/O  |
| 4    | IO_L10N_4         | IO_L10N_4         | AN25              | I/O  |
| 4    | IO_L10P_4         | IO_L10P_4         | AP25              | I/O  |
| 4    | IO_L11N_4         | IO_L11N_4         | AD23              | I/O  |
| 4    | IO_L11P_4         | IO_L11P_4         | AE23              | I/O  |
| 4    | IO_L12N_4         | IO_L12N_4         | AF23              | I/O  |
| 4    | IO_L12P_4         | IO_L12P_4         | AG23              | I/O  |
| 4    | IO_L13N_4         | IO_L13N_4         | AJ23              | I/O  |
| 4    | IO_L13P_4         | IO_L13P_4         | AK23              | I/O  |
| 4    | IO_L14N_4         | IO_L14N_4         | AL23              | I/O  |
| 4    | IO_L14P_4         | IO_L14P_4         | AM23              | I/O  |
| 4    | IO_L15N_4         | IO_L15N_4         | AN23              | I/O  |
| 4    | IO_L15P_4         | IO_L15P_4         | AP23              | I/O  |
| 4    | IO_L16N_4         | IO_L16N_4         | AG22              | I/O  |
| 4    | IO_L16P_4         | IO_L16P_4         | AH22              | I/O  |
| 4    | IO_L17N_4         | IO_L17N_4         | AL22              | I/O  |
| 4    | IO_L17P_4         | IO_L17P_4         | AM22              | I/O  |
| 4    | IO_L18N_4         | IO_L18N_4         | AD21              | I/O  |
| 4    | IO_L18P_4         | IO_L18P_4         | AE21              | I/O  |
| 4    | IO_L19N_4         | IO_L19N_4         | AG21              | I/O  |
| 4    | IO_L19P_4         | IO_L19P_4         | AH21              | I/O  |
| 4    | IO_L20N_4         | IO_L20N_4         | AJ21              | I/O  |
| 4    | IO_L20P_4         | IO_L20P_4         | AK21              | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name   | XC3S5000 Pin Name   | FG1156 Pin Number | Type |
|------|---------------------|---------------------|-------------------|------|
| 4    | IO_L21N_4           | IO_L21N_4           | AL21              | I/O  |
| 4    | IO_L21P_4           | IO_L21P_4           | AM21              | I/O  |
| 4    | IO_L22N_4/VREF_4    | IO_L22N_4/VREF_4    | AN21              | VREF |
| 4    | IO_L22P_4           | IO_L22P_4           | AP21              | I/O  |
| 4    | IO_L23N_4           | IO_L23N_4           | AE20              | I/O  |
| 4    | IO_L23P_4           | IO_L23P_4           | AF20              | I/O  |
| 4    | IO_L24N_4           | IO_L24N_4           | AH20              | I/O  |
| 4    | IO_L24P_4           | IO_L24P_4           | AJ20              | I/O  |
| 4    | IO_L25N_4           | IO_L25N_4           | AL20              | I/O  |
| 4    | IO_L25P_4           | IO_L25P_4           | AM20              | I/O  |
| 4    | IO_L26N_4           | IO_L26N_4           | AN20              | I/O  |
| 4    | IO_L26P_4/VREF_4    | IO_L26P_4/VREF_4    | AP20              | VREF |
| 4    | IO_L27N_4/DIN/D0    | IO_L27N_4/DIN/D0    | AH19              | DUAL |
| 4    | IO_L27P_4/D1        | IO_L27P_4/D1        | AJ19              | DUAL |
| 4    | IO_L28N_4           | IO_L28N_4           | AM19              | I/O  |
| 4    | IO_L28P_4           | IO_L28P_4           | AN19              | I/O  |
| 4    | IO_L29N_4           | IO_L29N_4           | AF18              | I/O  |
| 4    | IO_L29P_4           | IO_L29P_4           | AG18              | I/O  |
| 4    | IO_L30N_4/D2        | IO_L30N_4/D2        | AH18              | DUAL |
| 4    | IO_L30P_4/D3        | IO_L30P_4/D3        | AJ18              | DUAL |
| 4    | IO_L31N_4/INIT_B    | IO_L31N_4/INIT_B    | AL18              | DUAL |
| 4    | IO_L31P_4/DOUT/BUSY | IO_L31P_4/DOUT/BUSY | AM18              | DUAL |
| 4    | IO_L32N_4/GCLK1     | IO_L32N_4/GCLK1     | AN18              | GCLK |
| 4    | IO_L32P_4/GCLK0     | IO_L32P_4/GCLK0     | AP18              | GCLK |
| 4    | IO_L33N_4           | IO_L33N_4           | AL29              | I/O  |
| 4    | IO_L33P_4           | IO_L33P_4           | AM29              | I/O  |
| 4    | IO_L34N_4           | IO_L34N_4           | AN29              | I/O  |
| 4    | IO_L34P_4           | IO_L34P_4           | AP29              | I/O  |
| 4    | IO_L35N_4           | IO_L35N_4           | AJ28              | I/O  |
| 4    | IO_L35P_4           | IO_L35P_4           | AK28              | I/O  |
| 4    | N.C. (◆)            | IO_L36N_4           | AL28              | I/O  |
| 4    | N.C. (◆)            | IO_L36P_4           | AM28              | I/O  |
| 4    | N.C. (◆)            | IO_L37N_4           | AN28              | I/O  |
| 4    | N.C. (◆)            | IO_L37P_4           | AP28              | I/O  |
| 4    | IO_L38N_4           | IO_L38N_4           | AK27              | I/O  |
| 4    | IO_L38P_4           | IO_L38P_4           | AL27              | I/O  |
| 4    | N.C. (◆)            | IO_L39N_4           | AH24              | I/O  |
| 4    | N.C. (◆)            | IO_L39P_4           | AJ24              | I/O  |
| 4    | N.C. (◆)            | IO_L40N_4           | AN24              | I/O  |
| 4    | N.C. (◆)            | IO_L40P_4           | AP24              | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 4    | VCCO_4            | VCCO_4            | AC19              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AC20              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AC21              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AC22              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AG20              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AG24              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AH27              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AJ22              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AL19              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AL24              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AM27              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AM31              | VCCO |
| 4    | VCCO_4            | VCCO_4            | AN22              | VCCO |
| 5    | IO                | IO                | AD11              | I/O  |
| 5    | N.C. (◆)          | IO                | AD12              | I/O  |
| 5    | IO                | IO                | AD14              | I/O  |
| 5    | IO                | IO                | AD15              | I/O  |
| 5    | IO                | IO                | AD16              | I/O  |
| 5    | IO                | IO                | AD17              | I/O  |
| 5    | IO                | IO                | AE14              | I/O  |
| 5    | IO                | IO                | AE16              | I/O  |
| 5    | N.C. (◆)          | IO                | AF9               | I/O  |
| 5    | IO                | IO                | AG9               | I/O  |
| 5    | IO                | IO                | AG12              | I/O  |
| 5    | IO                | IO                | AJ6               | I/O  |
| 5    | IO                | IO                | AJ17              | I/O  |
| 5    | IO                | IO                | AK10              | I/O  |
| 5    | IO                | IO                | AK14              | I/O  |
| 5    | IO                | IO                | AM12              | I/O  |
| 5    | IO                | IO                | AN9               | I/O  |
| 5    | IO/VREF_5         | IO/VREF_5         | AJ8               | VREF |
| 5    | IO/VREF_5         | IO/VREF_5         | AL5               | VREF |
| 5    | IO/VREF_5         | IO/VREF_5         | AP17              | VREF |
| 5    | IO_L01N_5/RDWR_B  | IO_L01N_5/RDWR_B  | AP3               | DUAL |
| 5    | IO_L01P_5/CS_B    | IO_L01P_5/CS_B    | AN3               | DUAL |
| 5    | IO_L02N_5         | IO_L02N_5         | AP4               | I/O  |
| 5    | IO_L02P_5         | IO_L02P_5         | AN4               | I/O  |
| 5    | IO_L03N_5         | IO_L03N_5         | AN5               | I/O  |
| 5    | IO_L03P_5         | IO_L03P_5         | AM5               | I/O  |
| 5    | IO_L04N_5         | IO_L04N_5         | AM6               | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| 5    | IO_L04P_5            | IO_L04P_5            | AL6                  | I/O  |
| 5    | IO_L05N_5            | IO_L05N_5            | AP6                  | I/O  |
| 5    | IO_L05P_5            | IO_L05P_5            | AN6                  | I/O  |
| 5    | IO_L06N_5            | IO_L06N_5            | AK7                  | I/O  |
| 5    | IO_L06P_5            | IO_L06P_5            | AJ7                  | I/O  |
| 5    | IO_L07N_5            | IO_L07N_5            | AG10                 | I/O  |
| 5    | IO_L07P_5            | IO_L07P_5            | AF10                 | I/O  |
| 5    | IO_L08N_5            | IO_L08N_5            | AJ10                 | I/O  |
| 5    | IO_L08P_5            | IO_L08P_5            | AH10                 | I/O  |
| 5    | IO_L09N_5            | IO_L09N_5            | AM10                 | I/O  |
| 5    | IO_L09P_5            | IO_L09P_5            | AL10                 | I/O  |
| 5    | IO_L10N_5/VRP_5      | IO_L10N_5/VRP_5      | AP10                 | DCI  |
| 5    | IO_L10P_5/VRN_5      | IO_L10P_5/VRN_5      | AN10                 | DCI  |
| 5    | IO_L11N_5/VREF_5     | IO_L11N_5/VREF_5     | AP11                 | VREF |
| 5    | IO_L11P_5            | IO_L11P_5            | AN11                 | I/O  |
| 5    | IO_L12N_5            | IO_L12N_5            | AF12                 | I/O  |
| 5    | IO_L12P_5            | IO_L12P_5            | AE12                 | I/O  |
| 5    | IO_L13N_5            | IO_L13N_5            | AJ12                 | I/O  |
| 5    | IO_L13P_5            | IO_L13P_5            | AH12                 | I/O  |
| 5    | IO_L14N_5            | IO_L14N_5            | AL12                 | I/O  |
| 5    | IO_L14P_5            | IO_L14P_5            | AK12                 | I/O  |
| 5    | IO_L15N_5            | IO_L15N_5            | AP12                 | I/O  |
| 5    | IO_L15P_5            | IO_L15P_5            | AN12                 | I/O  |
| 5    | IO_L16N_5            | IO_L16N_5            | AE13                 | I/O  |
| 5    | IO_L16P_5            | IO_L16P_5            | AD13                 | I/O  |
| 5    | IO_L17N_5            | IO_L17N_5            | AH13                 | I/O  |
| 5    | IO_L17P_5            | IO_L17P_5            | AG13                 | I/O  |
| 5    | IO_L18N_5            | IO_L18N_5            | AM13                 | I/O  |
| 5    | IO_L18P_5            | IO_L18P_5            | AL13                 | I/O  |
| 5    | IO_L19N_5            | IO_L19N_5            | AG14                 | I/O  |
| 5    | IO_L19P_5/VREF_5     | IO_L19P_5/VREF_5     | AF14                 | VREF |
| 5    | IO_L20N_5            | IO_L20N_5            | AJ14                 | I/O  |
| 5    | IO_L20P_5            | IO_L20P_5            | AH14                 | I/O  |
| 5    | IO_L21N_5            | IO_L21N_5            | AM14                 | I/O  |
| 5    | IO_L21P_5            | IO_L21P_5            | AL14                 | I/O  |
| 5    | IO_L22N_5            | IO_L22N_5            | AP14                 | I/O  |
| 5    | IO_L22P_5            | IO_L22P_5            | AN14                 | I/O  |
| 5    | IO_L23N_5            | IO_L23N_5            | AF15                 | I/O  |
| 5    | IO_L23P_5            | IO_L23P_5            | AE15                 | I/O  |
| 5    | IO_L24N_5            | IO_L24N_5            | AJ15                 | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 5    | IO_L24P_5         | IO_L24P_5         | AH15              | I/O  |
| 5    | IO_L25N_5         | IO_L25N_5         | AM15              | I/O  |
| 5    | IO_L25P_5         | IO_L25P_5         | AL15              | I/O  |
| 5    | IO_L26N_5         | IO_L26N_5         | AP15              | I/O  |
| 5    | IO_L26P_5         | IO_L26P_5         | AN15              | I/O  |
| 5    | IO_L27N_5/VREF_5  | IO_L27N_5/VREF_5  | AJ16              | VREF |
| 5    | IO_L27P_5         | IO_L27P_5         | AH16              | I/O  |
| 5    | IO_L28N_5/D6      | IO_L28N_5/D6      | AN16              | DUAL |
| 5    | IO_L28P_5/D7      | IO_L28P_5/D7      | AM16              | DUAL |
| 5    | IO_L29N_5         | IO_L29N_5         | AF17              | I/O  |
| 5    | IO_L29P_5/VREF_5  | IO_L29P_5/VREF_5  | AE17              | VREF |
| 5    | IO_L30N_5         | IO_L30N_5         | AH17              | I/O  |
| 5    | IO_L30P_5         | IO_L30P_5         | AG17              | I/O  |
| 5    | IO_L31N_5/D4      | IO_L31N_5/D4      | AL17              | DUAL |
| 5    | IO_L31P_5/D5      | IO_L31P_5/D5      | AK17              | DUAL |
| 5    | IO_L32N_5/GCLK3   | IO_L32N_5/GCLK3   | AN17              | GCLK |
| 5    | IO_L32P_5/GCLK2   | IO_L32P_5/GCLK2   | AM17              | GCLK |
| 5    | N.C. (◆)          | IO_L33N_5         | AM7               | I/O  |
| 5    | N.C. (◆)          | IO_L33P_5         | AL7               | I/O  |
| 5    | N.C. (◆)          | IO_L34N_5         | AP7               | I/O  |
| 5    | N.C. (◆)          | IO_L34P_5         | AN7               | I/O  |
| 5    | IO_L35N_5         | IO_L35N_5         | AL8               | I/O  |
| 5    | IO_L35P_5         | IO_L35P_5         | AK8               | I/O  |
| 5    | IO_L36N_5         | IO_L36N_5         | AP8               | I/O  |
| 5    | IO_L36P_5         | IO_L36P_5         | AN8               | I/O  |
| 5    | IO_L37N_5         | IO_L37N_5         | AJ9               | I/O  |
| 5    | IO_L37P_5         | IO_L37P_5         | AH9               | I/O  |
| 5    | IO_L38N_5         | IO_L38N_5         | AM9               | I/O  |
| 5    | IO_L38P_5         | IO_L38P_5         | AL9               | I/O  |
| 5    | N.C. (◆)          | IO_L39N_5         | AF11              | I/O  |
| 5    | N.C. (◆)          | IO_L39P_5         | AE11              | I/O  |
| 5    | N.C. (◆)          | IO_L40N_5         | AJ11              | I/O  |
| 5    | N.C. (◆)          | IO_L40P_5         | AH11              | I/O  |
| 5    | VCCO_5            | VCCO_5            | AC13              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AC14              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AC15              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AC16              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AG11              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AG15              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AH8               | VCCO |



Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 5    | VCCO_5            | VCCO_5            | AJ13              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AL11              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AL16              | VCCO |
| 5    | VCCO_5            | VCCO_5            | AM4               | VCCO |
| 5    | VCCO_5            | VCCO_5            | AM8               | VCCO |
| 5    | VCCO_5            | VCCO_5            | AN13              | VCCO |
| 6    | IO                | IO                | AH1               | I/O  |
| 6    | IO                | IO                | AH2               | I/O  |
| 6    | IO                | IO                | V9                | I/O  |
| 6    | IO                | IO                | V10               | I/O  |
| 6    | IO_L01N_6/VRP_6   | IO_L01N_6/VRP_6   | AM2               | DCI  |
| 6    | IO_L01P_6/VRN_6   | IO_L01P_6/VRN_6   | AM1               | DCI  |
| 6    | IO_L02N_6         | IO_L02N_6         | AL2               | I/O  |
| 6    | IO_L02P_6         | IO_L02P_6         | AL1               | I/O  |
| 6    | IO_L03N_6/VREF_6  | IO_L03N_6/VREF_6  | AK3               | VREF |
| 6    | IO_L03P_6         | IO_L03P_6         | AK2               | I/O  |
| 6    | IO_L04N_6         | IO_L04N_6         | AJ4               | I/O  |
| 6    | IO_L04P_6         | IO_L04P_6         | AJ3               | I/O  |
| 6    | IO_L05N_6         | IO_L05N_6         | AJ2               | I/O  |
| 6    | IO_L05P_6         | IO_L05P_6         | AJ1               | I/O  |
| 6    | IO_L06N_6         | IO_L06N_6         | AH6               | I/O  |
| 6    | IO_L06P_6         | IO_L06P_6         | AH5               | I/O  |
| 6    | IO_L07N_6         | IO_L07N_6         | AG6               | I/O  |
| 6    | IO_L07P_6         | IO_L07P_6         | AG5               | I/O  |
| 6    | IO_L08N_6         | IO_L08N_6         | AG2               | I/O  |
| 6    | IO_L08P_6         | IO_L08P_6         | AG1               | I/O  |
| 6    | IO_L09N_6/VREF_6  | IO_L09N_6/VREF_6  | AF7               | VREF |
| 6    | IO_L09P_6         | IO_L09P_6         | AF6               | I/O  |
| 6    | IO_L10N_6         | IO_L10N_6         | AG4               | I/O  |
| 6    | IO_L10P_6         | IO_L10P_6         | AF4               | I/O  |
| 6    | IO_L11N_6         | IO_L11N_6         | AF3               | I/O  |
| 6    | IO_L11P_6         | IO_L11P_6         | AF2               | I/O  |
| 6    | IO_L12N_6         | IO_L12N_6         | AF8               | I/O  |
| 6    | IO_L12P_6         | IO_L12P_6         | AE9               | I/O  |
| 6    | IO_L13N_6         | IO_L13N_6         | AE8               | I/O  |
| 6    | IO_L13P_6/VREF_6  | IO_L13P_6/VREF_6  | AE7               | VREF |
| 6    | IO_L14N_6         | IO_L14N_6         | AE6               | I/O  |
| 6    | IO_L14P_6         | IO_L14P_6         | AE5               | I/O  |
| 6    | IO_L15N_6         | IO_L15N_6         | AE4               | I/O  |
| 6    | IO_L15P_6         | IO_L15P_6         | AE3               | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 6    | IO_L16N_6         | IO_L16N_6         | AE2               | I/O  |
| 6    | IO_L16P_6         | IO_L16P_6         | AE1               | I/O  |
| 6    | IO_L17N_6         | IO_L17N_6         | AD10              | I/O  |
| 6    | IO_L17P_6/VREF_6  | IO_L17P_6/VREF_6  | AD9               | VREF |
| 6    | IO_L19N_6         | IO_L19N_6         | AD2               | I/O  |
| 6    | IO_L19P_6         | IO_L19P_6         | AD1               | I/O  |
| 6    | IO_L20N_6         | IO_L20N_6         | AC11              | I/O  |
| 6    | IO_L20P_6         | IO_L20P_6         | AC10              | I/O  |
| 6    | IO_L21N_6         | IO_L21N_6         | AC8               | I/O  |
| 6    | IO_L21P_6         | IO_L21P_6         | AC7               | I/O  |
| 6    | IO_L22N_6         | IO_L22N_6         | AC6               | I/O  |
| 6    | IO_L22P_6         | IO_L22P_6         | AC5               | I/O  |
| 6    | IO_L23N_6         | IO_L23N_6         | AC2               | I/O  |
| 6    | IO_L23P_6         | IO_L23P_6         | AC1               | I/O  |
| 6    | IO_L24N_6/VREF_6  | IO_L24N_6/VREF_6  | AC9               | VREF |
| 6    | IO_L24P_6         | IO_L24P_6         | AB10              | I/O  |
| 6    | IO_L25N_6         | IO_L25N_6         | AB8               | I/O  |
| 6    | IO_L25P_6         | IO_L25P_6         | AB7               | I/O  |
| 6    | IO_L26N_6         | IO_L26N_6         | AB4               | I/O  |
| 6    | IO_L26P_6         | IO_L26P_6         | AB3               | I/O  |
| 6    | IO_L27N_6         | IO_L27N_6         | AB11              | I/O  |
| 6    | IO_L27P_6         | IO_L27P_6         | AA11              | I/O  |
| 6    | IO_L28N_6         | IO_L28N_6         | AA8               | I/O  |
| 6    | IO_L28P_6         | IO_L28P_6         | AA7               | I/O  |
| 6    | IO_L29N_6         | IO_L29N_6         | AA6               | I/O  |
| 6    | IO_L29P_6         | IO_L29P_6         | AA5               | I/O  |
| 6    | IO_L30N_6         | IO_L30N_6         | AA4               | I/O  |
| 6    | IO_L30P_6         | IO_L30P_6         | AA3               | I/O  |
| 6    | IO_L31N_6         | IO_L31N_6         | AA2               | I/O  |
| 6    | IO_L31P_6         | IO_L31P_6         | AA1               | I/O  |
| 6    | IO_L32N_6         | IO_L32N_6         | Y11               | I/O  |
| 6    | IO_L32P_6         | IO_L32P_6         | Y10               | I/O  |
| 6    | IO_L33N_6         | IO_L33N_6         | Y4                | I/O  |
| 6    | IO_L33P_6         | IO_L33P_6         | Y3                | I/O  |
| 6    | IO_L34N_6/VREF_6  | IO_L34N_6/VREF_6  | Y2                | VREF |
| 6    | IO_L34P_6         | IO_L34P_6         | Y1                | I/O  |
| 6    | IO_L35N_6         | IO_L35N_6         | Y9                | I/O  |
| 6    | IO_L35P_6         | IO_L35P_6         | W10               | I/O  |
| 6    | IO_L36N_6         | IO_L36N_6         | W7                | I/O  |
| 6    | IO_L36P_6         | IO_L36P_6         | W6                | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 6    | IO_L37N_6         | IO_L37N_6         | W3                | I/O  |
| 6    | IO_L37P_6         | IO_L37P_6         | W2                | I/O  |
| 6    | IO_L38N_6         | IO_L38N_6         | V6                | I/O  |
| 6    | IO_L38P_6         | IO_L38P_6         | V5                | I/O  |
| 6    | IO_L39N_6         | IO_L39N_6         | V4                | I/O  |
| 6    | IO_L39P_6         | IO_L39P_6         | V3                | I/O  |
| 6    | IO_L40N_6         | IO_L40N_6         | V2                | I/O  |
| 6    | IO_L40P_6/VREF_6  | IO_L40P_6/VREF_6  | V1                | VREF |
| 6    | N.C. (◆)          | IO_L41N_6         | AH4               | I/O  |
| 6    | N.C. (◆)          | IO_L41P_6         | AH3               | I/O  |
| 6    | N.C. (◆)          | IO_L44N_6         | AD7               | I/O  |
| 6    | N.C. (◆)          | IO_L44P_6         | AD6               | I/O  |
| 6    | IO_L45N_6         | IO_L45N_6         | AC4               | I/O  |
| 6    | IO_L45P_6         | IO_L45P_6         | AC3               | I/O  |
| 6    | N.C. (◆)          | IO_L46N_6         | AA10              | I/O  |
| 6    | N.C. (◆)          | IO_L46P_6         | AA9               | I/O  |
| 6    | IO_L48N_6         | IO_L48N_6         | Y7                | I/O  |
| 6    | IO_L48P_6         | IO_L48P_6         | Y6                | I/O  |
| 6    | N.C. (◆)          | IO_L49N_6         | W11               | I/O  |
| 6    | N.C. (◆)          | IO_L49P_6         | V11               | I/O  |
| 6    | IO_L52N_6         | IO_L52N_6         | V8                | I/O  |
| 6    | IO_L52P_6         | IO_L52P_6         | V7                | I/O  |
| 6    | VCCO_6            | VCCO_6            | AA12              | VCCO |
| 6    | VCCO_6            | VCCO_6            | AB12              | VCCO |
| 6    | VCCO_6            | VCCO_6            | AB2               | VCCO |
| 6    | VCCO_6            | VCCO_6            | AB6               | VCCO |
| 6    | VCCO_6            | VCCO_6            | AD4               | VCCO |
| 6    | VCCO_6            | VCCO_6            | AD8               | VCCO |
| 6    | VCCO_6            | VCCO_6            | AG3               | VCCO |
| 6    | VCCO_6            | VCCO_6            | AG7               | VCCO |
| 6    | VCCO_6            | VCCO_6            | AL3               | VCCO |
| 6    | VCCO_6            | VCCO_6            | W12               | VCCO |
| 6    | VCCO_6            | VCCO_6            | W4                | VCCO |
| 6    | VCCO_6            | VCCO_6            | Y12               | VCCO |
| 6    | VCCO_6            | VCCO_6            | Y8                | VCCO |
| 7    | IO                | IO                | G1                | I/O  |
| 7    | IO                | IO                | G2                | I/O  |
| 7    | IO                | IO                | U10               | I/O  |
| 7    | IO                | IO                | U9                | I/O  |
| 7    | IO_L01N_7/VRP_7   | IO_L01N_7/VRP_7   | C1                | DCI  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 7    | IO_L01P_7/VRN_7   | IO_L01P_7/VRN_7   | C2                | DCI  |
| 7    | IO_L02N_7         | IO_L02N_7         | D1                | I/O  |
| 7    | IO_L02P_7         | IO_L02P_7         | D2                | I/O  |
| 7    | IO_L03N_7/VREF_7  | IO_L03N_7/VREF_7  | E2                | VREF |
| 7    | IO_L03P_7         | IO_L03P_7         | E3                | I/O  |
| 7    | IO_L04N_7         | IO_L04N_7         | F3                | I/O  |
| 7    | IO_L04P_7         | IO_L04P_7         | F4                | I/O  |
| 7    | IO_L05N_7         | IO_L05N_7         | F1                | I/O  |
| 7    | IO_L05P_7         | IO_L05P_7         | F2                | I/O  |
| 7    | IO_L06N_7         | IO_L06N_7         | G5                | I/O  |
| 7    | IO_L06P_7         | IO_L06P_7         | G6                | I/O  |
| 7    | IO_L07N_7         | IO_L07N_7         | H5                | I/O  |
| 7    | IO_L07P_7         | IO_L07P_7         | H6                | I/O  |
| 7    | IO_L08N_7         | IO_L08N_7         | H1                | I/O  |
| 7    | IO_L08P_7         | IO_L08P_7         | H2                | I/O  |
| 7    | IO_L09N_7         | IO_L09N_7         | J6                | I/O  |
| 7    | IO_L09P_7         | IO_L09P_7         | J7                | I/O  |
| 7    | IO_L10N_7         | IO_L10N_7         | J4                | I/O  |
| 7    | IO_L10P_7/VREF_7  | IO_L10P_7/VREF_7  | H4                | VREF |
| 7    | IO_L11N_7         | IO_L11N_7         | J2                | I/O  |
| 7    | IO_L11P_7         | IO_L11P_7         | J3                | I/O  |
| 7    | IO_L12N_7         | IO_L12N_7         | K9                | I/O  |
| 7    | IO_L12P_7         | IO_L12P_7         | J8                | I/O  |
| 7    | IO_L13N_7         | IO_L13N_7         | K7                | I/O  |
| 7    | IO_L13P_7         | IO_L13P_7         | K8                | I/O  |
| 7    | IO_L14N_7         | IO_L14N_7         | K5                | I/O  |
| 7    | IO_L14P_7         | IO_L14P_7         | K6                | I/O  |
| 7    | IO_L15N_7         | IO_L15N_7         | K3                | I/O  |
| 7    | IO_L15P_7         | IO_L15P_7         | K4                | I/O  |
| 7    | IO_L16N_7         | IO_L16N_7         | K1                | I/O  |
| 7    | IO_L16P_7/VREF_7  | IO_L16P_7/VREF_7  | K2                | VREF |
| 7    | IO_L17N_7         | IO_L17N_7         | L9                | I/O  |
| 7    | IO_L17P_7         | IO_L17P_7         | L10               | I/O  |
| 7    | IO_L19N_7/VREF_7  | IO_L19N_7/VREF_7  | L1                | VREF |
| 7    | IO_L19P_7         | IO_L19P_7         | L2                | I/O  |
| 7    | IO_L20N_7         | IO_L20N_7         | M10               | I/O  |
| 7    | IO_L20P_7         | IO_L20P_7         | M11               | I/O  |
| 7    | IO_L21N_7         | IO_L21N_7         | M7                | I/O  |
| 7    | IO_L21P_7         | IO_L21P_7         | M8                | I/O  |
| 7    | IO_L22N_7         | IO_L22N_7         | M5                | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 7    | IO_L22P_7         | IO_L22P_7         | M6                | I/O  |
| 7    | IO_L23N_7         | IO_L23N_7         | M3                | I/O  |
| 7    | IO_L23P_7         | IO_L23P_7         | M4                | I/O  |
| 7    | IO_L24N_7         | IO_L24N_7         | N10               | I/O  |
| 7    | IO_L24P_7         | IO_L24P_7         | M9                | I/O  |
| 7    | IO_L25N_7         | IO_L25N_7         | N3                | I/O  |
| 7    | IO_L25P_7         | IO_L25P_7         | N4                | I/O  |
| 7    | IO_L26N_7         | IO_L26N_7         | P11               | I/O  |
| 7    | IO_L26P_7         | IO_L26P_7         | N11               | I/O  |
| 7    | IO_L27N_7         | IO_L27N_7         | P7                | I/O  |
| 7    | IO_L27P_7/VREF_7  | IO_L27P_7/VREF_7  | P8                | VREF |
| 7    | IO_L28N_7         | IO_L28N_7         | P5                | I/O  |
| 7    | IO_L28P_7         | IO_L28P_7         | P6                | I/O  |
| 7    | IO_L29N_7         | IO_L29N_7         | P3                | I/O  |
| 7    | IO_L29P_7         | IO_L29P_7         | P4                | I/O  |
| 7    | IO_L30N_7         | IO_L30N_7         | R6                | I/O  |
| 7    | IO_L30P_7         | IO_L30P_7         | R7                | I/O  |
| 7    | IO_L31N_7         | IO_L31N_7         | R3                | I/O  |
| 7    | IO_L31P_7         | IO_L31P_7         | R4                | I/O  |
| 7    | IO_L32N_7         | IO_L32N_7         | R1                | I/O  |
| 7    | IO_L32P_7         | IO_L32P_7         | R2                | I/O  |
| 7    | IO_L33N_7         | IO_L33N_7         | T10               | I/O  |
| 7    | IO_L33P_7         | IO_L33P_7         | R9                | I/O  |
| 7    | IO_L34N_7         | IO_L34N_7         | T6                | I/O  |
| 7    | IO_L34P_7         | IO_L34P_7         | T7                | I/O  |
| 7    | IO_L35N_7         | IO_L35N_7         | T2                | I/O  |
| 7    | IO_L35P_7         | IO_L35P_7         | T3                | I/O  |
| 7    | IO_L37N_7         | IO_L37N_7         | U7                | I/O  |
| 7    | IO_L37P_7/VREF_7  | IO_L37P_7/VREF_7  | U8                | VREF |
| 7    | IO_L38N_7         | IO_L38N_7         | U5                | I/O  |
| 7    | IO_L38P_7         | IO_L38P_7         | U6                | I/O  |
| 7    | IO_L39N_7         | IO_L39N_7         | U3                | I/O  |
| 7    | IO_L39P_7         | IO_L39P_7         | U4                | I/O  |
| 7    | IO_L40N_7/VREF_7  | IO_L40N_7/VREF_7  | U1                | VREF |
| 7    | IO_L40P_7         | IO_L40P_7         | U2                | I/O  |
| 7    | N.C. (◆)          | IO_L41N_7         | G3                | I/O  |
| 7    | N.C. (◆)          | IO_L41P_7         | G4                | I/O  |
| 7    | N.C. (◆)          | IO_L44N_7         | L6                | I/O  |
| 7    | N.C. (◆)          | IO_L44P_7         | L7                | I/O  |
| 7    | IO_L45N_7         | IO_L45N_7         | M1                | I/O  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type |
|------|-------------------|-------------------|-------------------|------|
| 7    | IO_L45P_7         | IO_L45P_7         | M2                | I/O  |
| 7    | IO_L46N_7         | IO_L46N_7         | N7                | I/O  |
| 7    | IO_L46P_7         | IO_L46P_7         | N8                | I/O  |
| 7    | N.C. (◆)          | IO_L47N_7         | P9                | I/O  |
| 7    | N.C. (◆)          | IO_L47P_7         | P10               | I/O  |
| 7    | IO_L49N_7         | IO_L49N_7         | P1                | I/O  |
| 7    | IO_L49P_7         | IO_L49P_7         | P2                | I/O  |
| 7    | IO_L50N_7         | IO_L50N_7         | R10               | I/O  |
| 7    | IO_L50P_7         | IO_L50P_7         | R11               | I/O  |
| 7    | N.C. (◆)          | IO_L51N_7         | U11               | I/O  |
| 7    | N.C. (◆)          | IO_L51P_7         | T11               | I/O  |
| 7    | VCCO_7            | VCCO_7            | D3                | VCCO |
| 7    | VCCO_7            | VCCO_7            | H3                | VCCO |
| 7    | VCCO_7            | VCCO_7            | H7                | VCCO |
| 7    | VCCO_7            | VCCO_7            | L4                | VCCO |
| 7    | VCCO_7            | VCCO_7            | L8                | VCCO |
| 7    | VCCO_7            | VCCO_7            | N12               | VCCO |
| 7    | VCCO_7            | VCCO_7            | N2                | VCCO |
| 7    | VCCO_7            | VCCO_7            | N6                | VCCO |
| 7    | VCCO_7            | VCCO_7            | P12               | VCCO |
| 7    | VCCO_7            | VCCO_7            | R12               | VCCO |
| 7    | VCCO_7            | VCCO_7            | R8                | VCCO |
| 7    | VCCO_7            | VCCO_7            | T12               | VCCO |
| 7    | VCCO_7            | VCCO_7            | T4                | VCCO |
| N/A  | GND               | GND               | A1                | GND  |
| N/A  | GND               | GND               | A13               | GND  |
| N/A  | GND               | GND               | A16               | GND  |
| N/A  | GND               | GND               | A19               | GND  |
| N/A  | GND               | GND               | A2                | GND  |
| N/A  | GND               | GND               | A22               | GND  |
| N/A  | GND               | GND               | A26               | GND  |
| N/A  | GND               | GND               | A30               | GND  |
| N/A  | GND               | GND               | A33               | GND  |
| N/A  | GND               | GND               | A34               | GND  |
| N/A  | GND               | GND               | A5                | GND  |
| N/A  | GND               | GND               | A9                | GND  |
| N/A  | GND               | GND               | AA14              | GND  |
| N/A  | GND               | GND               | AA15              | GND  |
| N/A  | GND               | GND               | AA16              | GND  |
| N/A  | GND               | GND               | AA17              | GND  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| N/A  | GND                  | GND                  | AA18                 | GND  |
| N/A  | GND                  | GND                  | AA19                 | GND  |
| N/A  | GND                  | GND                  | AA20                 | GND  |
| N/A  | GND                  | GND                  | AA21                 | GND  |
| N/A  | GND                  | GND                  | AB1                  | GND  |
| N/A  | GND                  | GND                  | AB17                 | GND  |
| N/A  | GND                  | GND                  | AB18                 | GND  |
| N/A  | GND                  | GND                  | AB26                 | GND  |
| N/A  | GND                  | GND                  | AB30                 | GND  |
| N/A  | GND                  | GND                  | AB34                 | GND  |
| N/A  | GND                  | GND                  | AB5                  | GND  |
| N/A  | GND                  | GND                  | AB9                  | GND  |
| N/A  | GND                  | GND                  | AD3                  | GND  |
| N/A  | GND                  | GND                  | AD32                 | GND  |
| N/A  | GND                  | GND                  | AE10                 | GND  |
| N/A  | GND                  | GND                  | AE25                 | GND  |
| N/A  | GND                  | GND                  | AF1                  | GND  |
| N/A  | GND                  | GND                  | AF13                 | GND  |
| N/A  | GND                  | GND                  | AF16                 | GND  |
| N/A  | GND                  | GND                  | AF19                 | GND  |
| N/A  | GND                  | GND                  | AF22                 | GND  |
| N/A  | GND                  | GND                  | AF30                 | GND  |
| N/A  | GND                  | GND                  | AF34                 | GND  |
| N/A  | GND                  | GND                  | AF5                  | GND  |
| N/A  | GND                  | GND                  | AH28                 | GND  |
| N/A  | GND                  | GND                  | AH7                  | GND  |
| N/A  | GND                  | GND                  | AK1                  | GND  |
| N/A  | GND                  | GND                  | AK13                 | GND  |
| N/A  | GND                  | GND                  | AK16                 | GND  |
| N/A  | GND                  | GND                  | AK19                 | GND  |
| N/A  | GND                  | GND                  | AK22                 | GND  |
| N/A  | GND                  | GND                  | AK26                 | GND  |
| N/A  | GND                  | GND                  | AK30                 | GND  |
| N/A  | GND                  | GND                  | AK34                 | GND  |
| N/A  | GND                  | GND                  | AK5                  | GND  |
| N/A  | GND                  | GND                  | AK9                  | GND  |
| N/A  | GND                  | GND                  | AM11                 | GND  |
| N/A  | GND                  | GND                  | AM24                 | GND  |
| N/A  | GND                  | GND                  | AM3                  | GND  |
| N/A  | GND                  | GND                  | AM32                 | GND  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| N/A  | GND                  | GND                  | AN1                  | GND  |
| N/A  | GND                  | GND                  | AN2                  | GND  |
| N/A  | GND                  | GND                  | AN33                 | GND  |
| N/A  | GND                  | GND                  | AN34                 | GND  |
| N/A  | GND                  | GND                  | AP1                  | GND  |
| N/A  | GND                  | GND                  | AP13                 | GND  |
| N/A  | GND                  | GND                  | AP16                 | GND  |
| N/A  | GND                  | GND                  | AP19                 | GND  |
| N/A  | GND                  | GND                  | AP2                  | GND  |
| N/A  | GND                  | GND                  | AP22                 | GND  |
| N/A  | GND                  | GND                  | AP26                 | GND  |
| N/A  | GND                  | GND                  | AP30                 | GND  |
| N/A  | GND                  | GND                  | AP33                 | GND  |
| N/A  | GND                  | GND                  | AP34                 | GND  |
| N/A  | GND                  | GND                  | AP5                  | GND  |
| N/A  | GND                  | GND                  | AP9                  | GND  |
| N/A  | GND                  | GND                  | B1                   | GND  |
| N/A  | GND                  | GND                  | B2                   | GND  |
| N/A  | GND                  | GND                  | B33                  | GND  |
| N/A  | GND                  | GND                  | B34                  | GND  |
| N/A  | GND                  | GND                  | C11                  | GND  |
| N/A  | GND                  | GND                  | C24                  | GND  |
| N/A  | GND                  | GND                  | C3                   | GND  |
| N/A  | GND                  | GND                  | C32                  | GND  |
| N/A  | GND                  | GND                  | E1                   | GND  |
| N/A  | GND                  | GND                  | E13                  | GND  |
| N/A  | GND                  | GND                  | E16                  | GND  |
| N/A  | GND                  | GND                  | E19                  | GND  |
| N/A  | GND                  | GND                  | E22                  | GND  |
| N/A  | GND                  | GND                  | E26                  | GND  |
| N/A  | GND                  | GND                  | E30                  | GND  |
| N/A  | GND                  | GND                  | E34                  | GND  |
| N/A  | GND                  | GND                  | E5                   | GND  |
| N/A  | GND                  | GND                  | E9                   | GND  |
| N/A  | GND                  | GND                  | G28                  | GND  |
| N/A  | GND                  | GND                  | G7                   | GND  |
| N/A  | GND                  | GND                  | J1                   | GND  |
| N/A  | GND                  | GND                  | J13                  | GND  |
| N/A  | GND                  | GND                  | J16                  | GND  |
| N/A  | GND                  | GND                  | J19                  | GND  |



Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| N/A  | GND                  | GND                  | J22                  | GND  |
| N/A  | GND                  | GND                  | J30                  | GND  |
| N/A  | GND                  | GND                  | J34                  | GND  |
| N/A  | GND                  | GND                  | J5                   | GND  |
| N/A  | GND                  | GND                  | K10                  | GND  |
| N/A  | GND                  | GND                  | K25                  | GND  |
| N/A  | GND                  | GND                  | L3                   | GND  |
| N/A  | GND                  | GND                  | L32                  | GND  |
| N/A  | GND                  | GND                  | N1                   | GND  |
| N/A  | GND                  | GND                  | N17                  | GND  |
| N/A  | GND                  | GND                  | N18                  | GND  |
| N/A  | GND                  | GND                  | N26                  | GND  |
| N/A  | GND                  | GND                  | N30                  | GND  |
| N/A  | GND                  | GND                  | N34                  | GND  |
| N/A  | GND                  | GND                  | N5                   | GND  |
| N/A  | GND                  | GND                  | N9                   | GND  |
| N/A  | GND                  | GND                  | P14                  | GND  |
| N/A  | GND                  | GND                  | P15                  | GND  |
| N/A  | GND                  | GND                  | P16                  | GND  |
| N/A  | GND                  | GND                  | P17                  | GND  |
| N/A  | GND                  | GND                  | P18                  | GND  |
| N/A  | GND                  | GND                  | P19                  | GND  |
| N/A  | GND                  | GND                  | P20                  | GND  |
| N/A  | GND                  | GND                  | P21                  | GND  |
| N/A  | GND                  | GND                  | R14                  | GND  |
| N/A  | GND                  | GND                  | R15                  | GND  |
| N/A  | GND                  | GND                  | R16                  | GND  |
| N/A  | GND                  | GND                  | R17                  | GND  |
| N/A  | GND                  | GND                  | R18                  | GND  |
| N/A  | GND                  | GND                  | R19                  | GND  |
| N/A  | GND                  | GND                  | R20                  | GND  |
| N/A  | GND                  | GND                  | R21                  | GND  |
| N/A  | GND                  | GND                  | T1                   | GND  |
| N/A  | GND                  | GND                  | T14                  | GND  |
| N/A  | GND                  | GND                  | T15                  | GND  |
| N/A  | GND                  | GND                  | T16                  | GND  |
| N/A  | GND                  | GND                  | T17                  | GND  |
| N/A  | GND                  | GND                  | T18                  | GND  |
| N/A  | GND                  | GND                  | T19                  | GND  |
| N/A  | GND                  | GND                  | T20                  | GND  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type |
|------|----------------------|----------------------|----------------------|------|
| N/A  | GND                  | GND                  | T21                  | GND  |
| N/A  | GND                  | GND                  | T26                  | GND  |
| N/A  | GND                  | GND                  | T30                  | GND  |
| N/A  | GND                  | GND                  | T34                  | GND  |
| N/A  | GND                  | GND                  | T5                   | GND  |
| N/A  | GND                  | GND                  | T9                   | GND  |
| N/A  | GND                  | GND                  | U13                  | GND  |
| N/A  | GND                  | GND                  | U14                  | GND  |
| N/A  | GND                  | GND                  | U15                  | GND  |
| N/A  | GND                  | GND                  | U16                  | GND  |
| N/A  | GND                  | GND                  | U17                  | GND  |
| N/A  | GND                  | GND                  | U18                  | GND  |
| N/A  | GND                  | GND                  | U19                  | GND  |
| N/A  | GND                  | GND                  | U20                  | GND  |
| N/A  | GND                  | GND                  | U21                  | GND  |
| N/A  | GND                  | GND                  | U22                  | GND  |
| N/A  | GND                  | GND                  | V13                  | GND  |
| N/A  | GND                  | GND                  | V14                  | GND  |
| N/A  | GND                  | GND                  | V15                  | GND  |
| N/A  | GND                  | GND                  | V16                  | GND  |
| N/A  | GND                  | GND                  | V17                  | GND  |
| N/A  | GND                  | GND                  | V18                  | GND  |
| N/A  | GND                  | GND                  | V19                  | GND  |
| N/A  | GND                  | GND                  | V20                  | GND  |
| N/A  | GND                  | GND                  | V21                  | GND  |
| N/A  | GND                  | GND                  | V22                  | GND  |
| N/A  | GND                  | GND                  | W1                   | GND  |
| N/A  | GND                  | GND                  | W14                  | GND  |
| N/A  | GND                  | GND                  | W15                  | GND  |
| N/A  | GND                  | GND                  | W16                  | GND  |
| N/A  | GND                  | GND                  | W17                  | GND  |
| N/A  | GND                  | GND                  | W18                  | GND  |
| N/A  | GND                  | GND                  | W19                  | GND  |
| N/A  | GND                  | GND                  | W20                  | GND  |
| N/A  | GND                  | GND                  | W21                  | GND  |
| N/A  | GND                  | GND                  | W26                  | GND  |
| N/A  | GND                  | GND                  | W30                  | GND  |
| N/A  | GND                  | GND                  | W34                  | GND  |
| N/A  | GND                  | GND                  | W5                   | GND  |
| N/A  | GND                  | GND                  | W9                   | GND  |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000 Pin Name | XC3S5000 Pin Name | FG1156 Pin Number | Type   |
|------|-------------------|-------------------|-------------------|--------|
| N/A  | GND               | GND               | Y14               | GND    |
| N/A  | GND               | GND               | Y15               | GND    |
| N/A  | GND               | GND               | Y16               | GND    |
| N/A  | GND               | GND               | Y17               | GND    |
| N/A  | GND               | GND               | Y18               | GND    |
| N/A  | GND               | GND               | Y19               | GND    |
| N/A  | GND               | GND               | Y20               | GND    |
| N/A  | GND               | GND               | Y21               | GND    |
| N/A  | N.C. (◆)          | N.C. (■)          | AK31              | N.C.   |
| N/A  | VCCAUX            | VCCAUX            | AD30              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AD5               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AG16              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AG19              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AJ30              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AJ5               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AK11              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AK15              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AK20              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AK24              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AK29              | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | AK6               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | E11               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | E15               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | E20               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | E24               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | E29               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | E6                | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | F30               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | F5                | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | H16               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | H19               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | L30               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | L5                | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | R30               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | R5                | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | T27               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | T8                | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | W27               | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | W8                | VCCAUX |
| N/A  | VCCAUX            | VCCAUX            | Y30               | VCCAUX |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type   |
|------|----------------------|----------------------|----------------------|--------|
| N/A  | VCCAUX               | VCCAUX               | Y5                   | VCCAUX |
| N/A  | VCCINT               | VCCINT               | AA13                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AA22                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB13                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB14                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB15                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB16                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB19                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB20                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB21                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AB22                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AC12                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AC17                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AC18                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | AC23                 | VCCINT |
| N/A  | VCCINT               | VCCINT               | M12                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | M17                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | M18                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | M23                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N13                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N14                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N15                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N16                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N19                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N20                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N21                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | N22                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | P13                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | P22                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | R13                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | R22                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | T13                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | T22                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | U12                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | U23                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | V12                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | V23                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | W13                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | W22                  | VCCINT |
| N/A  | VCCINT               | VCCINT               | Y13                  | VCCINT |

Table 110: FG1156 Package Pinout (Cont'd)

| Bank   | XC3S4000<br>Pin Name | XC3S5000<br>Pin Name | FG1156<br>Pin Number | Type   |
|--------|----------------------|----------------------|----------------------|--------|
| N/A    | VCCINT               | VCCINT               | Y22                  | VCCINT |
| VCCAUX | CCLK                 | CCLK                 | AL31                 | CONFIG |
| VCCAUX | DONE                 | DONE                 | AD24                 | CONFIG |
| VCCAUX | HSWAP_EN             | HSWAP_EN             | L11                  | CONFIG |
| VCCAUX | M0                   | M0                   | AL4                  | CONFIG |
| VCCAUX | M1                   | M1                   | AK4                  | CONFIG |
| VCCAUX | M2                   | M2                   | AG8                  | CONFIG |
| VCCAUX | PROG_B               | PROG_B               | D4                   | CONFIG |
| VCCAUX | TCK                  | TCK                  | D31                  | JTAG   |
| VCCAUX | TDI                  | TDI                  | E4                   | JTAG   |
| VCCAUX | TDO                  | TDO                  | E31                  | JTAG   |
| VCCAUX | TMS                  | TMS                  | H27                  | JTAG   |

## User I/Os by Bank

**Note:** The FG(G)1156 package is discontinued. See [http://www.xilinx.com/support/documentation/spartan-3\\_customer\\_notices.htm](http://www.xilinx.com/support/documentation/spartan-3_customer_notices.htm).

Table 111 indicates how the available user-I/O pins are distributed between the eight I/O banks for the XC3S4000 in the FG1156 package. Similarly, Table 112 shows how the available user-I/O pins are distributed between the eight I/O banks for the XC3S5000 in the FG1156 package.

Table 111: User I/Os Per Bank for XC3S4000 in FG1156 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 90          | 79                            | 0    | 2   | 7    | 2    |
|              | 1        | 90          | 79                            | 0    | 2   | 7    | 2    |
| Right        | 2        | 88          | 80                            | 0    | 2   | 6    | 0    |
|              | 3        | 88          | 79                            | 0    | 2   | 7    | 0    |
| Bottom       | 4        | 90          | 73                            | 6    | 2   | 7    | 2    |
|              | 5        | 90          | 73                            | 6    | 2   | 7    | 2    |
| Left         | 6        | 88          | 79                            | 0    | 2   | 7    | 0    |
|              | 7        | 88          | 79                            | 0    | 2   | 7    | 0    |

**Notes:**

- The FG1156 and FGG1156 packages are discontinued. See [www.xilinx.com/support/documentation/spartan-3.htm#19600](http://www.xilinx.com/support/documentation/spartan-3.htm#19600).

Table 112: User I/Os Per Bank for XC3S5000 in FG1156 Package

| Package Edge | I/O Bank | Maximum I/O | All Possible I/O Pins by Type |      |     |      |      |
|--------------|----------|-------------|-------------------------------|------|-----|------|------|
|              |          |             | I/O                           | DUAL | DCI | VREF | GCLK |
| Top          | 0        | 100         | 89                            | 0    | 2   | 7    | 2    |
|              | 1        | 100         | 89                            | 0    | 2   | 7    | 2    |
| Right        | 2        | 96          | 87                            | 0    | 2   | 7    | 0    |
|              | 3        | 96          | 87                            | 0    | 2   | 7    | 0    |
| Bottom       | 4        | 100         | 83                            | 6    | 2   | 7    | 2    |
|              | 5        | 100         | 83                            | 6    | 2   | 7    | 2    |
| Left         | 6        | 96          | 87                            | 0    | 2   | 7    | 0    |
|              | 7        | 96          | 87                            | 0    | 2   | 7    | 0    |

**Notes:**

- The FG1156 and FGG1156 packages are discontinued. See [www.xilinx.com/support/documentation/spartan-3.htm#19600](http://www.xilinx.com/support/documentation/spartan-3.htm#19600).

FG1156 Footprint

Top Left Corner of FG1156 Package (Top View)

**XC3S4000**  
(712 max. user I/O)  
621 I/O: Unrestricted, general-purpose user I/O

55 VREF: User I/O or input voltage reference for bank

73 N.C.: Unconnected pins for XC3S4000 (◆)

**XC3S5000**  
(784 max. user I/O)  
692 I/O: Unrestricted, general-purpose user I/O

56 VREF: User I/O or input voltage reference for bank

1 N.C.: Unconnected pins for XC3S5000 (■)

|        |   | Bank 0            |                   |                  |                   |            |                   |              |            |              |              |              |            |            |            |                   |            |                   |     |
|--------|---|-------------------|-------------------|------------------|-------------------|------------|-------------------|--------------|------------|--------------|--------------|--------------|------------|------------|------------|-------------------|------------|-------------------|-----|
|        |   | 1                 | 2                 | 3                | 4                 | 5          | 6                 | 7            | 8          | 9            | 10           | 11           | 12         | 13         | 14         | 15                | 16         | 17                |     |
| Bank 7 | A | GND               | GND               | I/O L01P_0 VRN_0 | I/O L02P_0        | GND        | I/O L05P_0 VREF_0 | I/O L34P_0 ◆ | I/O L36P_0 | GND          | I/O L38P_0   | I/O L40P_0 ◆ | I/O L15P_0 | GND        | I/O L22P_0 | I/O L26P_0 VREF_0 | GND        | I/O L32P_0 GCLK6  |     |
|        | B | GND               | GND               | I/O L01N_0 VRP_0 | I/O L02N_0        | I/O L03P_0 | I/O L05N_0        | I/O L34N_0 ◆ | I/O L36N_0 | I/O          | I/O L38N_0   | I/O L40N_0 ◆ | I/O L15N_0 | VCCO_0     | I/O L22N_0 | I/O L26N_0        | I/O L28P_0 | I/O L32N_0 GCLK7  |     |
|        | C | I/O L01N_7 VRP_7  | I/O L01P_7 VRN_7  | GND              | VCCO_0            | I/O L03N_0 | I/O L04P_0        | I/O L33P_0 ◆ | VCCO_0     | I/O L08P_0   | I/O L37P_0   | GND          | I/O L14P_0 | I/O L17P_0 | I/O L21P_0 | I/O L25P_0        | I/O L28N_0 | I/O L31P_0 VREF_0 |     |
|        | D | I/O L02N_7        | I/O L02P_7        | VCCO_7           | PROG_B            | I/O VREF_0 | I/O L04N_0        | I/O L33N_0 ◆ | I/O L35P_0 | I/O L08N_0   | I/O L37N_0   | VCCO_0       | I/O L14N_0 | I/O L17N_0 | I/O L21N_0 | I/O L25N_0        | VCCO_0     | I/O L31N_0        |     |
|        | E | GND               | I/O L03N_7 VREF_7 | I/O L03P_7       | TDI               | GND        | VCCAUX            | I/O L06P_0   | I/O L35N_0 | GND          | IO VREF_0    | VCCAUX       | I/O L13P_0 | GND        | I/O L20P_0 | VCCAUX            | GND        | I/O               |     |
|        | F | I/O L05N_7        | I/O L05P_7        | I/O L04N_7       | I/O L04P_7        | VCCAUX     | I/O               | I/O L06N_0   | I/O        | I/O L07P_0   | I/O L10P_0   | I/O L39P_0 ◆ | I/O L13N_0 | VCCO_0     | I/O L20N_0 | I/O L24P_0        | I/O L27P_0 | I/O L30P_0        |     |
|        | G | I/O               | I/O               | I/O L41N_7 ◆     | I/O L41P_7 ◆      | I/O L06N_7 | I/O L06P_7        | GND          | VCCO_0     | I/O L07N_0   | I/O L10N_0   | I/O L39N_0 ◆ | I/O        | I/O L16P_0 | I/O L19P_0 | I/O L24N_0        | I/O L27N_0 | I/O L30N_0        |     |
|        | H | I/O L08N_7        | I/O L08P_7        | VCCO_7           | I/O L10P_7 VREF_7 | I/O L07N_7 | I/O L07P_7        | VCCO_7       | I/O        | I/O          | I/O L09P_0   | VCCO_0       | I/O L12P_0 | I/O L16N_0 | I/O L19N_0 | VCCO_0            | VCCAUX     | I/O L29P_0        |     |
|        | J | GND               | I/O L11N_7        | I/O L11P_7       | I/O L10N_7        | GND        | I/O L09N_7        | I/O L09P_7   | I/O L12P_7 | I/O ◆        | I/O L09N_0   | I/O          | I/O L12N_0 | GND        | IO VREF_0  | I/O L23P_0        | GND        | I/O L29N_0        |     |
|        | K | I/O L16N_7        | I/O L16P_7 VREF_7 | I/O L15N_7       | I/O L15P_7        | I/O L14N_7 | I/O L14P_7        | I/O L13N_7   | I/O L13P_7 | I/O L12N_7   | GND          | I/O ◆        | I/O L11P_0 | I/O        | I/O L18P_0 | I/O L23N_0        | I/O        | I/O               |     |
|        | L | I/O L19N_7 VREF_7 | I/O L19P_7        | GND              | VCCO_7            | VCCAUX     | I/O L44N_7 ◆      | I/O L44P_7 ◆ | VCCO_7     | I/O L17N_7   | I/O L17P_7   | HSWAP_EN     | I/O L11N_0 | I/O        | I/O L18N_0 | IO VREF_0         | I/O        | I/O               |     |
|        | M | I/O L45N_7        | I/O L45P_7        | I/O L23N_7       | I/O L23P_7        | I/O L22N_7 | I/O L22P_7        | I/O L21N_7   | I/O L21P_7 | I/O L24P_7   | I/O L20N_7   | I/O L20P_7   | VCCINT     | VCCO_0     | VCCO_0     | VCCO_0            | VCCO_0     | VCCINT            |     |
|        | N | GND               | VCCO_7            | I/O L25N_7       | I/O L25P_7        | GND        | VCCO_7            | I/O L46N_7   | I/O L46P_7 | GND          | I/O L24N_7   | I/O L26P_7   | VCCO_7     | VCCINT     | VCCINT     | VCCINT            | VCCINT     | VCCINT            | GND |
|        | P | I/O L49N_7        | I/O L49P_7        | I/O L29N_7       | I/O L29P_7        | I/O L28N_7 | I/O L28P_7        | I/O L27N_7   | I/O L27P_7 | I/O L47N_7 ◆ | I/O L47P_7 ◆ | I/O L26N_7   | VCCO_7     | VCCINT     | GND        | GND               | GND        | GND               |     |
|        | R | I/O L32N_7        | I/O L32P_7        | I/O L31N_7       | I/O L31P_7        | VCCAUX     | I/O L30N_7        | I/O L30P_7   | VCCO_7     | I/O L33P_7   | I/O L50N_7   | I/O L50P_7   | VCCO_7     | VCCINT     | GND        | GND               | GND        | GND               |     |
|        | T | GND               | I/O L35N_7        | I/O L35P_7       | VCCO_7            | GND        | I/O L34N_7        | I/O L34P_7   | VCCAUX     | GND          | I/O L33N_7   | I/O L51P_7 ◆ | VCCO_7     | VCCINT     | GND        | GND               | GND        | GND               |     |
|        | U | I/O L40N_7 VREF_7 | I/O L40P_7        | I/O L39N_7       | I/O L39P_7        | I/O L38N_7 | I/O L38P_7        | I/O L37N_7   | I/O L37P_7 | I/O          | I/O          | I/O L51N_7 ◆ | VCCINT     | GND        | GND        | GND               | GND        | GND               |     |

Figure 57: FG1156 Package Footprint (Top View)

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All Devices

Top Right Corner of FG1156 Package (Top View)

- 12 **DUAL:** Configuration pin, then possible user I/O
- 16 **DCI:** User I/O or reference resistor input for bank
- 8 **GCLK:** User I/O or global clock buffer input
- 7 **CONFIG:** Dedicated configuration pins
- 4 **JTAG:** Dedicated JTAG port pins
- 104 **VCCO:** Output voltage supply for bank
- 40 **VCCINT:** Internal core voltage supply (+1.2V)
- 32 **VCCAUX:** Auxiliary voltage supply (+2.5V)
- 184 **GND:** Ground

| Bank 1            |            |            |            |            |                   |            |            |                   |            |                   |            |            |                   |                   |                  |                  | Bank 2 |   |  |
|-------------------|------------|------------|------------|------------|-------------------|------------|------------|-------------------|------------|-------------------|------------|------------|-------------------|-------------------|------------------|------------------|--------|---|--|
| 18                | 19         | 20         | 21         | 22         | 23                | 24         | 25         | 26                | 27         | 28                | 29         | 30         | 31                | 32                | 33               | 34               |        |   |  |
| I/O               | GND        | I/O L40N_1 | I/O L26N_1 | GND        | I/O L19N_1        | I/O L15N_1 | I/O L14N_1 | GND               | I/O L08N_1 | I/O L34N_1        | I/O L05N_1 | GND        | I/O L02N_1        | I/O L01N_1 VRP_1  | GND              | GND              | A      |   |  |
| I/O L32N_1 GCLK5  | I/O L28N_1 | I/O L40P_1 | I/O L26P_1 | VCCO_1     | I/O L19P_1        | I/O L15P_1 | I/O L14P_1 | I/O               | I/O L08P_1 | I/O L34P_1        | I/O L05P_1 | I/O L03N_1 | I/O L02P_1        | I/O L01P_1 VRN_1  | GND              | GND              | B      |   |  |
| I/O L32P_1 GCLK4  | I/O L28P_1 | I/O L39N_1 | I/O L25N_1 | I/O L22N_1 | I/O               | GND        | I/O L13N_1 | I/O L10N_1 VREF_1 | VCCO_1     | I/O L33N_1        | I/O L04N_1 | I/O L03P_1 | VCCO_1            | GND               | I/O L01N_2 VRP_2 | I/O L01P_2 VRN_2 | C      |   |  |
| I/O L31N_1 VREF_1 | VCCO_1     | I/O L39P_1 | I/O L25P_1 | I/O L22P_1 | I/O L18N_1        | VCCO_1     | I/O L13P_1 | I/O L10P_1        | I/O L07N_1 | I/O L33P_1        | I/O L04P_1 | I/O VREF_1 | TCK               | VCCO_2            | I/O L02N_2       | I/O L02P_2       | D      |   |  |
| I/O L31P_1        | GND        | VCCAUX     | I/O        | GND        | I/O L18P_1        | VCCAUX     | I/O        | GND               | I/O L07P_1 | I/O L06N_1 VREF_1 | VCCAUX     | GND        | TDO               | I/O L03N_2 VREF_2 | I/O L03P_2       | GND              | E      |   |  |
| I/O               | I/O L27N_1 | I/O L38N_1 | I/O L24N_1 | VCCO_1     | I/O L17N_1 VREF_1 | I/O L36N_1 | I/O L12N_1 | I/O L09N_1        | I/O        | I/O L06P_1        | I/O        | VCCAUX     | I/O L04N_2        | I/O L04P_2        | I/O L41N_2       | I/O L41P_2       | F      |   |  |
| I/O L30N_1        | I/O L27P_1 | I/O L38P_1 | I/O L24P_1 | I/O L21N_1 | I/O L17P_1        | I/O L36P_1 | I/O L12P_1 | I/O L09P_1        | VCCO_1     | GND               | I/O L05N_2 | I/O L05P_2 | I/O L42N_2        | I/O L42P_2        | I/O              | I/O              | G      |   |  |
| I/O L30P_1        | VCCAUX     | VCCO_1     | I/O L23N_1 | I/O L21P_1 | I/O               | VCCO_1     | I/O L11N_1 | I/O               | TMS        | VCCO_2            | I/O L06N_2 | I/O L06P_2 | I/O L09N_2 VREF_2 | VCCO_2            | I/O L07N_2       | I/O L07P_2       | H      |   |  |
| I/O L29N_1        | GND        | I/O L37N_1 | I/O L23P_1 | GND        | I/O L16N_1        | I/O L35N_1 | I/O L11P_1 | I/O               | I/O L11N_2 | I/O L08N_2        | I/O L08P_2 | GND        | I/O L09P_2        | I/O L10N_2        | I/O L10P_2       | GND              | J      |   |  |
| I/O L29P_1        | I/O        | I/O L37P_1 | I/O VREF_1 | I/O L20N_1 | I/O L16P_1        | I/O L35P_1 | GND        | I/O L11P_2        | I/O L12N_2 | I/O L12P_2        | I/O L13N_2 | I/O L13P_2 | I/O L14N_2        | I/O L14P_2        | I/O L15N_2       | I/O L15P_2       | K      |   |  |
| I/O VREF_1        | I/O        | I/O        | I/O        | I/O L20P_1 | I/O               | I/O        | I/O L16N_2 | I/O L16P_2        | VCCO_2     | I/O L17N_2        | I/O L17P_2 | VCCAUX     | VCCO_2            | GND               | I/O L45N_2       | I/O L45P_2       | L      |   |  |
| VCCINT            | VCCO_1     | VCCO_1     | VCCO_1     | VCCO_1     | VCCINT            | I/O L46N_2 | I/O L46P_2 | I/O L21N_2        | I/O L47N_2 | I/O L47P_2        | I/O L19N_2 | I/O L19P_2 | I/O L20N_2        | I/O L20P_2        | I/O L48N_2       | I/O L48P_2       | M      |   |  |
| GND               | VCCINT     | VCCINT     | VCCINT     | VCCINT     | VCCO_2            | I/O L24N_2 | I/O L21P_2 | GND               | I/O L22N_2 | I/O L22P_2        | VCCO_2     | GND        | I/O L23N_2 VREF_2 | I/O L23P_2        | VCCO_2           | GND              | N      |   |  |
| GND               | GND        | GND        | GND        | VCCINT     | VCCO_2            | I/O L24P_2 | I/O L49N_2 | I/O L49P_2        | I/O L50N_2 | I/O L50P_2        | I/O L26N_2 | I/O L26P_2 | I/O L27N_2        | I/O L27P_2        | I/O L28N_2       | I/O L28P_2       | P      |   |  |
| GND               | GND        | GND        | GND        | VCCINT     | VCCO_2            | I/O L29N_2 | I/O L29P_2 | I/O L33N_2        | VCCO_2     | I/O L30N_2        | I/O L30P_2 | VCCAUX     | I/O L31N_2        | I/O L31P_2        | I/O L32N_2       | I/O L32P_2       | R      |   |  |
| GND               | GND        | GND        | GND        | VCCINT     | VCCO_2            | I/O L51N_2 | I/O L33P_2 | GND               | VCCAUX     | I/O L34N_2 VREF_2 | I/O L34P_2 | GND        | VCCO_2            | I/O L35N_2        | I/O L35P_2       | GND              | T      |   |  |
| GND               | GND        | GND        | GND        | GND        | VCCINT            | I/O L51P_2 | I/O        | I/O               | I/O L37N_2 | I/O L37P_2        | I/O L38N_2 | I/O L38P_2 | I/O L39N_2        | I/O L39P_2        | I/O L40N_2       | I/O L40P_2       | VREF_2 | U |  |

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Figure 58: FG1156 Package Footprint (Top View) Continued



|          | 1                    | 2                    | 3                    | 4               | 5          | 6               | 7                    | 8          | 9                    | 10                  | 11                   | 12         | 13         | 14                   | 15         | 16                   | 17                   |
|----------|----------------------|----------------------|----------------------|-----------------|------------|-----------------|----------------------|------------|----------------------|---------------------|----------------------|------------|------------|----------------------|------------|----------------------|----------------------|
| <b>V</b> | I/O L40P_6<br>VREF_6 | I/O L40N_6           | I/O L39P_6           | I/O L39N_6      | I/O L38P_6 | I/O L38N_6      | I/O L52P_6           | I/O L52N_6 | I/O                  | I/O                 | I/O L49P_6<br>◆      | VCCINT     | GND        | GND                  | GND        | GND                  | GND                  |
| <b>W</b> | GND                  | I/O L37P_6           | I/O L37N_6           | VCCO_6          | GND        | I/O L36P_6      | I/O L36N_6           | VCCAUX     | GND                  | I/O L35P_6          | I/O L49N_6<br>◆      | VCCO_6     | VCCINT     | GND                  | GND        | GND                  | GND                  |
| <b>Y</b> | I/O L34P_6           | I/O L34N_6<br>VREF_6 | I/O L33P_6           | I/O L33N_6      | VCCAUX     | I/O L48P_6      | I/O L48N_6           | VCCO_6     | I/O L35N_6           | I/O L32P_6          | I/O L32N_6           | VCCO_6     | VCCINT     | GND                  | GND        | GND                  | GND                  |
| <b>A</b> | I/O L31P_6           | I/O L31N_6           | I/O L30P_6           | I/O L30N_6      | I/O L29P_6 | I/O L29N_6      | I/O L28P_6           | I/O L28N_6 | I/O L46P_6<br>◆      | I/O L46N_6<br>◆     | I/O L27P_6           | VCCO_6     | VCCINT     | GND                  | GND        | GND                  | GND                  |
| <b>A</b> | GND                  | VCCO_6               | I/O L26P_6           | I/O L26N_6      | GND        | VCCO_6          | I/O L25P_6           | I/O L25N_6 | GND                  | I/O L24P_6          | I/O L27N_6           | VCCO_6     | VCCINT     | VCCINT               | VCCINT     | VCCINT               | GND                  |
| <b>A</b> | I/O L23P_6           | I/O L23N_6           | I/O L45P_6           | I/O L45N_6      | I/O L22P_6 | I/O L22N_6      | I/O L21P_6           | I/O L21N_6 | I/O L24N_6<br>VREF_6 | I/O L20P_6          | I/O L20N_6           | VCCINT     | VCCO_5     | VCCO_5               | VCCO_5     | VCCO_5               | VCCINT               |
| <b>A</b> | I/O L19P_6           | I/O L19N_6           | GND                  | VCCO_6          | VCCAUX     | I/O L44P_6<br>◆ | I/O L44N_6<br>◆      | VCCO_6     | I/O L17P_6<br>VREF_6 | I/O L17N_6          | I/O                  | I/O<br>◆   | I/O L16P_5 | I/O                  | I/O        | I/O                  | I/O                  |
| <b>A</b> | I/O L16P_6           | I/O L16N_6           | I/O L15P_6           | I/O L15N_6      | I/O L14P_6 | I/O L14N_6      | I/O L13P_6<br>VREF_6 | I/O L13N_6 | I/O L12P_6           | GND                 | I/O L39P_5<br>◆      | I/O L12P_5 | I/O L16N_5 | I/O                  | I/O L23P_5 | I/O                  | I/O L29P_5<br>VREF_5 |
| <b>A</b> | GND                  | I/O L11P_6           | I/O L11N_6           | I/O L10P_6      | GND        | I/O L09P_6      | I/O L09N_6<br>VREF_6 | I/O L12N_6 | I/O<br>◆             | I/O L07P_5          | I/O L39N_5<br>◆      | I/O L12N_5 | GND        | I/O L19P_5<br>VREF_5 | I/O L23N_5 | GND                  | I/O L29N_5           |
| <b>A</b> | I/O L08P_6           | I/O L08N_6           | VCCO_6               | I/O L10N_6      | I/O L07P_6 | I/O L07N_6      | VCCO_6               | M2         | I/O                  | I/O L07N_5          | VCCO_5               | I/O        | I/O L17P_5 | I/O L19N_5           | VCCO_5     | VCCAUX               | I/O L30P_5           |
| <b>A</b> | I/O                  | I/O                  | I/O L41P_6<br>◆      | I/O L41N_6<br>◆ | I/O L06P_6 | I/O L06N_6      | GND                  | VCCO_5     | I/O L37P_5           | I/O L08P_5          | I/O L40P_5<br>◆      | I/O L13P_5 | I/O L17N_5 | I/O L20P_5           | I/O L24P_5 | I/O L27P_5           | I/O L30N_5           |
| <b>A</b> | I/O L05P_6           | I/O L05N_6           | I/O L04P_6           | I/O L04N_6      | VCCAUX     | I/O             | I/O L06P_5           | I/O VREF_5 | I/O L37N_5           | I/O L08N_5          | I/O L40N_5<br>◆      | I/O L13N_5 | VCCO_5     | I/O L20N_5           | I/O L24N_5 | I/O L27N_5<br>VREF_5 | I/O                  |
| <b>A</b> | GND                  | I/O L03P_6           | I/O L03N_6<br>VREF_6 | M1              | GND        | VCCAUX          | I/O L06N_5           | I/O L35P_5 | GND                  | I/O                 | VCCAUX               | I/O L14P_5 | GND        | I/O                  | VCCAUX     | GND                  | I/O L31P_5<br>D5     |
| <b>A</b> | I/O L02P_6           | I/O L02N_6           | VCCO_6               | M0              | I/O VREF_5 | I/O L04P_5      | I/O L33P_5<br>◆      | I/O L35N_5 | I/O L38P_5           | I/O L09P_5          | VCCO_5               | I/O L14N_5 | I/O L18P_5 | I/O L21P_5           | I/O L25P_5 | VCCO_5               | I/O L31N_5<br>D4     |
| <b>A</b> | I/O L01P_6<br>VRN_6  | I/O L01N_6<br>VRP_6  | GND                  | VCCO_5          | I/O L03P_5 | I/O L04N_5      | I/O L33N_5<br>◆      | VCCO_5     | I/O L38N_5           | I/O L09N_5          | GND                  | I/O        | I/O L18N_5 | I/O L21N_5           | I/O L25N_5 | I/O L28P_5<br>D7     | I/O L32P_5<br>GCLK2  |
| <b>A</b> | GND                  | GND                  | I/O L01P_5<br>CS_B   | I/O L02P_5      | I/O L03N_5 | I/O L05P_5      | I/O L34P_5<br>◆      | I/O L36P_5 | I/O                  | I/O L10P_5<br>VRN_5 | I/O L11P_5           | I/O L15P_5 | VCCO_5     | I/O L22P_5           | I/O L26P_5 | I/O L28N_5<br>D6     | I/O L32N_5<br>GCLK3  |
| <b>A</b> | GND                  | GND                  | I/O L01N_5<br>RDWR_B | I/O L02N_5      | GND        | I/O L05N_5      | I/O L34N_5<br>◆      | I/O L36N_5 | GND                  | I/O L10N_5<br>VRP_5 | I/O L11N_5<br>VREF_5 | I/O L15N_5 | GND        | I/O L22N_5           | I/O L26N_5 | GND                  | I/O VREF_5           |

Bank 5

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Bottom Left Corner of FG1156 Package (Top View)

Figure 59: FG1156 Package Footprint (Top View) Continued

| 18                         | 19                      | 20                   | 21                  | 22         | 23         | 24              | 25                   | 26                   | 27         | 28                   | 29              | 30         | 31                   | 32                  | 33                  | 34                   |    |
|----------------------------|-------------------------|----------------------|---------------------|------------|------------|-----------------|----------------------|----------------------|------------|----------------------|-----------------|------------|----------------------|---------------------|---------------------|----------------------|----|
| GND                        | GND                     | GND                  | GND                 | GND        | VCCINT     | I/O L51N_3<br>◆ | I/O                  | I/O                  | I/O L37P_3 | I/O L37N_3           | I/O L38P_3      | I/O L38N_3 | I/O L39P_3           | I/O L39N_3          | I/O L40P_3          | I/O L40N_3<br>VREF_3 | V  |
| GND                        | GND                     | GND                  | GND                 | VCCINT     | VCCO_3     | I/O L51P_3<br>◆ | I/O L33N_3           | GND                  | VCCAUX     | I/O L34P_3<br>VREF_3 | I/O L34N_3      | GND        | VCCO_3               | I/O L35P_3          | I/O L35N_3          | GND                  | W  |
| GND                        | GND                     | GND                  | GND                 | VCCINT     | VCCO_3     | I/O L50P_3      | I/O L50N_3           | I/O L33P_3           | VCCO_3     | I/O L30P_3           | I/O L30N_3      | VCCAUX     | I/O L31P_3           | I/O L31N_3          | I/O L32P_3          | I/O L32N_3           | Y  |
| GND                        | GND                     | GND                  | GND                 | VCCINT     | VCCO_3     | I/O L48N_3<br>◆ | I/O L49P_3<br>◆      | I/O L49N_3<br>◆      | I/O L26P_3 | I/O L26N_3           | I/O L27P_3      | I/O L27N_3 | I/O L28P_3           | I/O L28N_3          | I/O L29P_3          | I/O L29N_3           | AA |
| GND                        | VCCINT                  | VCCINT               | VCCINT              | VCCINT     | VCCO_3     | I/O L48P_3      | I/O L24N_3           | GND                  | I/O L46P_3 | I/O L46N_3           | VCCO_3          | GND        | I/O L47P_3           | I/O L47N_3          | VCCO_3              | GND                  | AB |
| VCCINT                     | VCCO_4                  | VCCO_4               | VCCO_4              | VCCO_4     | VCCINT     | I/O L20P_3      | I/O L20N_3           | I/O L24P_3           | I/O L21P_3 | I/O L21N_3           | I/O L22P_3      | I/O L22N_3 | I/O L23P_3<br>VREF_3 | I/O L23N_3          | I/O L45P_3          | I/O L45N_3           | AC |
| I/O                        | I/O                     | I/O                  | I/O L18N_4          | I/O        | I/O L11N_4 | DONE            | I/O L17P_3<br>VREF_3 | I/O L17N_3           | VCCO_3     | I/O L44P_3<br>◆      | I/O L44N_3<br>◆ | VCCAUX     | VCCO_3               | GND                 | I/O L19P_3          | I/O L19N_3           | AD |
| I/O                        | I/O                     | I/O L23N_4           | I/O L18P_4          | I/O        | I/O L11P_4 | I/O<br>◆        | GND                  | I/O L12N_3           | I/O L13P_3 | I/O L13N_3<br>VREF_3 | I/O L14P_3      | I/O L14N_3 | I/O L15P_3           | I/O L15N_3          | I/O L16P_3          | I/O L16N_3           | AE |
| I/O L29N_4                 | GND                     | I/O L23P_4           | IO VREF_4           | GND        | I/O L12N_4 | I/O             | I/O L07N_4<br>◆      | I/O                  | I/O L12P_3 | I/O L09P_3<br>VREF_3 | I/O L09N_3      | GND        | I/O L10N_3           | I/O L11P_3          | I/O L11N_3          | GND                  | AF |
| I/O L29P_4                 | VCCAUX                  | VCCO_4               | I/O L19N_4          | I/O L16N_4 | I/O L12P_4 | VCCO_4          | I/O L07P_4           | I/O                  | I/O        | VCCO_3               | I/O L07P_3      | I/O L07N_3 | I/O L10P_3           | VCCO_3              | I/O L08P_3          | I/O L08N_3           | AG |
| I/O L30N_4<br>D2           | I/O L27N_4<br>DIN<br>D0 | I/O L24N_4           | I/O L19P_4          | I/O L16P_4 | IO VREF_4  | I/O L39N_4<br>◆ | I/O L08N_4           | I/O L05N_4           | VCCO_4     | GND                  | I/O L06P_3      | I/O L06N_3 | I/O L41P_3<br>◆      | I/O L41N_3<br>◆     | I/O                 | I/O                  | AH |
| I/O L30P_4<br>D3           | I/O L27P_4<br>D1        | I/O L24P_4           | I/O L20N_4          | VCCO_4     | I/O L13N_4 | I/O L39P_4<br>◆ | I/O L08P_4           | I/O L05P_4           | I/O        | I/O L35N_4           | I/O             | VCCAUX     | I/O L04P_3           | I/O L04N_3          | I/O L05P_3          | I/O L05N_3           | AJ |
| IO VREF_4                  | GND                     | VCCAUX               | I/O L20P_4          | GND        | I/O L13P_4 | VCCAUX          | I/O                  | GND                  | I/O L38N_4 | I/O L35P_4           | VCCAUX          | GND        | N.C.<br>◆<br>■       | I/O L03P_3          | I/O L03N_3          | GND                  | AK |
| I/O L31N_4<br>INIT_B       | VCCO_4                  | I/O L25N_4           | I/O L21N_4          | I/O L17N_4 | I/O L14N_4 | VCCO_4          | I/O L09N_4           | I/O L06N_4<br>VREF_4 | I/O L38P_4 | I/O L36N_4<br>◆      | I/O L33N_4      | IO VREF_4  | CCLK                 | VCCO_3              | I/O L02P_3          | I/O L02N_3<br>VREF_3 | AL |
| I/O L31P_4<br>DOUT<br>BUSY | I/O L28N_4              | I/O L25P_4           | I/O L21P_4          | I/O L17P_4 | I/O L14P_4 | GND             | I/O L09P_4           | I/O L06P_4           | VCCO_4     | I/O L36P_4<br>◆      | I/O L33P_4      | I/O L03N_4 | VCCO_4               | GND                 | I/O L01P_3<br>VRN_3 | I/O L01N_3<br>VRP_3  | AM |
| I/O L32N_4<br>GCLK1        | I/O L28P_4              | I/O L26N_4           | IO L22N_4<br>VREF_4 | VCCO_4     | I/O L15N_4 | I/O L40N_4<br>◆ | I/O L10N_4           | I/O                  | I/O L04N_4 | I/O L37N_4<br>◆      | I/O L34N_4      | I/O L03P_4 | I/O L02N_4           | I/O L01N_4<br>VRP_4 | GND                 | GND                  | AN |
| I/O L32P_4<br>GCLK0        | GND                     | I/O L26P_4<br>VREF_4 | I/O L22P_4          | GND        | I/O L15P_4 | I/O L40P_4<br>◆ | I/O L10P_4           | GND                  | I/O L04P_4 | I/O L37P_4<br>◆      | I/O L34P_4      | GND        | I/O L02P_4           | I/O L01P_4<br>VRN_4 | GND                 | GND                  | AP |

Bank 3

Bank 4

DS099-4\_14d\_072903

Bottom Right Corner  
of FG1156 Package  
(Top View)

Figure 60: FG1156 Package Footprint (Top View) Continued

## Revision History

| Date       | Version | Description   |
|------------|---------|---|
| 04/03/2003 | 1.0     | Initial Xilinx release.   |
| 04/21/2003 | 1.1     | Added information on the VQ100 package footprint, including a complete pinout table ( <a href="#">Table 87</a> ) and footprint diagram ( <a href="#">Figure 44</a> ). Updated <a href="#">Table 85</a> with final I/O counts for the VQ100 package. Also added final differential I/O pair counts for the TQ144 package. Added clarifying comments to HSWAP_EN pin description on <a href="#">page 119</a> . Updated the footprint diagram for the FG900 package shown in <a href="#">Figure 55a</a> and <a href="#">Figure 55b</a> . Some thick lines separating I/O banks were incorrect. Made cosmetic changes to <a href="#">Figure 40</a> , <a href="#">Figure 42</a> , and <a href="#">Figure 43</a> . Updated Xilinx hypertext links. Added XC3S200 and XC3S400 to Pin Name column in <a href="#">Table 91</a> . |
| 05/12/2003 | 1.1.1   | AM32 pin was missing GND label in FG1156 package diagram ( <a href="#">Figure 53</a> ).   |
| 07/11/2003 | 1.1.2   | Corrected misspellings of GCLK in <a href="#">Table 69</a> and <a href="#">Table 70</a> . Changed CMOS25 to LVCMOS25 in <a href="#">Dual-Purpose Pin I/O Standard During Configuration</a> section. Clarified references to Module 2. For XC3S5000 in FG1156 package, corrected N.C. symbol to a black square in <a href="#">Table 110</a> , key, and package drawing.  |
| 07/29/2003 | 1.2     | Corrected pin names on FG1156 package. Some package balls incorrectly included LVDS pair names. The affected balls on the FG1156 package include G1, G2, G33, G34, U9, U10, U25, U26, V9, V10, V25, V26, AH1, AH2, AH33, AH34. The number of LVDS pairs is unaffected. Modified affected balls and re-sorted rows in <a href="#">Table 110</a> . Updated affected balls in <a href="#">Figure 53</a> . Also updated ASCII and Excel electronic versions of FG1156 pinout.   |
| 08/19/2003 | 1.2.1   | Removed 100 MHz ConfigRate option in <a href="#">CCLK: Configuration Clock</a> section and in <a href="#">Table 80</a> . Added note that TDO is a totem-pole output in <a href="#">Table 77</a> .   |
| 10/09/2003 | 1.2.2   | Some pins had incorrect bank designations and were improperly sorted in <a href="#">Table 93</a> . No pin names or functions changed. Renamed DCI_IN to DCI and added black diamond to N.C. pins in <a href="#">Table 93</a> . In <a href="#">Figure 47</a> , removed some extraneous text from pin 106 and corrected spelling of pins 45, 48, and 81.  |
| 12/17/2003 | 1.3     | Added FG320 pin tables and pinout diagram ( <a href="#">FG320: 320-lead Fine-pitch Ball Grid Array</a> ). Made cosmetic changes to the TQ144 footprint ( <a href="#">Figure 46</a> ), the PQ208 footprint ( <a href="#">Figure 47</a> ), the FG676 footprint ( <a href="#">Figure 53</a> ), and the FG900 footprint ( <a href="#">Figure 55</a> ). Clarified wording in <a href="#">Precautions When Using the JTAG Port in 3.3V Environments</a> section.  |
| 02/27/2004 | 1.4     | Clarified wording in <a href="#">Using JTAG Port After Configuration</a> section. In <a href="#">Table 81</a> , reduced package height for FG320 and increased maximum I/O values for the FG676, FG900, and FG1156 packages.  |
| 07/13/2004 | 1.5     | Added information on lead-free (Pb-free) package options to the <a href="#">Package Overview</a> section plus <a href="#">Table 81</a> and <a href="#">Table 83</a> . Clarified the VRN_# reference resistor requirements for I/O standards that use single termination as described in the <a href="#">DCI Termination Types</a> section and in <a href="#">Figure 42b</a> . Graduated from Advance Product Specification to Product Specification.  |
| 08/24/2004 | 1.5.1   | Removed XC3S2000 references from <a href="#">FG1156: 1156-lead Fine-pitch Ball Grid Array</a> .   |
| 01/17/2005 | 1.6     | Added XC3S50 in CP132 package option. Added XC3S2000 in FG456 package option. Added XC3S4000 in FG676 package option. Added <a href="#">Selecting the Right Package Option</a> section. Modified or added <a href="#">Table 81</a> , <a href="#">Table 83</a> , <a href="#">Table 84</a> , <a href="#">Table 85</a> , <a href="#">Table 89</a> , <a href="#">Table 90</a> , <a href="#">Table 100</a> , <a href="#">Table 102</a> , <a href="#">Table 103</a> , <a href="#">Table 106</a> , <a href="#">Figure 45</a> , and <a href="#">Figure 53</a> .   |
| 08/19/2005 | 1.7     | Removed term “weak” from the description of pull-up and pull-down resistors. Added <a href="#">IDCODE Register</a> values. Added signal integrity precautions to <a href="#">CCLK: Configuration Clock</a> and indicated that CCLK should be treated as an I/O during Master mode in <a href="#">Table 79</a> .   |
| 04/03/2006 | 2.0     | Added <a href="#">Package Thermal Characteristics</a> . Updated <a href="#">Figure 41</a> to make it a more obvious example. Added detail about which pins have dedicated pull-up resistors during configuration, regardless of the HSWAP_EN value to <a href="#">Table 70</a> and to <a href="#">Pin Behavior During Configuration</a> . Updated <a href="#">Precautions When Using the JTAG Port in 3.3V Environments</a> .   |
| 04/26/2006 | 2.1     | Corrected swapped data row in <a href="#">Table 86</a> . The Theta-JA with zero airflow column was swapped with the Theta-JC column. Made additional notations on CONFIG and JTAG pins that have pull-up resistors during configuration, regardless of the HSWAP_EN input.  |
| 05/25/2007 | 2.2     | Added link on <a href="#">page 128</a> to Material Declaration Data Sheets. Corrected units typo in <a href="#">Table 74</a> . Added Note 1 to <a href="#">Table 103</a> about VREF for XC3S1500 in FG676.  |

| Date       | Version | Description   |
|------------|---------|---|
| 11/30/2007 | 2.3     | Added XC3S5000 FG(G)676 package. Noted that the FG(G)1156 package is being discontinued. Updated <a href="#">Table 86</a> with latest thermal characteristics data.   |
| 06/25/2008 | 2.4     | Updated formatting and links.   |
| 12/04/2009 | 2.5     | Added link to UG332 in <a href="#">CCLK: Configuration Clock</a> . Noted that the CP132, CPG132, FG1156, and FGG1156 packages are being discontinued in <a href="#">Table 81</a> , <a href="#">Table 83</a> , <a href="#">Table 84</a> , <a href="#">Table 85</a> , and <a href="#">Table 86</a> . Updated <a href="#">CP132: 132-Ball Chip-Scale Package</a> to indicate that the CP132 and CPG132 packages are being discontinued.  |
| 10/29/2012 | 3.0     | Added <a href="#">Notice of Disclaimer</a> . Per <a href="#">XCN07022</a> , updated the FG1156 and FGG1156 package discussion throughout document including in <a href="#">Table 81</a> , <a href="#">Table 83</a> , <a href="#">Table 84</a> , <a href="#">Table 85</a> , and <a href="#">Table 86</a> . Per <a href="#">XCN08011</a> , updated CP132 and CPG132 package discussion throughout document including in <a href="#">Table 81</a> , <a href="#">Table 83</a> , <a href="#">Table 84</a> , <a href="#">Table 85</a> , and <a href="#">Table 86</a> . This product is not recommended for new designs. |
| 06/27/2013 | 3.1     | Removed banner. This product IS recommended for new designs.  |

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