

# Military ProASIC3/EL Low Power Flash FPGAs with Flash\*Freeze Technology

## Features and Benefits

### Military Temperature Tested and Qualified

- Each Device Tested from –55°C to 125°C

### Firm-Error Immune

- Not Susceptible to Neutron-Induced Configuration Loss

### Low Power

- Dramatic Reduction in Dynamic and Static Power
- 1.2 V to 1.5 V Core and I/O Voltage Support for Low Power<sup>†</sup>
- Low Power Consumption in Flash\*Freeze Mode Allows for Instantaneous Entry To / Exit From Low-Power Flash\*Freeze Mode<sup>‡</sup>
- Supports Single-Voltage System Operation
- Low-Impedance Switches

### High Capacity

- 250K to 3M System Gates
- Up to 504 kbits of True Dual-Port SRAM
- Up to 620 User I/Os

### Reprogrammable Flash Technology

- 130-nm, 7-Layer Metal (6 Copper), Flash-Based CMOS Process
- Live-at-Power-Up (LAPU) Level 0 Support
- Single-Chip Solution
- Retains Programmed Design when Powered Off

### High Performance

- 350 MHz (1.5 V systems) and 250 MHz (1.2 V systems) System Performance
- 3.3 V, 66 MHz, 64-Bit PCI (1.5 V systems) and 66 MHz, 32-Bit PCI (1.2 V systems)

### In-System Programming (ISP) and Security

- Secure ISP Using On-Chip 128-Bit Advanced Encryption Standard (AES) Decryption via JTAG (IEEE 1532–compliant)
- FlashLock<sup>®</sup> to Secure FPGA Contents

### High-Performance Routing Hierarchy

- Segmented, Hierarchical Routing and Clock Structure
- High-Performance, Low-Skew Global Network

- Architecture Supports Ultra-High Utilization

### Advanced and Pro (Professional) I/Os<sup>††</sup>

- 700 Mbps DDR, LVDS-Capable I/Os
- 1.2 V, 1.5 V, 1.8 V, 2.5 V, and 3.3 V Mixed-Voltage Operation<sup>†</sup>
- Bank-Selectable I/O Voltages—up to 8 Banks per Chip
- Single-Ended I/O Standards: LVTTTL, LVCMOS 3.3 V / 2.5 V / 1.8 V / 1.5 V / 1.2 V, 3.3 V PCI / 3.3 V PCI-X, and LVCMOS 2.5 V / 5.0 V Input<sup>†</sup>
- Differential I/O Standards: LVPECL, LVDS, BLVDS, and M-LVDS
- Voltage-Referenced I/O Standards: GTL+ 2.5 V / 3.3 V, GTL 2.5 V / 3.3 V, HSTL Class I and II, SSTL2 Class I and II, SSTL3 Class I and II (A3PE3000L only)
- I/O Registers on Input, Output, and Enable Paths
- Hot-Swappable and Cold-Sparing I/Os
- Programmable Output Slew Rate and Drive Strength
- Programmable Input Delay (A3PE3000L only)
- Schmitt Trigger Option on Single-Ended Inputs (A3PE3000L)
- Weak Pull-Up/-Down
- IEEE 1149.1 (JTAG) Boundary Scan Test
- Pin-Compatible Packages across the Military ProASIC<sup>®</sup>3EL Family

### Clock Conditioning Circuit (CCC) and PLL

- Six CCC Blocks—One Block with Integrated PLL in ProASIC3 and All Blocks with Integrated PLL in ProASIC3EL
- Configurable Phase Shift, Multiply/Divide, Delay Capabilities, and External Feedback
- Wide Input Frequency Range 1.5 MHz to 250 MHz (1.2 V systems) and 350 MHz (1.5 V systems)

### SRAMs and FIFOs

- Variable-Aspect-Ratio 4,608-Bit RAM Blocks (x1, x2, x4, x9, and x18 organizations available)
- True Dual-Port SRAM (except x18)
- 24 SRAM and FIFO Configurations with Synchronous Operation:
  - 250 MHz: For 1.2 V Systems
  - 350 MHz: For 1.5 V Systems

### ARM<sup>®</sup> Processor Support in ProASIC3/EL FPGAs

- ARM Cortex<sup>™</sup>-M1 Soft Processor Available with or without Debug

Table 1 • Military ProASIC3/EL Low-Power Devices

| ProASIC3/EL Devices                      | A3P250  | A3PE600L | A3P1000               | A3PE3000L          |
|--|---------|----------|-----------------------|--------------------|
| <b>ARM Cortex-M1 Devices<sup>1</sup></b> |         |          | <b>M1A3P1000</b>      | <b>M1A3PE3000L</b> |
| System Gates                             | 250,000 | 600,000  | 1M                    | 3M                 |
| VersaTiles (D-flip-flops)                | 6,144   | 13,824   | 24,576                | 75,264             |
| RAM kbits (1,024 bits)                   | 36      | 108      | 144                   | 504                |
| 4,608-Bit Blocks                         | 8       | 24       | 32                    | 112                |
| FlashROM Kbits                           | 1       | 1        | 1                     | 1                  |
| Secure (AES) ISP <sup>2</sup>            | Yes     | Yes      | Yes                   | Yes                |
| Integrated PLL in CCCs                   | 1       | 6        | 1                     | 6                  |
| VersaNet Globals                         | 18      | 18       | 18                    | 18                 |
| I/O Banks                                | 4       | 8        | 4                     | 8                  |
| Maximum User I/Os                        | 68      | 270      | 154                   | 620                |
| Package Pins<br>VQFP<br>PQFP<br>FBGA     | VQ100   | FG484    | PQ208<br>FG144, FG484 | FG484, FG896       |

#### Notes:

1. Refer to the Cortex-M1 product brief for more information.
2. AES is not available for ARM-enabled ProASIC3/EL devices.

<sup>†</sup> A3P250 and A3P1000 support only 1.5 V core operation.

<sup>‡</sup> Flash\*Freeze technology is not available for A3P250 or A3P1000.

<sup>††</sup> Pro I/Os are not available on A3P250 or A3P1000.

## I/Os Per Package <sup>1</sup>

| ProASIC3/EL<br>Low Power Devices | A3P250                            |                           | A3PE600L                          |                           | A3P1000                           |                           | A3PE3000L                         |                           |
|----------------------------------|-----------------------------------|---------------------------|-----------------------------------|---------------------------|-----------------------------------|---------------------------|-----------------------------------|---------------------------|
| ARM<br>Cortex-M1 Devices         |                                   |                           |                                   |                           | M1A3P1000                         |                           | M1A3PE3000L                       |                           |
| Package                          | Single-<br>Ended I/O <sup>2</sup> | Differential<br>I/O Pairs | Single-<br>Ended I/O <sup>2</sup> | Differential<br>I/O Pairs | Single-<br>Ended I/O <sup>2</sup> | Differential<br>I/O Pairs | Single-<br>Ended I/O <sup>2</sup> | Differential<br>I/O Pairs |
| VQ100                            | 68                                | 13                        | –                                 | –                         | –                                 | –                         | –                                 | –                         |
| PQ208                            | –                                 | –                         | –                                 | –                         | 154                               | 35                        | –                                 | –                         |
| FG144                            | –                                 | –                         | –                                 | –                         | 97                                | 25                        | –                                 | –                         |
| FG484                            | –                                 | –                         | 270                               | 135                       | 300                               | 74                        | 341                               | 168                       |
| FG896                            | –                                 | –                         | –                                 | –                         | –                                 | –                         | 620                               | 300                       |

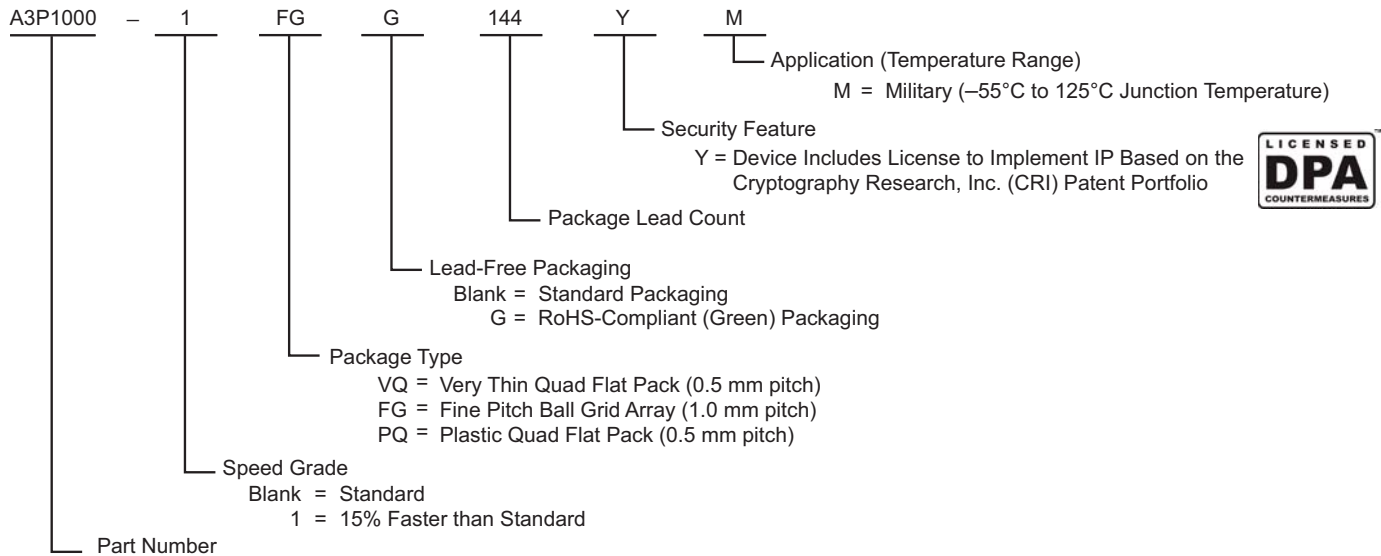
### Notes:

1. When considering migrating your design to a lower- or higher-density device, refer to the packaging section of the datasheet to ensure you are complying with design and board migration requirements.
2. Each used differential I/O pair reduces the number of single-ended I/Os available by two.
3. "G" indicates RoHS-compliant packages. Refer to "Military ProASIC3/EL Ordering Information" on page III for the location of the "G" in the part number.
4. For A3PE3000L devices, the usage of certain I/O standards is limited as follows:
  - SSTL3(I) and (II): up to 40 I/Os per north or south bank
  - LVPECL / GTL+ 3.3 V / GTL 3.3 V: up to 48 I/Os per north or south bank
  - SSTL2(I) and (II) / GTL+ 2.5 V / GTL 2.5 V: up to 72 I/Os per north or south bank
5. When the Flash\*Freeze pin is used to directly enable Flash\*Freeze mode and not as a regular I/O, the number of single-ended user I/Os available is reduced by one.

## Military ProASIC3/EL Device Status

| Military ProASIC3/EL Devices | Status     | M1 Military ProASIC3/EL Devices | Status     |
|------------------------------|------------|---------------------------------|------------|
| A3P250                       | Production |                                 |            |
| A3PE600L                     | Production |                                 |            |
| A3P1000                      | Production | M1A3P1000                       | Production |
| A3PE3000L                    | Production | M1A3PE3000L                     | Production |

# Military ProASIC3/EL Ordering Information



**Military ProASIC3/EL Devices**

- A3P250 = 250,000 System Gates
- A3PE600L = 600,000 System Gates
- A3P1000 = 1,000,000 System Gates
- A3PE3000L = 3,000,000 System Gates

**Military ProASIC3/EL Devices with ARM Cortex-M1**

- M1A3P1000 = 1,000,000 System Gates
- M1A3PE3000L = 3,000,000 System Gates

## Temperature Grade Offerings

| Package                      | A3P250 | A3PE600L | A3P1000          | A3PE3000L          |
|------------------------------|--------|----------|------------------|--------------------|
| <b>ARM Cortex-M1 Devices</b> |        |          | <b>M1A3P1000</b> | <b>M1A3PE3000L</b> |
| VQ100                        | M      | –        | –                | –                  |
| PQ208                        | –      | –        | M                | –                  |
| FG144                        | –      | –        | M                | –                  |
| FG484                        | –      | M        | M                | M                  |
| FG896                        | –      | –        | –                | M                  |

*Note:* M = Military temperature range: –55°C to 125°C junction temperature

## Speed Grade and Temperature Grade Matrix

| Temperature Grade | Std. | –1 |
|-------------------|------|----|
| M                 | ✓    | ✓  |

*Note:* M = Military temperature range: –55°C to 125°C junction temperature

Contact your local Microsemi SoC Products Group (formerly Actel) representative for device availability:

<http://www.actel.com/contact/default.aspx>.

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# 1 – Military ProASIC3/EL Device Family Overview

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## General Description

The military ProASIC3/EL family of flash FPGAs dramatically reduces dynamic power consumption by 40% and static power by 50%. These power savings are coupled with performance, density, true single chip, 1.2 V to 1.5 V core and I/O operation, reprogrammability, and advanced features.

Microsemi's proven Flash\*Freeze technology enables military ProASIC3EL device users to shut off dynamic power instantaneously and switch the device to static mode without the need to switch off clocks or power supplies, and retaining internal states of the device. This greatly simplifies power management. In addition, optimized software tools using power-driven layout provide instant push-button power reduction.

Nonvolatile flash technology gives military ProASIC3/EL devices the advantage of being a secure, low-power, single-chip solution that is live at power-up (LAPU). Military ProASIC3/EL devices offer dramatic dynamic power savings, giving FPGA users flexibility to combine low power with high performance.

These features enable designers to create high-density systems using existing ASIC or FPGA design flows and tools.

Military ProASIC3/EL devices offer 1 kbit of on-chip, reprogrammable, nonvolatile FlashROM storage as well as clock conditioning circuitry (CCC) based on an integrated phase-locked loop (PLL). Military ProASIC3/EL devices support devices from 250K system gates to 3 million system gates with up to 504 kbits of true dual-port SRAM and 620 user I/Os.

M1 military ProASIC3/EL devices support the high-performance, 32-bit Cortex-M1 processor developed by ARM for implementation in FPGAs. ARM Cortex-M1 is a soft processor that is fully implemented in the FPGA fabric. It has a three-stage pipeline that offers a good balance between low-power consumption and speed when implemented in an M1 military ProASIC3/EL device. The processor runs the ARMv6-M instruction set, has a configurable nested interrupt controller, and can be implemented with or without the debug block. ARM Cortex-M1 is available at no cost from Microsemi for use in M1 military ProASIC3/EL FPGAs.

The ARM-enabled devices have ordering numbers that begin with M1 and do not support AES decryption.

## Flash\*Freeze Technology†

Military ProASIC3EL devices offer Flash\*Freeze technology, which allows instantaneous switching from an active state to a static state. When Flash\*Freeze mode is activated, military ProASIC3EL devices enter a static state while retaining the contents of registers and SRAM. Power is conserved without the need for additional external components to turn off I/Os or clocks. Flash\*Freeze technology is combined with in-system programmability, which enables users to quickly and easily upgrade and update their designs in the final stages of manufacturing or in the field. The ability of military ProASIC3EL devices to support a 1.2 V core voltage allows for an even greater reduction in power consumption, which enables low total system power.

When the military ProASIC3EL device enters Flash\*Freeze mode, the device automatically shuts off the clocks and inputs to the FPGA core; when the device exits Flash\*Freeze mode, all activity resumes and data is retained.

The availability of low-power modes, combined with a reprogrammable, single-chip, single-voltage solution, make military ProASIC3EL devices suitable for low-power data transfer and manipulation in military-temperature applications where available power may be limited (e.g., in battery-powered equipment); or where heat dissipation may be limited (e.g., in enclosures with no forced cooling).

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† Flash\*Freeze technology is not supported on A3P1000.

## Flash Advantages

### **Low Power<sup>f</sup>**

The military ProASIC3EL family of flash-based FPGAs provides a low-power advantage, and when coupled with high performance, enables designers to make power-smart choices using a single-chip, reprogrammable, and live-at-power-up device.

Military ProASIC3EL devices offer 40% dynamic power and 50% static power savings by reducing the core operating voltage to 1.2 V. In addition, the power-driven layout (PDL) feature in Libero<sup>®</sup> Integrated Design Environment (IDE) offers up to 30% additional power reduction. With Flash\*Freeze technology, military ProASIC3EL device is able to retain device SRAM and logic while dynamic power is reduced to a minimum, without the need to stop clock or power supplies. Combining these features provides a low-power, feature-rich, and high-performance solution.

### **Security**

Nonvolatile, flash-based military ProASIC3/EL devices do not require a boot PROM, so there is no vulnerable external bitstream that can be easily copied. Military ProASIC3/EL devices incorporate FlashLock, which provides a unique combination of reprogrammability and design security without external overhead, advantages that only an FPGA with nonvolatile flash programming can offer.

Military ProASIC3/EL devices utilize a 128-bit flash-based lock and a separate AES key to secure programmed intellectual property and configuration data. In addition, all FlashROM data in military ProASIC3/EL devices can be encrypted prior to loading, using the industry-leading AES-128 (FIPS192) bit block cipher encryption standard. AES was adopted by the National Institute of Standards and Technology (NIST) in 2000 and replaces the 1977 DES standard. Military ProASIC3/EL devices have a built-in AES decryption engine and a flash-based AES key that make them the most comprehensive programmable logic device security solution available today. Military ProASIC3/EL devices with AES-based security allow for secure, remote field updates over public networks such as the Internet, and ensure that valuable IP remains out of the hands of system overbuilders, system cloners, and IP thieves.

Security, built into the FPGA fabric, is an inherent component of the military ProASIC3/EL family. The flash cells are located beneath seven metal layers, and many device design and layout techniques have been used to make invasive attacks extremely difficult. The military ProASIC3/EL family, with FlashLock and AES security, is unique in being highly resistant to both invasive and noninvasive attacks. Your valuable IP is protected and secure, making remote ISP possible. A military ProASIC3/EL device provides the most impenetrable security for programmable logic designs.

### **Single Chip**

Flash-based FPGAs store their configuration information in on-chip flash cells. Once programmed, the configuration data is an inherent part of the FPGA structure, and no external configuration data needs to be loaded at system power-up (unlike SRAM-based FPGAs). Therefore, flash-based military ProASIC3/EL FPGAs do not require system configuration components such as EEPROMs or microcontrollers to load device configuration data. This reduces bill-of-materials costs and PCB area, and increases security and system reliability.

### **Live at Power-Up**

Flash-based military ProASIC3/EL devices support Level 0 of the LAPU classification standard. This feature helps in system component initialization, execution of critical tasks before the processor wakes up, setup and configuration of memory blocks, clock generation, and bus activity management. The LAPU feature of flash-based military ProASIC3/EL devices greatly simplifies total system design and reduces total system cost, often eliminating the need for CPLDs and clock generation PLLs. In addition, glitches and brownouts in system power will not corrupt the military ProASIC3/EL device's flash configuration, and unlike SRAM-based FPGAs, the device will not have to be reloaded when system power is restored. This enables the reduction or complete removal of the configuration PROM, expensive voltage monitor, brownout detection, and clock generator devices from the PCB design. Flash-based military ProASIC3/EL devices simplify total system design and reduce cost and design risk while increasing system reliability and improving system initialization time.

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<sup>f</sup> A3P1000 only supports 1.5 V core operation.



## **Reduced Cost of Ownership**

Advantages to the designer extend beyond low unit cost, performance, and ease of use. Unlike SRAM-based FPGAs, flash-based military ProASIC3/EL devices allow all functionality to be live at power-up; no external boot PROM is required. On-board security mechanisms prevent access to all the programming information and enable secure remote updates of the FPGA logic. Designers can perform secure remote in-system reprogramming to support future design iterations and field upgrades with confidence that valuable intellectual property cannot be compromised or copied. Secure ISP can be performed using the industry-standard AES algorithm. The military ProASIC3/EL family device architecture mitigates the need for ASIC migration at higher volumes. This makes the military ProASIC3/EL family a cost-effective ASIC replacement.

## **Firm-Error Immunity**

Firm errors occur most commonly when high-energy neutrons, generated in the upper atmosphere, strike a configuration cell of an SRAM FPGA. The energy of the collision can change the state of the configuration cell and thus change the logic, routing, or I/O behavior in an unpredictable way. These errors are impossible to prevent in SRAM FPGAs. The consequence of this type of error can be a complete system failure. Firm errors do not exist in the configuration memory of military ProASIC3/EL flash-based FPGAs. Once it is programmed, the flash cell configuration element of military ProASIC3/EL FPGAs cannot be altered by high-energy neutrons and is therefore immune to them. Recoverable (or soft) errors occur in the user data SRAM of all FPGA devices. These can easily be mitigated by using error detection and correction (EDAC) circuitry built into the FPGA fabric.

## **Advanced Flash Technology**

The military ProASIC3/EL family offers many benefits, including nonvolatility and reprogrammability, through an advanced flash-based, 130-nm LVCMOS process with 7 layers of metal. Standard CMOS design techniques are used to implement logic and control functions. The combination of fine granularity, enhanced flexible routing resources, and abundant flash switches allows for very high logic utilization without compromising device routability or performance. Logic functions within the device are interconnected through a four-level routing hierarchy.

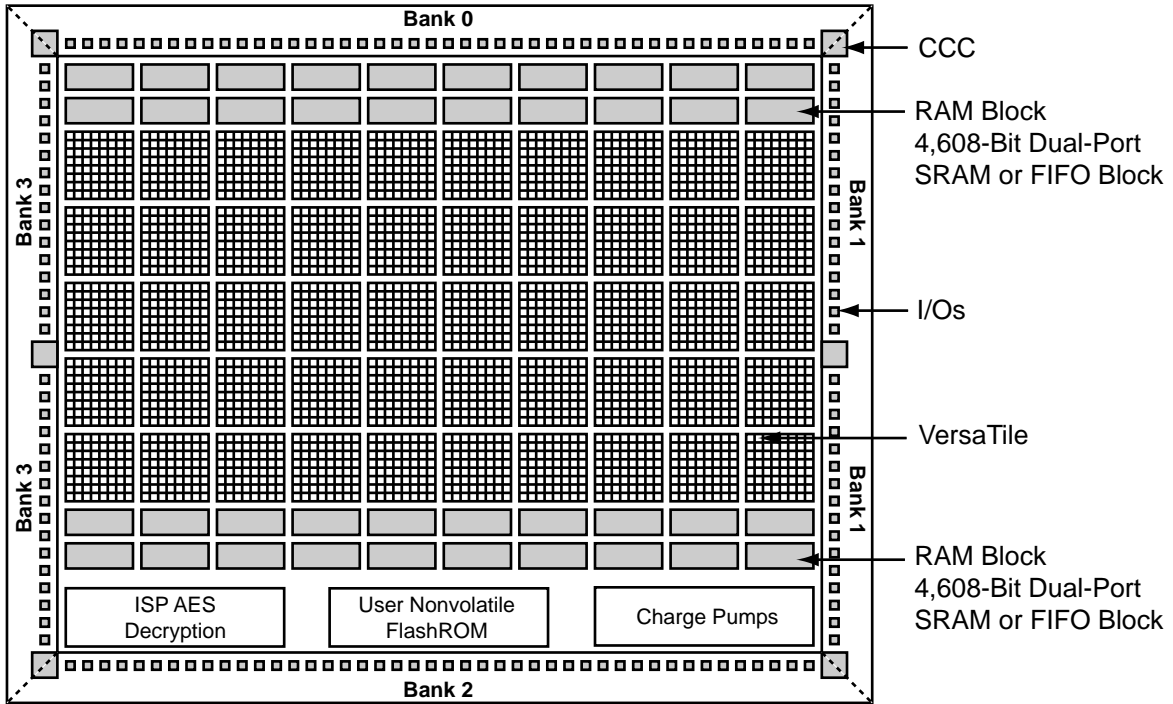
## **Advanced Architecture**

The proprietary military ProASIC3/EL architecture provides granularity comparable to standard-cell ASICs. The military ProASIC3/EL device consists of five distinct and programmable architectural features (Figure 1-1 on page 1-4 and Figure 1-2):

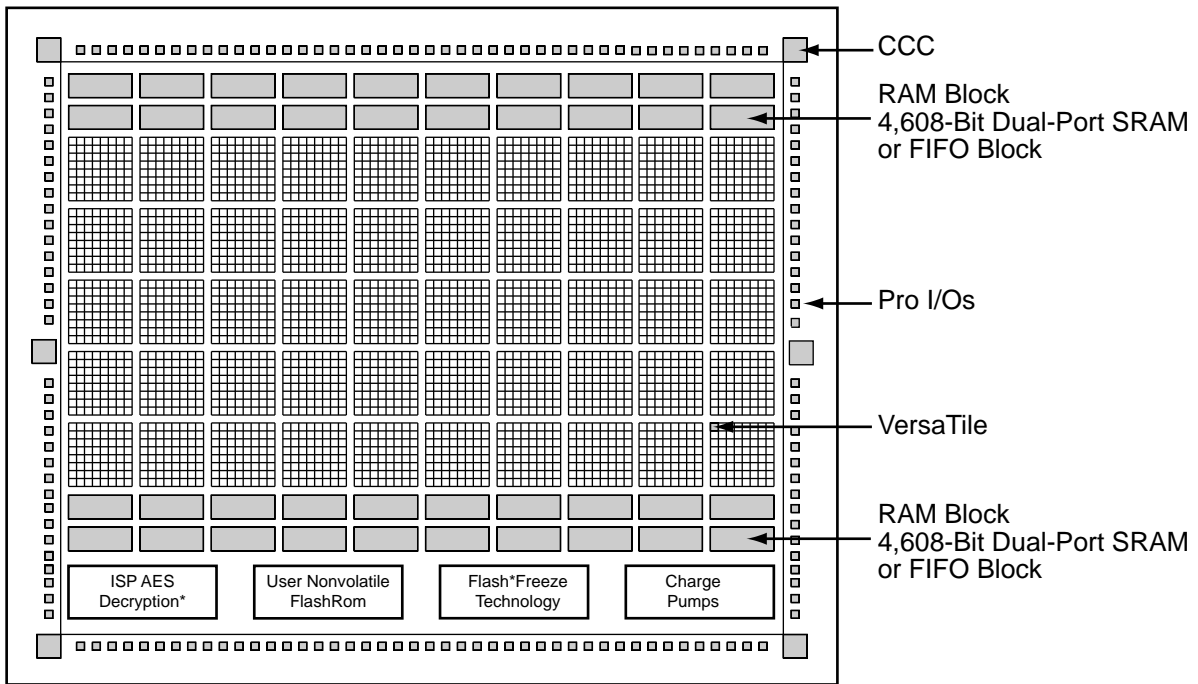
- FPGA VersaTiles
- Dedicated FlashROM
- Dedicated SRAM/FIFO memory
- Extensive CCCs and PLLs
- I/O structure

The FPGA core consists of a sea of VersaTiles. Each VersaTile can be configured as a three-input logic function, a D-flip-flop (with or without enable), or a latch by programming the appropriate flash switch interconnections. The versatility of the military ProASIC3/EL core tile, as either a three-input lookup table (LUT) equivalent or a D-flip-flop/latch with enable, allows for efficient use of the FPGA fabric. The VersaTile capability is unique to the ProASIC family of third-generation-architecture flash FPGAs. VersaTiles are connected with any of the four levels of routing hierarchy. Flash switches are distributed throughout the device to provide nonvolatile, reconfigurable interconnect programming. Maximum core utilization is possible for virtually any design.

In addition, extensive on-chip programming circuitry allows for rapid, single-voltage (3.3 V) programming of military ProASIC3/EL devices via an IEEE 1532 JTAG interface.



**Figure 1-1 • Military ProASIC3 Device Architecture Overview with Four I/O Banks (A3P250 and A3P1000)**

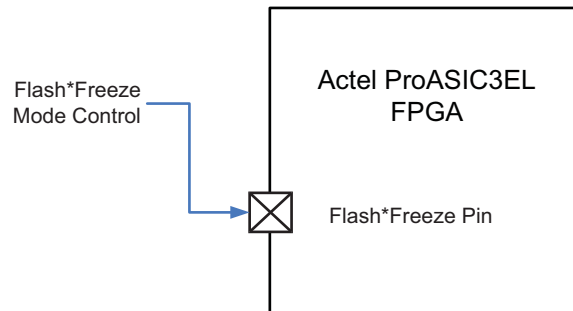


**Figure 1-2 • Military ProASIC3EL Device Architecture Overview (A3PE600L and A3PE3000L)**

## Flash\*Freeze Technology<sup>††</sup>

Military ProASIC3EL devices offer proven Flash\*Freeze technology, which enables designers to instantaneously shut off dynamic power consumption while retaining all SRAM and register information. Flash\*Freeze technology enables the user to quickly (within 1  $\mu$ s) enter and exit Flash\*Freeze mode by activating the Flash\*Freeze (FF) pin while all power supplies are kept at their original values. In addition, I/Os and global I/Os can still be driven and can be toggling without impact on power consumption; clocks can still be driven or can be toggling without impact on power consumption; all core registers and SRAM cells retain their states. I/Os are tristated during Flash\*Freeze mode or can be set to a certain state using weak pull-up or pull-down I/O attribute configuration. No power is consumed by the I/O banks, clocks, JTAG pins, or PLLs. Flash\*Freeze technology allows the user to switch to active mode on demand, thus simplifying the power management of the device.

The FF pin (active low) can be routed internally to the core to allow the user's logic to decide when it is safe to transition to this mode. It is also possible to use the FF pin as a regular I/O if Flash\*Freeze mode usage is not planned, which is advantageous because of the inherent low-power static and dynamic capabilities of the military ProASIC3EL device. Refer to [Figure 1-3](#) for an illustration of entering/exiting Flash\*Freeze mode.



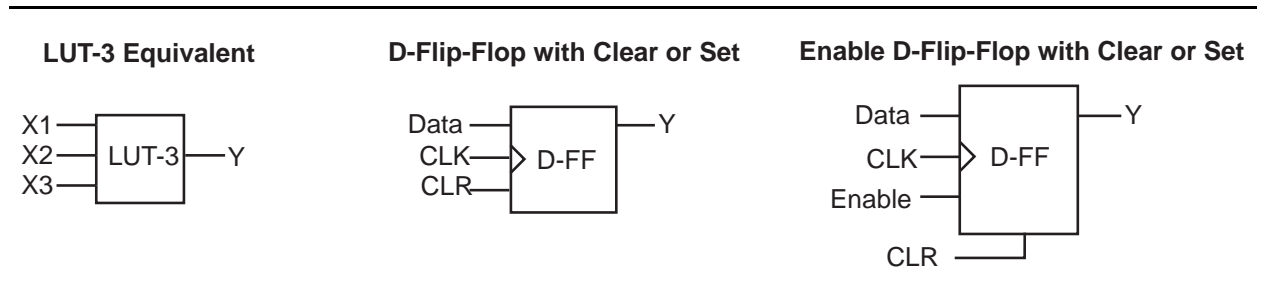
**Figure 1-3 • Military ProASIC3EL Flash\*Freeze Mode**

### VersaTiles

The military ProASIC3/EL core consists of VersaTiles, which have been enhanced beyond the ProASIC<sup>PLUS</sup>® core tiles. The military ProASIC3/EL VersaTile supports the following:

- All 3-input logic functions—LUT-3 equivalent
- Latch with clear or set
- D-flip-flop with clear or set
- Enable D-flip-flop with clear or set

Refer to [Figure 1-4](#) for VersaTile configurations.



**Figure 1-4 • VersaTile Configurations**

<sup>††</sup>Flash\*Freeze technology is not supported for A3P1000.

## **User Nonvolatile FlashROM**

Military ProASIC3/EL devices have 1 kbit of on-chip, user-accessible, nonvolatile FlashROM. The FlashROM can be used in diverse system applications:

- Internet protocol addressing (wireless or fixed)
- System calibration settings
- Device serialization and/or inventory control
- Subscription-based business models (for example, set-top boxes)
- Secure key storage for secure communications algorithms
- Asset management/tracking
- Date stamping
- Version management

FlashROM is written using the standard military ProASIC3/EL IEEE 1532 JTAG programming interface. The core can be individually programmed (erased and written), and on-chip AES decryption can be used selectively to securely load data over public networks, as in security keys stored in the FlashROM for a user design.

FlashROM can be programmed via the JTAG programming interface, and its contents can be read back either through the JTAG programming interface or via direct FPGA core addressing. Note that the FlashROM can only be programmed from the JTAG interface and cannot be programmed from the internal logic array.

FlashROM is programmed as 8 banks of 128 bits; however, reading is performed on a byte-by-byte basis using a synchronous interface. A 7-bit address from the FPGA core defines which of the 8 banks and which of the 16 bytes within that bank are being read. The three most significant bits (MSBs) of the FlashROM address determine the bank, and the four least significant bits (LSBs) of the FlashROM address define the byte.

Microsemi military ProASIC3/EL development software solutions, Libero IDE and Designer, have extensive support for the FlashROM. One such feature is auto-generation of sequential programming files for applications requiring a unique serial number in each part. Another feature allows the inclusion of static data for system version control. Data for the FlashROM can be generated quickly and easily using Libero IDE and Designer software tools. Comprehensive programming file support is also included to allow for easy programming of large numbers of parts with differing FlashROM contents.

## **SRAM and FIFO**

Military ProASIC3/EL devices have embedded SRAM blocks along their north and south sides. Each variable-aspect-ratio SRAM block is 4,608 bits in size. Available memory configurations are 256x18, 512x9, 1kx4, 2kx2, and 4kx1 bits. The individual blocks have independent read and write ports that can be configured with different bit widths on each port. For example, data can be sent through a 4-bit port and read as a single bitstream. The embedded SRAM blocks can be initialized via the device JTAG port (ROM emulation mode) using the UJTAG macro.

In addition, every SRAM block has an embedded FIFO control unit. The control unit allows the SRAM block to be configured as a synchronous FIFO without using additional core VersaTiles. The FIFO width and depth are programmable. The FIFO also features programmable Almost Empty (AEMPTY) and Almost Full (AFULL) flags in addition to the normal Empty and Full flags. The embedded FIFO control unit contains the counters necessary for generation of the read and write address pointers. The embedded SRAM/FIFO blocks can be cascaded to create larger configurations.

## **PLL and CCC**

Military ProASIC3 devices provide designers with flexible clock conditioning circuit (CCC) capabilities. Each member of the military ProASIC3 family contains six CCCs, located at the four corners and the centers of the east and west sides. One CCC (center west side) has a PLL. All six CCC blocks are usable; the four corner CCCs and the east CCC allow simple clock delay operations as well as clock spine access.

Military ProASIC3EL devices also contain six CCCs; however, all six are equipped with a PLL.

The inputs of the six CCC blocks are accessible from the FPGA core or from one of several inputs located near the CCC that have dedicated connections to the CCC block.

The CCC block has these key features:

- Wide input frequency range ( $f_{IN\_CCC}$ ) = 1.5 MHz up to 250 MHz
- Output frequency range ( $f_{OUT\_CCC}$ ) = 0.75 MHz up to 250 MHz
- 2 programmable delay types for clock skew minimization
- Clock frequency synthesis

Additional CCC specifications:

- Internal phase shift = 0°, 90°, 180°, and 270°. Output phase shift depends on the output divider configuration.
- Output duty cycle = 50%  $\pm$  1.5% or better
- Low output jitter: worst case < 2.5%  $\times$  clock period peak-to-peak period jitter when single global network used
- Maximum acquisition time is 300  $\mu$ s
- Exceptional tolerance to input period jitter—allowable input jitter is up to 1.5 ns
- Four precise phases; maximum misalignment between adjacent phases of 40 ps  $\times$  250 MHz /  $f_{OUT\_CCC}$

### **Global Clocking**

Military ProASIC3/EL devices have extensive support for multiple clocking domains. In addition to the CCC and PLL support described above, there is a comprehensive global clock distribution network.

Each VersaTile input and output port has access to nine VersaNets: six chip (main) and three quadrant global networks. The VersaNets can be driven by the CCC or directly accessed from the core via multiplexers (MUXes). The VersaNets can be used to distribute low-skew clock signals or for rapid distribution of high-fanout nets.

### **I/Os with Advanced I/O Standards**

The military ProASIC3/EL family of FPGAs features a flexible I/O structure, supporting a range of voltages (1.5 V, 1.8 V, 2.5 V, and 3.3 V). In addition, 1.2 V I/O operation is supported for military ProASIC3EL devices. Military ProASIC3/EL FPGAs support different I/O standards, including single-ended, differential, and voltage-referenced (military ProASIC3EL). The I/Os are organized into banks, with two, four, or eight (military ProASIC3EL only) banks per device. The configuration of these banks determines the I/O standards supported. For military ProASIC3EL, each I/O bank is subdivided into  $V_{REF}$  minibanks, which are used by voltage-referenced I/Os.  $V_{REF}$  minibanks contain 8 to 18 I/Os. All the I/Os in a given minibank share a common  $V_{REF}$  line. Therefore, if any I/O in a given  $V_{REF}$  minibank is configured as a  $V_{REF}$  pin, the remaining I/Os in that minibank will be able to use that reference voltage.

Each I/O module contains several input, output, and enable registers. These registers allow the implementation of the following:

- Single-data-rate applications (e.g., PCI 66 MHz, bidirectional SSTL 2 and 3, Class I and II)
- Double-data-Rate applications (e.g., DDR LVDS, B-LVDS, and M-LVDS I/Os for point-to-point communications, and DDR 200 MHz SRAM using bidirectional HSTL Class II).

Military ProASIC3EL banks support LVPECL, LVDS, B-LVDS, and M-LVDS. B-LVDS and M-LVDS can support up to 20 loads.



## 2 – Military ProASIC3/EL DC and Switching Characteristics

### General Specifications

#### Operating Conditions

Stresses beyond those listed in [Table 2-1](#) may cause permanent damage to the device.

Exposure to absolute maximum rating conditions for extended periods may affect device reliability. absolute maximum ratings are stress ratings only; functional operation of the device at these or any other conditions beyond those listed under the Recommended Operating Conditions specified in [Table 2-2](#) on [page 2-2](#) is not implied.

**Table 2-1 • Absolute Maximum Ratings<sup>1</sup>**

| Symbol                        | Parameter  | Limits  | Units |
|-------------------------------|--|---|-------|
| VCC                           | DC core supply voltage   | –0.3 to 1.65  | V     |
| VJTAG                         | JTAG DC voltage  | –0.3 to 3.75  | V     |
| VPUMP                         | Programming voltage  | –0.3 to 3.75  | V     |
| VCCPLL                        | Analog power supply (PLL)  | –0.3 to 1.65  | V     |
| VCCI                          | DC I/O buffer supply voltage for A3PE600/3000L<br>DC output buffer supply voltage for A3P250/A3P1000 | –0.3 to 3.75  | V     |
| VMV                           | DC input buffer supply voltage for A3P250/A3P1000  | –0.3 to 3.75  | V     |
| VI                            | I/O input voltage  | –0.3 V to 3.6 V (when I/O hot insertion mode is enabled)<br>–0.3 V to (VCCI + 1 V) or 3.6 V, whichever voltage is lower (when I/O hot-insertion mode is disabled) | V     |
| T <sub>STG</sub> <sup>2</sup> | Storage temperature  | –65 to +150   | °C    |
| T <sub>J</sub> <sup>2</sup>   | Junction temperature   | +150  | °C    |

**Notes:**

1. The device should be operated within the limits specified by the datasheet. During transitions, the input signal may undershoot or overshoot according to the limits shown in [Table 2-4](#) on [page 2-7](#).
2. For flash programming and retention maximum limits, refer to [Table 2-3](#) on [page 2-3](#), and for recommended operating limits, refer to [Table 2-2](#) on [page 2-2](#).

**Table 2-2 • Recommended Operating Conditions <sup>1</sup>**

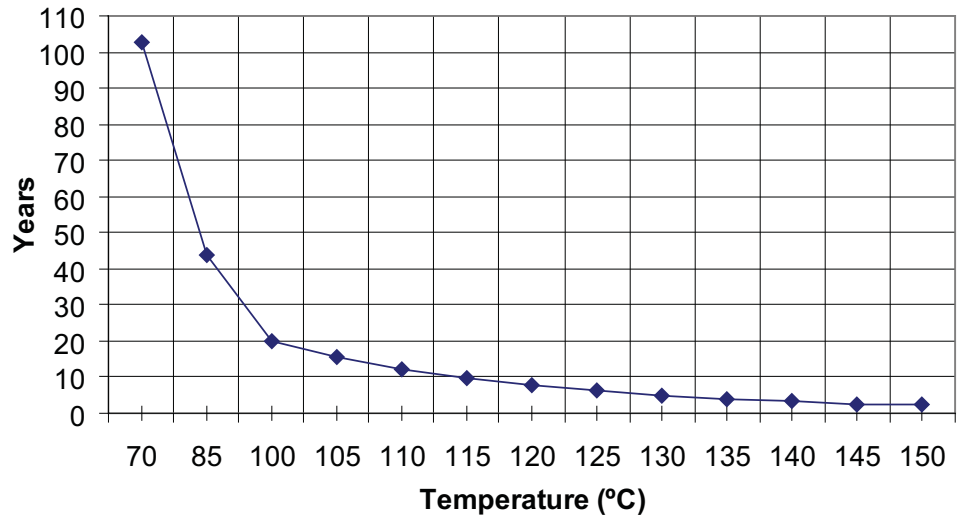
| Symbol                    | Parameter  |   | Military       | Units |
|---------------------------|--|---|----------------|-------|
| T <sub>A</sub>            | Ambient temperature  |   | -55 to 125     | °C    |
| T <sub>J</sub>            | Junction temperature   |   | -55 to 125     | °C    |
| VCC                       | 1.5 V DC core supply voltage <sup>2</sup>                    |   | 1.425 to 1.575 | V     |
|                           | 1.2 V – 1.5 V wide range DC core supply voltage <sup>3</sup> |   | 1.14 to 1.575  | V     |
| VJTAG                     | JTAG DC voltage  |   | 1.4 to 3.6     | V     |
| VPUMP <sup>4</sup>        | Programming voltage  | Programming mode                                  | 3.15 to 3.45   | V     |
|                           |  | Operation <sup>5</sup>                            | 0 to 3.6       | V     |
| VCCPLL <sup>4</sup>       | Analog power supply (PLL)                                    | 1.5 V DC core supply voltage <sup>2</sup>         | 1.425 to 1.575 | V     |
|                           |  | 1.2 V – 1.5 V DC core supply voltage <sup>3</sup> | 1.14 to 1.575  | V     |
| VCCI and VMV <sup>4</sup> | 1.2 V DC supply voltage <sup>3</sup>                         |   | 1.14 to 1.26   | V     |
|                           | 1.2 V wide range DC supply voltage <sup>3</sup>              |   | 1.14 to 1.575  | V     |
|                           | 1.5 V DC supply voltage                                      |   | 1.425 to 1.575 | V     |
|                           | 1.8 V DC supply voltage                                      |   | 1.7 to 1.9     | V     |
|                           | 2.5 V DC supply voltage                                      |   | 2.3 to 2.7     | V     |
|                           | 3.0 V DC supply voltage <sup>6</sup>                         |   | 2.7 to 3.6     | V     |
|                           | 3.3 V DC supply voltage                                      |   | 3.0 to 3.6     | V     |
|                           | LVDS differential I/O  |   | 2.375 to 2.625 | V     |
|                           | LVPECL differential I/O                                      |   | 3.0 to 3.6     | V     |

**Notes:**

1. All parameters representing voltages are measured with respect to GND unless otherwise specified.
2. For A3P250 and A3P1000
3. For A3PE600L and A3PE3000L devices only, operating at VCCI ≥ VCC.
4. See the "Pin Descriptions and Packaging" section on page 3-1 for instructions and recommendations on tie-off and supply grouping.
5. The ranges given here are for power supplies only. The recommended input voltage ranges specific to each I/O standard are given in Table 2-24 on page 2-24. VCCI should be at the same voltage within a given I/O bank.
6. 3.3 V wide range is compliant to the JESD8-B specification and supports 3.0 V VCCI operation.
7. To ensure targeted reliability standards are met across ambient and junction operating temperatures, Microsemi recommends that the user follow best design practices using Microsemi's timing and power simulation tools.



| T <sub>J</sub> (°C) | HTR Lifetime (yrs) |
|---------------------|--------------------|
| 70                  | 102.7              |
| 85                  | 43.8               |
| 100                 | 20.0               |
| 105                 | 15.6               |
| 110                 | 12.3               |
| 115                 | 9.7                |
| 120                 | 7.7                |
| 125                 | 6.2                |
| 130                 | 5.0                |
| 135                 | 4.0                |
| 140                 | 3.3                |
| 145                 | 2.7                |
| 150                 | 2.2                |



*Note:* HTR time is the period during which you would not expect a verify failure due to flash cell leakage.

**Figure 2-1 • High-Temperature Data Retention (HTR)**

**Table 2-3 • Overshoot and Undershoot Limits<sup>1</sup>**

| VCCI and VMV  | Average VCCI–GND Overshoot or Undershoot Duration as a Percentage of Clock Cycle <sup>2</sup> | Maximum Overshoot/Undershoot (125°C) <sup>2</sup> |
|---------------|---|---|
| 2.7 V or less | 10%   | 0.72 V  |
|               | 5%  | 0.82 V  |
| 3 V           | 10%   | 0.72 V  |
|               | 5%  | 0.82 V  |
| 3.3 V         | 10%   | 0.69 V  |
|               | 5%  | 0.79 V  |
| 3.6 V         | 10%   | N/A   |
|               | 5%  | N/A   |

**Notes:**

1. The duration is allowed at one out of six clock cycles. If the overshoot/undershoot occurs at one out of two cycles, the maximum overshoot/undershoot has to be reduced by 0.15 V.
2. This table does not provide PCI overshoot/undershoot limits.

## I/O Power-Up and Supply Voltage Thresholds for Power-On Reset (Military)

Sophisticated power-up management circuitry is designed into every ProASIC<sup>®</sup>3 device. These circuits ensure easy transition from the powered-off state to the powered-up state of the device. The many different supplies can power up in any sequence with minimized current spikes or surges. In addition, the I/O will be in a known state through the power-up sequence. The basic principle is shown in [Figure 2-2 on page 2-5](#) and [Figure 2-3 on page 2-6](#).

There are five regions to consider during power-up.

Military ProASIC3 I/Os are activated only if ALL of the following three conditions are met:

1. VCC and VCCI are above the minimum specified trip points ([Figure 2-2 on page 2-5](#) and [Figure 2-3 on page 2-6](#)).
2.  $VCCI > VCC - 0.75 \text{ V}$  (typical)
3. Chip is in the operating mode.

### VCCI Trip Point:

Ramping up:  $0.6 \text{ V} < \text{trip\_point\_up} < 1.2 \text{ V}$

Ramping down:  $0.5 \text{ V} < \text{trip\_point\_down} < 1.1 \text{ V}$

### VCC Trip Point:

Ramping up:  $0.6 \text{ V} < \text{trip\_point\_up} < 1.1 \text{ V}$

Ramping down:  $0.5 \text{ V} < \text{trip\_point\_down} < 1 \text{ V}$

VCC and VCCI ramp-up trip points are about 100 mV higher than ramp-down trip points. This specifically built-in hysteresis prevents undesirable power-up oscillations and current surges. Note the following:

- During programming, I/Os become tristated and weakly pulled up to VCCI.
- JTAG supply, PLL power supplies, and charge pump VPUMP supply have no influence on I/O behavior.

### PLL Behavior at Brownout Condition

Microsemi recommends using monotonic power supplies or voltage regulators to ensure proper power-up behavior. Power ramp-up should be monotonic, at least until VCC and VCCPLX exceed brownout activation levels. The VCC activation level is specified as 1.1 V worst-case (see Figure 2-2 and Figure 2-3 on page 2-6 for more details).

When PLL power supply voltage and/or VCC levels drop below the VCC brownout levels ( $0.75\text{ V} \pm 0.25\text{ V}$ ), the PLL output lock signal goes low and/or the output clock is lost. Refer to the "Power-Up/Down Behavior of Low-Power Flash Devices" chapter of the *Military ProASIC3/EL FPGA Fabric User's Guide* for information on clock and lock recovery.

### Internal Power-Up Activation Sequence

1. Core
2. Input buffers

Output buffers, after 200 ns delay from input buffer activation.

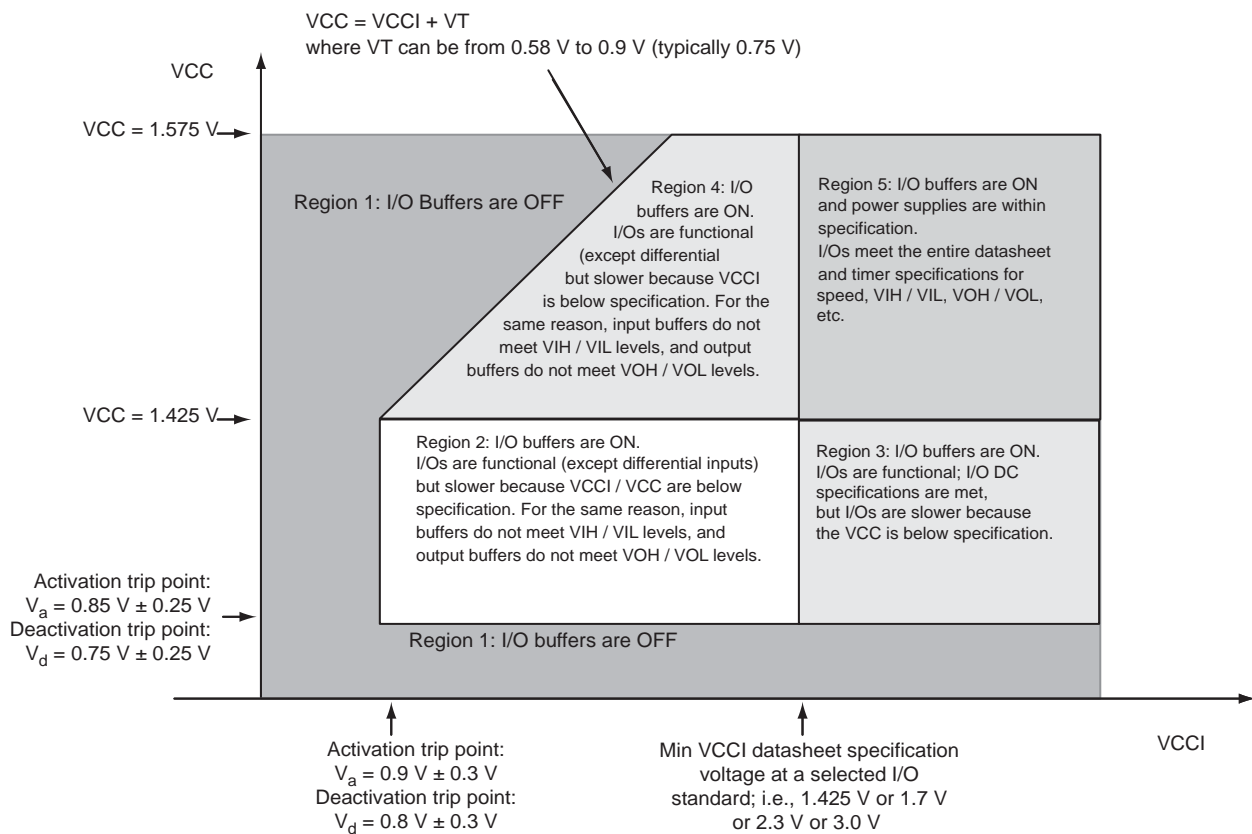
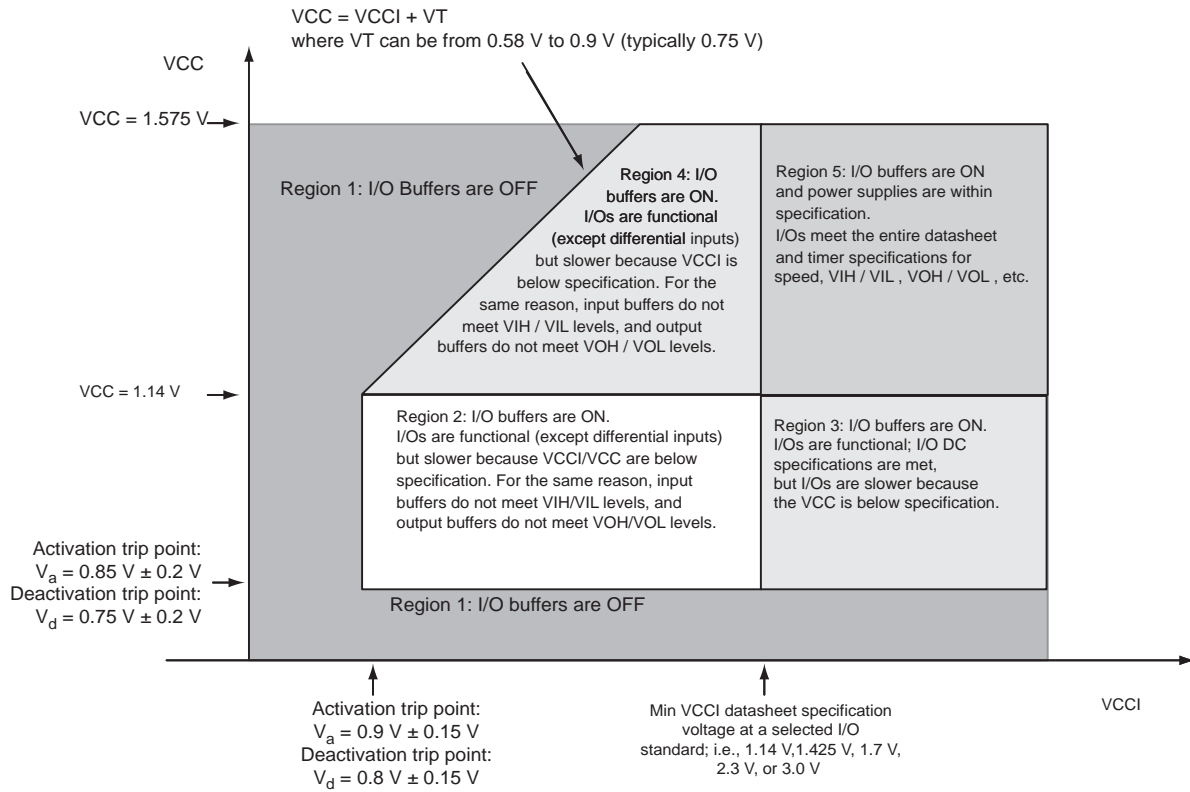


Figure 2-2 • Devices Operating at 1.5 V Core – I/O State as a Function of VCCI and VCC Voltage Levels



**Figure 2-3 • Device Operating at 1.2 V Core Voltage – I/O State as a Function of VCCI and VCC Voltage Levels; Only A3PE600L and A3PE3000L Devices Operate at 1.2 V Core Voltage**

## Thermal Characteristics

### Introduction

The temperature variable in the Designer software refers to the junction temperature, not the ambient temperature. This is an important distinction because dynamic and static power consumption cause the chip junction temperature to be higher than the ambient temperature.

EQ 1 can be used to calculate junction temperature.

$$T_J = \text{Junction Temperature} = \Delta T + T_A$$

EQ 1

where:

$T_A$  = Ambient Temperature

$\Delta T$  = Temperature gradient between junction (silicon) and ambient  $\Delta T = \theta_{ja} * P$

$\theta_{ja}$  = Junction-to-ambient of the package.  $\theta_{ja}$  numbers are located in Table 2-4.

P = Power dissipation

### Package Thermal Characteristics

The device junction-to-case thermal resistivity is  $\theta_{jc}$  and the junction-to-ambient air thermal resistivity is  $\theta_{ja}$ . The thermal characteristics for  $\theta_{ja}$  are shown for two air flow rates. The recommended maximum junction temperature is 125°C. EQ 2 shows a sample calculation of the recommended maximum power dissipation allowed for a 484-pin FBGA package at military temperature and in still air.

$$\text{Maximum Power Allowed} = \frac{\text{Max. junction temp. (}^\circ\text{C)} - \text{Max. ambient temp. (}^\circ\text{C)}}{\theta_{ja} (\text{}^\circ\text{C/W)}} = \frac{125^\circ\text{C} - 70^\circ\text{C}}{20.6^\circ\text{C/W}} = 2.670$$

EQ 2

**Table 2-4 • Package Thermal Resistivities**

| Package Type                      | Device    | Pin Count | $\theta_{jc}$ | $\theta_{ja}$ |              |              | Units |
|-----------------------------------|-----------|-----------|---------------|---------------|--------------|--------------|-------|
|                                   |           |           |               | Still Air     | 200 ft./min. | 500 ft./min. |       |
| Very Thin Quad Flat Pack (VQ100)  | A3P250    | 100       | 10.0          | 35.3          | 29.4         | 27.1         | C/W   |
| Plastic Quad Flat Pack (PQ208)*   | A3P1000   | 208       | 3.8           | 16.2          | 13.3         | 11.9         | C/W   |
| Fine Pitch Ball Grid Array (FBGA) | A3P1000   | 144       | 6.3           | 31.6          | 26.2         | 24.2         | C/W   |
|                                   | A3PE600L  | 484       | 9.5           | 27.5          | 21.9         | 20.2         | C/W   |
|                                   | A3PE3000L | 484       | 4.7           | 20.6          | 15.7         | 14.0         | C/W   |
|                                   | A3PE3000L | 896       | 2.4           | 13.6          | 10.4         | 9.4          | C/W   |

\* Embedded heatspreader

### Temperature and Voltage Derating Factors

**Table 2-5 • Temperature and Voltage Derating Factors for Timing Delays**  
 (normalized to  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.14\text{ V}$ )  
 Applicable to A3PE600L and A3PE3000L Only

| Array Voltage VCC (V) | Junction Temperature |                     |                   |                    |                    |                    |                     |
|-----------------------|----------------------|---------------------|-------------------|--------------------|--------------------|--------------------|---------------------|
|                       | $-55^\circ\text{C}$  | $-40^\circ\text{C}$ | $0^\circ\text{C}$ | $25^\circ\text{C}$ | $70^\circ\text{C}$ | $85^\circ\text{C}$ | $125^\circ\text{C}$ |
| 1.14                  | 0.85                 | 0.86                | 0.89              | 0.92               | 0.96               | 0.97               | 1.00                |
| 1.2                   | 0.82                 | 0.83                | 0.86              | 0.88               | 0.92               | 0.93               | 0.96                |
| 1.26                  | 0.79                 | 0.80                | 0.83              | 0.85               | 0.89               | 0.90               | 0.93                |
| 1.30                  | 0.77                 | 0.78                | 0.81              | 0.83               | 0.86               | 0.88               | 0.90                |
| 1.35                  | 0.74                 | 0.75                | 0.78              | 0.80               | 0.84               | 0.85               | 0.88                |
| 1.40                  | 0.72                 | 0.73                | 0.75              | 0.77               | 0.81               | 0.82               | 0.85                |
| 1.425                 | 0.71                 | 0.71                | 0.74              | 0.76               | 0.79               | 0.80               | 0.83                |
| 1.5                   | 0.67                 | 0.68                | 0.70              | 0.72               | 0.75               | 0.76               | 0.79                |
| 1.575                 | 0.65                 | 0.66                | 0.68              | 0.70               | 0.73               | 0.74               | 0.76                |

**Table 2-6 • Temperature and Voltage Derating Factors for Timing Delays**  
 (normalized to  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ )  
 Applicable to A3P250 and A3P1000 Devices Only

| Array Voltage VCC (V) | Junction Temperature |                     |                   |                    |                    |                    |                     |
|-----------------------|----------------------|---------------------|-------------------|--------------------|--------------------|--------------------|---------------------|
|                       | $-55^\circ\text{C}$  | $-40^\circ\text{C}$ | $0^\circ\text{C}$ | $25^\circ\text{C}$ | $70^\circ\text{C}$ | $85^\circ\text{C}$ | $125^\circ\text{C}$ |
| 1.425                 | 0.80                 | 0.82                | 0.87              | 0.89               | 0.94               | 0.96               | 1.00                |
| 1.5                   | 0.76                 | 0.78                | 0.82              | 0.84               | 0.89               | 0.91               | 0.95                |
| 1.575                 | 0.73                 | 0.75                | 0.79              | 0.82               | 0.86               | 0.87               | 0.91                |

## Calculating Power Dissipation

### Quiescent Supply Current

**Table 2-7 • Power Supply State Per Mode**

| Modes/Power Supplies | Power Supply Configurations |        |      |       |                 |
|----------------------|-----------------------------|--------|------|-------|-----------------|
|                      | VCC                         | VCCPLL | VCCI | VJTAG | VPUMP           |
| Flash*Freeze         | On                          | On     | On   | On    | On/off/floating |
| Sleep                | Off                         | Off    | On   | Off   | Off             |
| Shutdown             | Off                         | Off    | Off  | Off   | Off             |
| Static and Active    | On                          | On     | On   | On    | On/off/floating |

**Table 2-8 • Quiescent Supply Current (IDD) Characteristics, Flash\*Freeze Mode\***

|                          | Core Voltage | A3PE600L | A3PE3000L | Units |
|--------------------------|--------------|----------|-----------|-------|
| Nominal (25°C)           | 1.2 V        | 0.55     | 2.75      | mA    |
|                          | 1.5 V        | 0.83     | 4.2       | mA    |
| Typical maximum (25°C)   | 1.2 V        | 9        | 17        | mA    |
|                          | 1.5 V        | 12       | 20        | mA    |
| Military maximum (125°C) | 1.2 V        | 65       | 165       | mA    |
|                          | 1.5 V        | 85       | 185       | mA    |

Note: \*IDD includes VCC, VPUMP, VCCI, VJTAG, and VCCPLL currents. Values do not include I/O static contribution (PDC6 and PDC7).

**Table 2-9 • Quiescent Supply Current (IDD) Characteristics, Sleep Mode (VCC = 0 V)\***

|   | Core Voltage  | A3PE600L | A3PE3000L | Units |
|---|---------------|----------|-----------|-------|
| VCCI / VJTAG = 1.2 V (per bank)<br>Typical (25°C) | 1.2 V         | 1.7      | 1.7       | μA    |
| VCCI / VJTAG = 1.5 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 1.8      | 1.8       | μA    |
| VCCI / VJTAG = 1.8 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 1.9      | 1.9       | μA    |
| VCCI / VJTAG = 2.5 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 2.2      | 2.2       | μA    |
| VCCI / VJTAG = 3.3 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 2.5      | 2.5       | μA    |

Note: \*IDD =  $N_{BANKS} \times ICCI$ . Values do not include I/O static contribution, which is shown in Table 2-21 on page 2-16 (PDC6 and PDC7).

**Table 2-10 • Quiescent Supply Current (IDD) Characteristics, Shutdown Mode\***

|                  | Core Voltage  | A3P250 | A3P1000 | A3PE600L | A3PE3000L | Units |
|------------------|---------------|--------|---------|----------|-----------|-------|
| Nominal (25°C)   | 1.2 V / 1.5 V | N/A    |         | 0        |           | μA    |
| Military (125°C) | 1.2 V / 1.5 V | N/A    |         | 0        |           | μA    |

Note: \*This is applicable to A3PE600L and A3PE3000L only for cold-sparable I/O devices. Not available on A3P250 or A3P1000.

**Table 2-11 • Quiescent Supply Current (IDD), Static Mode and Active Mode <sup>1</sup>**

|   | Core Voltage  | A3PE600L | A3PE3000L | Units |
|---|---------------|----------|-----------|-------|
| <b>ICCA Current<sup>2</sup></b>                   |               |          |           |       |
| Nominal (25°C)                                    | 1.2 V         | 0.55     | 2.75      | mA    |
|   | 1.5 V         | 0.83     | 4.2       | mA    |
| Typical maximum (25°C)                            | 1.2 V         | 9        | 17        | mA    |
|   | 1.5 V         | 12       | 20        | mA    |
| Military maximum (125°C)                          | 1.2 V         | 65       | 165       | mA    |
|   | 1.5 V         | 85       | 185       | mA    |
| <b>ICCI or IJTAG Current<sup>3</sup></b>          |               |          |           |       |
| VCCI / VJTAG = 1.2 V (per bank)<br>Typical (25°C) | 1.2 V         | 1.7      | 1.7       | μA    |
| VCCI / VJTAG = 1.5 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 1.8      | 1.8       | μA    |
| VCCI / VJTAG = 1.8 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 1.9      | 1.9       | μA    |
| VCCI / VJTAG = 2.5 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 2.2      | 2.2       | μA    |
| VCCI / VJTAG = 3.3 V (per bank)<br>Typical (25°C) | 1.2 V / 1.5 V | 2.5      | 2.5       | μA    |

**Notes:**

1.  $IDD = N_{BANKS} \times ICCI + ICCA$ . JTAG counts as one bank when powered.
2. Includes VCC, VCCPLL, and VPUMP currents.
3. Values do not include I/O static contribution (PDC6 and PDC7).

**Table 2-12 • Quiescent Supply Current (IDD) Characteristics for A3P250 and A3P1000**

|                          | Core Voltage | A3P250 | A3P1000 | Units |
|--------------------------|--------------|--------|---------|-------|
| Nominal (25°C)           | 1.5 V        | 3      | 8       | mA    |
| Typical maximum (25°C)   | 1.5 V        | 15     | 30      | mA    |
| Military maximum (125°C) | 1.5 V        | 65     | 150     | mA    |

**Note:** IDD includes VCC, VPUMP, VCCI, and VMV currents. Values do not include I/O static contribution (PDC6 and PDC7), which is shown in Table 2-21 on page 2-16.



## Power per I/O Pin

**Table 2-13 • Summary of I/O Input Buffer Power (Per Pin) – Default I/O Software Settings**  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

|   | VCCI (V) | Static Power PDC6 (mW) <sup>1</sup> | Dynamic Power PAC9 (μW/MHz) <sup>2</sup> |
|---|----------|-------------------------------------|--|
| <b>Single-Ended</b>                       |          |                                     |  |
| 3.3 V LVTTTL/LVCMOS                       | 3.3      | –                                   | 16.34                                    |
| 3.3 V LVTTTL/LVCMOS – Schmitt trigger     | 3.3      | –                                   | 24.49                                    |
| 3.3 V LVCMOS Wide Range                   | 3.3      | –                                   | 16.34                                    |
| 3.3 V LVCMOS – Schmitt trigger Wide Range | 3.3      | –                                   | 24.49                                    |
| 2.5 V LVCMOS                              | 2.5      | –                                   | 4.71                                     |
| 2.5 V LVCMOS – Schmitt trigger            | 2.5      | –                                   | 6.13                                     |
| 1.8 V LVCMOS                              | 1.8      | –                                   | 1.66                                     |
| 1.8 V LVCMOS – Schmitt trigger            | 1.8      | –                                   | 1.78                                     |
| 1.5 V LVCMOS (JESD8-11)                   | 1.5      | –                                   | 1.01                                     |
| 1.5 V LVCMOS (JESD8-11) – Schmitt trigger | 1.5      | –                                   | 0.97                                     |
| 1.2 V LVCMOS                              | 1.2      | –                                   | 0.60                                     |
| 1.2 V LVCMOS (JESD8-11) – Schmitt trigger | 1.2      | –                                   | 0.53                                     |
| 1.2 V LVCMOS Wide Range                   | 1.2      | –                                   | 0.60                                     |
| 1.2 V LVCMOS Schmitt trigger Wide Range   | 1.2      | –                                   | 0.53                                     |
| 3.3 V PCI                                 | 3.3      | –                                   | 17.76                                    |
| 3.3 V PCI – Schmitt trigger               | 3.3      | –                                   | 19.10                                    |
| 3.3 V PCI-X                               | 3.3      | –                                   | 17.76                                    |
| 3.3 V PCI-X – Schmitt trigger             | 3.3      | –                                   | 19.10                                    |
| <b>Voltage-Referenced</b>                 |          |                                     |  |
| 3.3 V GTL                                 | 3.3      | 2.90                                | 7.14                                     |
| 2.5 V GTL                                 | 2.5      | 2.13                                | 3.54                                     |
| 3.3 V GTL+                                | 3.3      | 2.81                                | 2.91                                     |
| 2.5 V GTL+                                | 2.5      | 2.57                                | 2.61                                     |
| HSTL (I)                                  | 1.5      | 0.17                                | 0.79                                     |
| HSTL (II)                                 | 1.5      | 0.17                                | 0.79                                     |
| SSTL2 (I)                                 | 2.5      | 1.38                                | 3.26                                     |
| SSTL2 (II)                                | 2.5      | 1.38                                | 3.26                                     |
| SSTL3 (I)                                 | 3.3      | 3.21                                | 7.97                                     |
| SSTL3 (II)                                | 3.3      | 3.21                                | 7.97                                     |
| <b>Differential</b>                       |          |                                     |  |
| LVDS                                      | 2.5      | 2.26                                | 0.89                                     |
| LVPECL                                    | 3.3      | 5.71                                | 1.94                                     |

**Notes:**

1. PDC6 is the static power (where applicable) measured on VCCI.
2. PAC9 is the total dynamic power measured on VCCI.

**Table 2-14 • Summary of I/O Input Buffer Power (per pin) – Default I/O Software Settings  
Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only**

|                             | VMV (V) | Static Power<br>PDC6 (mW) <sup>1</sup> | Dynamic Power<br>PAC9 (μW/MHz) <sup>2</sup> |
|-----------------------------|---------|--|---|
| <b>Single-Ended</b>         |         |  |   |
| 3.3 V LVTTTL / 3.3 V LVCMOS | 3.3     | –                                      | 16.22                                       |
| 3.3 V LVCMOS – Wide Range   | 3.3     | –                                      | 16.22                                       |
| 2.5 V LVCMOS                | 2.5     | –                                      | 4.65  |
| 1.8 V LVCMOS                | 1.8     | –                                      | 1.65  |
| 1.5 V LVCMOS (JESD8-11)     | 1.5     | –                                      | 0.98  |
| 3.3 V PCI                   | 3.3     | –                                      | 17.64                                       |
| 3.3 V PCI-X                 | 3.3     | –                                      | 17.64                                       |
| <b>Differential</b>         |         |  |   |
| LVDS                        | 2.5     | 2.26                                   | 0.83  |
| LVPECL                      | 3.3     | 5.72                                   | 1.81  |

**Notes:**

1. PDC6 is the static power (where applicable) measured on VMV.
2. PAC9 is the total dynamic power measured on VMV.

**Table 2-15 • Summary of I/O Input Buffer Power (per pin) – Default I/O Software Settings  
Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only**

|                             | VMV (V) | Static Power<br>PDC6 (mW) <sup>1</sup> | Dynamic Power<br>PAC9 (μW/MHz) <sup>2</sup> |
|-----------------------------|---------|--|---|
| <b>Single-Ended</b>         |         |  |   |
| 3.3 V LVTTTL / 3.3 V LVCMOS | 3.3     | –                                      | 16.23                                       |
| 3.3 V LVCMOS – Wide Range   | 3.3     | –                                      | 16.23                                       |
| 2.5 V LVCMOS                | 2.5     | –                                      | 4.66  |
| 1.8 V LVCMOS                | 1.8     | –                                      | 1.64  |
| 1.5 V LVCMOS (JESD8-11)     | 1.5     | –                                      | 0.99  |
| 3.3 V PCI                   | 3.3     | –                                      | 17.64                                       |
| 3.3 V PCI-X                 | 3.3     | –                                      | 17.64                                       |

**Notes:**

1. PDC6 is the static power (where applicable) measured on VMV.
2. PAC9 is the total dynamic power measured on VMV.

**Table 2-16 • Summary of I/O Output Buffer Power (per pin) – Default I/O Software Settings <sup>1</sup>**  
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

|                           | C <sub>LOAD</sub> (pF) | VCCI (V) | Static Power PDC7 (mW) <sup>2</sup> | Dynamic Power PAC10 (μW/MHz) <sup>3</sup> |
|---------------------------|------------------------|----------|-------------------------------------|---|
| <b>Single-Ended</b>       |                        |          |                                     |   |
| 3.3 V LVTTTL/LVCMOS       | 5                      | 3.3      | –                                   | 148.00                                    |
| 3.3 V LVCMOS Wide Range   | 5                      | 3.3      | –                                   | 148.00                                    |
| 2.5 V LVCMOS              | 5                      | 2.5      | –                                   | 83.23                                     |
| 1.8 V LVCMOS              | 5                      | 1.8      | –                                   | 54.58                                     |
| 1.5 V LVCMOS (JESD8-11)   | 5                      | 1.5      | –                                   | 37.05                                     |
| 1.2 V LVCMOS              | 5                      | 1.2      | –                                   | 17.94                                     |
| 1.2 V LVCMOS Wide Range   | 5                      | 1.2      | –                                   | 17.94                                     |
| 3.3 V PCI                 | 10                     | 3.3      | –                                   | 204.61                                    |
| 3.3 V PCI-X               | 10                     | 3.3      | –                                   | 204.61                                    |
| <b>Voltage-Referenced</b> |                        |          |                                     |   |
| 3.3 V GTL                 | 10                     | 3.3      | –                                   | 24.08                                     |
| 2.5 V GTL                 | 10                     | 2.5      | –                                   | 13.52                                     |
| 3.3 V GTL+                | 10                     | 3.3      | –                                   | 24.10                                     |
| 2.5 V GTL+                | 10                     | 2.5      | –                                   | 13.54                                     |
| HSTL (I)                  | 20                     | 1.5      | 7.08                                | 26.22                                     |
| HSTL (II)                 | 20                     | 1.5      | 13.88                               | 27.18                                     |
| SSTL2 (I)                 | 30                     | 2.5      | 16.69                               | 105.56                                    |
| SSTL2 (II)                | 30                     | 2.5      | 25.91                               | 116.48                                    |
| SSTL3 (I)                 | 30                     | 3.3      | 26.02                               | 114.67                                    |
| SSTL3 (II)                | 30                     | 3.3      | 42.21                               | 131.69                                    |
| <b>Differential</b>       |                        |          |                                     |   |
| LVDS                      | –                      | 2.5      | 7.70                                | 89.58                                     |
| LVPECL                    | –                      | 3.3      | 19.42                               | 167.86                                    |

**Notes:**

1. Dynamic power consumption is given for standard load and software default drive strength and output slew.
2. PDC7 is the static power (where applicable) measured on VCCI.
3. PAC10 is the total dynamic power measured on VCCI.

**Table 2-17 • Summary of I/O Output Buffer Power (per pin) – Default I/O Software Settings <sup>1</sup>**  
**Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only**

|                                | C <sub>LOAD</sub> (pF) | VCCI (V) | Static Power PDC7 (mW) <sup>2</sup> | Dynamic Power PAC10 (μW/MHz) <sup>3</sup> |
|--------------------------------|------------------------|----------|-------------------------------------|---|
| <b>Single-Ended</b>            |                        |          |                                     |   |
| 3.3 V LVTTTL /<br>3.3 V LVCMOS | 5                      | 3.3      | –                                   | 141.97                                    |
| 3.3 V LVCMOS Wide Range        | 5                      | 3.3      | –                                   | 141.97                                    |
| 2.5 V LVCMOS                   | 5                      | 2.5      | –                                   | 79.98                                     |
| 1.8 V LVCMOS                   | 5                      | 1.8      | –                                   | 52.26                                     |
| 1.5 V LVCMOS (JESD8-11)        | 5                      | 1.5      | –                                   | 35.62                                     |
| 3.3 V PCI                      | 10                     | 3.3      | –                                   | 201.02                                    |
| 3.3 V PCI-X                    | 10                     | 3.3      | –                                   | 201.02                                    |
| <b>Differential</b>            |                        |          |                                     |   |
| LVDS                           | –                      | 2.5      | 7.74                                | 89.82                                     |
| LVPECL                         | –                      | 3.3      | 19.54                               | 167.55                                    |

**Notes:**

1. Dynamic Power consumption is given for software default drive strength and output slew. Output load is lower than the software default.
2. PDC7 is the static power (where applicable) measured on VCCI.
3. PAC10 is the total dynamic power measured on VCCI.

**Table 2-18 • Summary of I/O Output Buffer Power (per pin) – Default I/O Software Settings**  
**Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only**

|                                | C <sub>LOAD</sub> (pF) | VCCI (V) | Static Power PDC7 (mW) <sup>2</sup> | Dynamic Power PAC10 (μW/MHz) <sup>3</sup> |
|--------------------------------|------------------------|----------|-------------------------------------|---|
| <b>Single-Ended</b>            |                        |          |                                     |   |
| 3.3 V LVTTTL /<br>3.3 V LVCMOS | 5                      | 3.3      | –                                   | 125.97                                    |
| 3.3 V LVCMOS – Wide Range      | 5                      | 3.3      | –                                   | 125.97                                    |
| 2.5 V LVCMOS                   | 5                      | 2.5      | –                                   | 70.82                                     |
| 1.8 V LVCMOS                   | 5                      | 1.8      | –                                   | 36.39                                     |
| 1.5 V LVCMOS (JESD8-11)        | 5                      | 1.5      | –                                   | 25.34                                     |
| 3.3 V PCI                      | 10                     | 3.3      | –                                   | 184.92                                    |
| 3.3 V PCI-X                    | 10                     | 3.3      | –                                   | 184.92                                    |

**Notes:**

1. Dynamic Power consumption is given for software default drive strength and output slew. Output load is lower than the software default.
2. PDC7 is the static power (where applicable) measured on VCCI.
3. PAC10 is the total dynamic power measured on VCCI.

## Power Consumption of Various Internal Resources

**Table 2-19 • Different Components Contributing to Dynamic Power Consumption in Military ProASIC3/EL Devices Operating at 1.2 V VCC**

| Parameter | Definition   | Device-Specific Dynamic Power (μW/MHz)                       |          |
|-----------|--|--|----------|
|           |  | A3PE3000L  | A3PE600L |
| PAC1      | Clock contribution of a Global Rib                             | 8.34   | 3.99     |
| PAC2      | Clock contribution of a Global Spine                           | 4.28   | 2.22     |
| PAC3      | Clock contribution of a VersaTile row                          | 0.94   | 0.94     |
| PAC4      | Clock contribution of a VersaTile used as a sequential module  | 0.08   | 0.08     |
| PAC5      | First contribution of a VersaTile used as a sequential module  | 0.05   |          |
| PAC6      | Second contribution of a VersaTile used as a sequential module | 0.19   |          |
| PAC7      | Contribution of a VersaTile used as a combinatorial module     | 0.11   |          |
| PAC8      | Average contribution of a routing net                          | 0.45   |          |
| PAC9      | Contribution of an I/O input pin (standard-dependent)          | See Table 2-13 on page 2-11 through Table 2-15 on page 2-12. |          |
| PAC10     | Contribution of an I/O output pin (standard-dependent)         | See Table 2-16 on page 2-13 through Table 2-18 on page 2-14. |          |
| PAC11     | Average contribution of a RAM block during a read operation    | 25.00  |          |
| PAC12     | Average contribution of a RAM block during a write operation   | 30.00  |          |
| PAC13     | Dynamic contribution for PLL                                   | 1.74   |          |

**Table 2-20 • Different Components Contributing to Dynamic Power Consumption in Military ProASIC3 and ProASIC3/EL Devices at 1.5 V VCC**

| Parameter | Definition   | Device-Specific Dynamic Power ( $\mu\text{W}/\text{MHz}$ )   |          |         |        |
|-----------|--|--|----------|---------|--------|
|           |  | A3PE3000L  | A3PE600L | A3P1000 | A3P250 |
| PAC1      | Clock contribution of a Global Rib                             | 13.03  | 6.24     | 14.50   | 11.00  |
| PAC2      | Clock contribution of a Global Spine                           | 6.69   | 3.47     | 2.48    | 1.58   |
| PAC3      | Clock contribution of a VersaTile row                          | 1.46   | 1.46     | 0.81    | 0.81   |
| PAC4      | Clock contribution of a VersaTile used as a sequential module  | 0.13   | 0.13     | 0.12    | 0.12   |
| PAC5      | First contribution of a VersaTile used as a sequential module  | 0.07   |          |         |        |
| PAC6      | Second contribution of a VersaTile used as a sequential module | 0.29   |          |         |        |
| PAC7      | Contribution of a VersaTile used as a combinatorial Module     | 0.29   |          |         |        |
| PAC8      | Average contribution of a routing net                          | 0.70   |          |         |        |
| PAC9      | Contribution of an I/O input pin (standard-dependent)          | See Table 2-13 on page 2-11 through Table 2-15 on page 2-12. |          |         |        |
| PAC10     | Contribution of an I/O output pin (standard-dependent)         | See Table 2-16 on page 2-13 through Table 2-18 on page 2-14. |          |         |        |
| PAC11     | Average contribution of a RAM block during a read operation    | 25.00  |          |         |        |
| PAC12     | Average contribution of a RAM block during a write operation   | 30.00  |          |         |        |
| PAC13     | Dynamic contribution for PLL                                   | 2.60   |          |         |        |

**Table 2-21 • Different Components Contributing to the Static Power Consumption in Military ProASIC3/EL Devices**

| Parameter | Definition  | Device-Specific Dynamic Power ( $\mu\text{W}$ )                            |          |         |        |
|-----------|---|--|----------|---------|--------|
|           |   | A3PE3000L  | A3PE600L | A3P1000 | A3P250 |
| PDC0      | Array static power in Sleep mode  | 0 mW   | 0 mW     | N/A     | N/A    |
| PDC1      | Array static power in Active mode   | See Table 2-11 on page 2-10.   |          |         |        |
| PDC2      | Array static power in Static (Idle) mode  | See Table 2-11 on page 2-10.   |          |         |        |
| PDC3      | Array static power in Flash*Freeze mode   | See Table 2-8 on page 2-9.   |          |         |        |
| PDC4      | Static PLL contribution at 1.2 V operating core voltage (for A3PE600L and A3PE3000L only) | 1.42 mW  |          | N/A     |        |
|           | Static PLL contribution 1.5 V operating core voltage                                      | 2.55 mW  |          |         |        |
| PDC5      | Bank quiescent power ( $V_{\text{CC1}}$ -dependent)                                       | See Table 2-8 on page 2-9, Table 2-9 on page 2-9, Table 2-11 on page 2-10. |          |         |        |
| PDC6      | I/O input pin static power (standard-dependent)   | See Table 2-13 on page 2-11. through Table 2-15 on page 2-12.              |          |         |        |
| PDC7      | I/O output pin static power (standard-dependent)  | See Table 2-16 on page 2-13 through Table 2-18 on page 2-14.               |          |         |        |

*Note:* For a different output load, drive strength, or slew rate, Microsemi recommends using the Microsemi power spreadsheet calculator or SmartPower tool in Libero® Integrated Design Environment (IDE).

## Power Calculation Methodology

This section describes a simplified method to estimate power consumption of an application. For more accurate and detailed power estimations, use the SmartPower tool in Libero IDE software.

The power calculation methodology described below uses the following variables:

- The number of PLLs as well as the number and the frequency of each output clock generated
- The number of combinatorial and sequential cells used in the design
- The internal clock frequencies
- The number and the standard of I/O pins used in the design
- The number of RAM blocks used in the design
- Toggle rates of I/O pins as well as VersaTiles—guidelines are provided in [Table 2-22 on page 2-19](#).
- Enable rates of output buffers—guidelines are provided for typical applications in [Table 2-23 on page 2-19](#).
- Read rate and write rate to the memory—guidelines are provided for typical applications in [Table 2-23 on page 2-19](#). The calculation should be repeated for each clock domain defined in the design.

### Methodology

#### Total Power Consumption— $P_{TOTAL}$

$$P_{TOTAL} = P_{STAT} + P_{DYN}$$

$P_{STAT}$  is the total static power consumption.

$P_{DYN}$  is the total dynamic power consumption.

#### Total Static Power Consumption— $P_{STAT}$

$$P_{STAT} = (PDC0 \text{ or } PDC1 \text{ or } PDC2 \text{ or } PDC3) + N_{BANKS} * P_{DC5} + N_{INPUTS} * PDC6 + N_{OUTPUTS} * PDC7$$

$N_{INPUTS}$  is the number of I/O input buffers used in the design.

$N_{OUTPUTS}$  is the number of I/O output buffers used in the design.

$N_{BANKS}$  is the number of I/O banks powered in the design.

#### Total Dynamic Power Consumption— $P_{DYN}$

$$P_{DYN} = P_{CLOCK} + P_{S-CELL} + P_{C-CELL} + P_{NET} + P_{INPUTS} + P_{OUTPUTS} + P_{MEMORY} + P_{PLL}$$

#### Global Clock Contribution— $P_{CLOCK}$

$$P_{CLOCK} = (PAC1 + N_{SPINE} * PAC2 + N_{ROW} * PAC3 + N_{S-CELL} * PAC4) * F_{CLK}$$

$N_{SPINE}$  is the number of global spines used in the user design—guidelines are provided in [Table 2-22 on page 2-19](#).

$N_{ROW}$  is the number of VersaTile rows used in the design—guidelines are provided in [Table 2-22 on page 2-19](#).

$F_{CLK}$  is the global clock signal frequency.

$N_{S-CELL}$  is the number of VersaTiles used as sequential modules in the design.

PAC1, PAC2, PAC3, and PAC4 are device-dependent.

#### Sequential Cells Contribution— $P_{S-CELL}$

$$P_{S-CELL} = N_{S-CELL} * (PAC5 + \alpha_1 / 2 * PAC6) * F_{CLK}$$

$N_{S-CELL}$  is the number of VersaTiles used as sequential modules in the design. When a multi-tile sequential cell is used, it should be accounted for as 1.

$\alpha_1$  is the toggle rate of VersaTile outputs—guidelines are provided in [Table 2-22 on page 2-19](#).

$F_{CLK}$  is the global clock signal frequency.

**Combinatorial Cells Contribution— $P_{C-CELL}$** 

$$P_{C-CELL} = N_{C-CELL} * \alpha_1 / 2 * PAC7 * F_{CLK}$$

$N_{C-CELL}$  is the number of VersaTiles used as combinatorial modules in the design.

$\alpha_1$  is the toggle rate of VersaTile outputs—guidelines are provided in Table 2-22 on page 2-19.

$F_{CLK}$  is the global clock signal frequency.

**Routing Net Contribution— $P_{NET}$** 

$$P_{NET} = (N_{S-CELL} + N_{C-CELL}) * \alpha_1 / 2 * PAC8 * F_{CLK}$$

$N_{S-CELL}$  is the number of VersaTiles used as sequential modules in the design.

$N_{C-CELL}$  is the number of VersaTiles used as combinatorial modules in the design.

$\alpha_1$  is the toggle rate of VersaTile outputs—guidelines are provided in Table 2-22 on page 2-19.

$F_{CLK}$  is the global clock signal frequency.

**I/O Input Buffer Contribution— $P_{INPUTS}$** 

$$P_{INPUTS} = N_{INPUTS} * \alpha_2 / 2 * PAC9 * F_{CLK}$$

$N_{INPUTS}$  is the number of I/O input buffers used in the design.

$\alpha_2$  is the I/O buffer toggle rate—guidelines are provided in Table 2-22 on page 2-19.

$F_{CLK}$  is the global clock signal frequency.

**I/O Output Buffer Contribution— $P_{OUTPUTS}$** 

$$P_{OUTPUTS} = N_{OUTPUTS} * \alpha_2 / 2 * \beta_1 * PAC10 * F_{CLK}$$

$N_{OUTPUTS}$  is the number of I/O output buffers used in the design.

$\alpha_2$  is the I/O buffer toggle rate—guidelines are provided in Table 2-22 on page 2-19.

$\beta_1$  is the I/O buffer enable rate—guidelines are provided in Table 2-23 on page 2-19.

$F_{CLK}$  is the global clock signal frequency.

**RAM Contribution— $P_{MEMORY}$** 

$$P_{MEMORY} = PAC11 * N_{BLOCKS} * F_{READ-CLOCK} * \beta_2 + PAC12 * N_{BLOCK} * F_{WRITE-CLOCK} * \beta_3$$

$N_{BLOCKS}$  is the number of RAM blocks used in the design.

$F_{READ-CLOCK}$  is the memory read clock frequency.

$\beta_2$  is the RAM enable rate for read operations.

$F_{WRITE-CLOCK}$  is the memory write clock frequency.

$\beta_3$  is the RAM enable rate for write operations—guidelines are provided in Table 2-23 on page 2-19.

**PLL Contribution— $P_{PLL}$** 

$$P_{PLL} = PDC4 + PAC13 * F_{CLKOUT}$$

$F_{CLKOUT}$  is the output clock frequency.<sup>1</sup>

---

1. If a PLL is used to generate more than one output clock, include each output clock in the formula by adding its corresponding contribution ( $PAC13 * F_{CLKOUT}$  product) to the total PLL contribution.



## Guidelines

### Toggle Rate Definition

A toggle rate defines the frequency of a net or logic element relative to a clock. It is a percentage. If the toggle rate of a net is 100%, this means that this net switches at half the clock frequency. Below are some examples:

- The average toggle rate of a shift register is 100% because all flip-flop outputs toggle at half of the clock frequency.
- The average toggle rate of an 8-bit counter is 25%:
  - Bit 0 (LSB) = 100%
  - Bit 1 = 50%
  - Bit 2 = 25%
  - ...
  - Bit 7 (MSB) = 0.78125%
  - Average toggle rate =  $(100\% + 50\% + 25\% + 12.5\% + \dots + 0.78125\%) / 8$

### Enable Rate Definition

Output enable rate is the average percentage of time during which tristate outputs are enabled. When nontristate output buffers are used, the enable rate should be 100%.

**Table 2-22 • Toggle Rate Guidelines Recommended for Power Calculation**

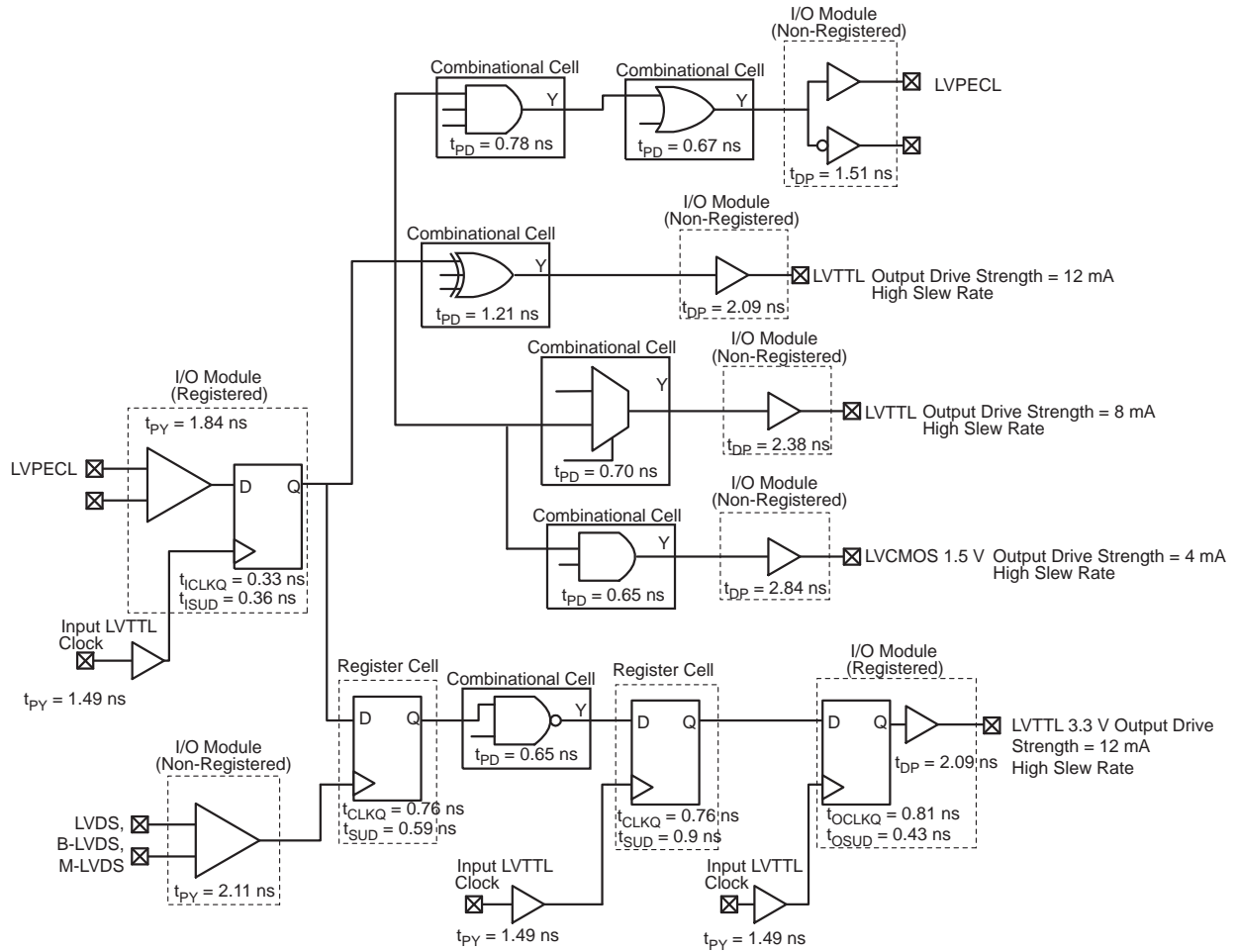
| Component  | Definition                       | Guideline |
|------------|----------------------------------|-----------|
| $\alpha_1$ | Toggle rate of VersaTile outputs | 10%       |
| $\alpha_2$ | I/O buffer toggle rate           | 10%       |

**Table 2-23 • Enable Rate Guidelines Recommended for Power Calculation**

| Component | Definition                           | Guideline |
|-----------|--------------------------------------|-----------|
| $\beta_1$ | I/O output buffer enable rate        | 100%      |
| $\beta_2$ | RAM enable rate for read operations  | 12.5%     |
| $\beta_3$ | RAM enable rate for write operations | 12.5%     |

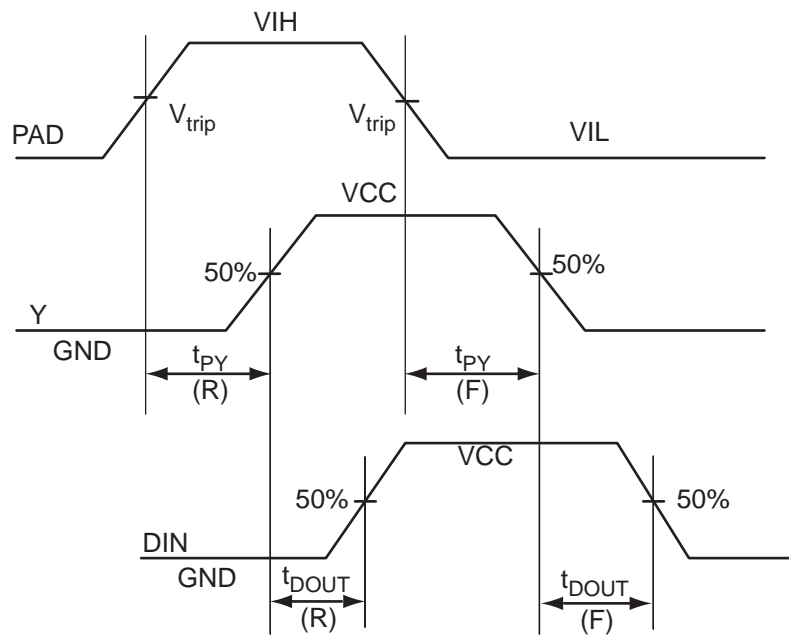
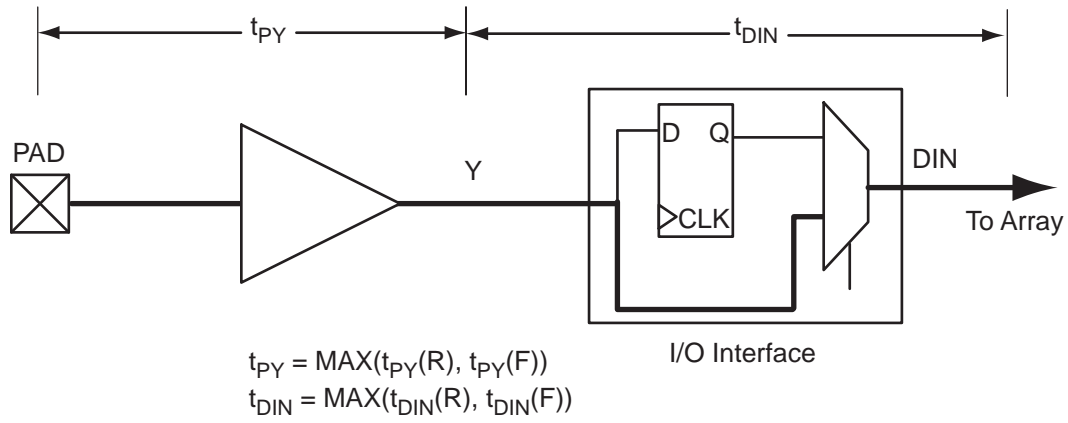
# User I/O Characteristics

## Timing Model



**Figure 2-4 • Timing Model**

**Operating Conditions: -1 Speed, Military Temperature Range ( $T_J = 125^\circ\text{C}$ ), Worst-Case VCC = 1.14 V (example for A3PE3000L and A3PE600L)**



**Figure 2-5 • Input Buffer Timing Model and Delays (example)**

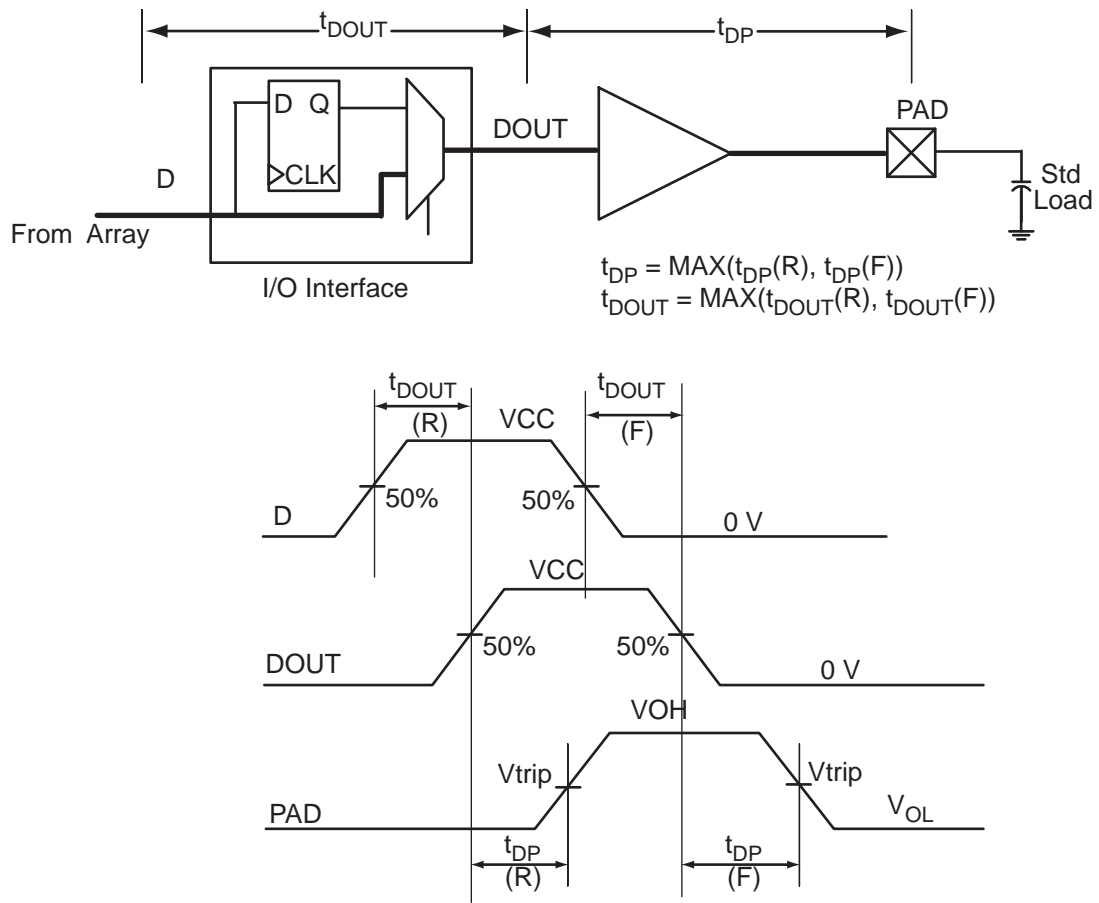


Figure 2-6 • Output Buffer Model and Delays (example)

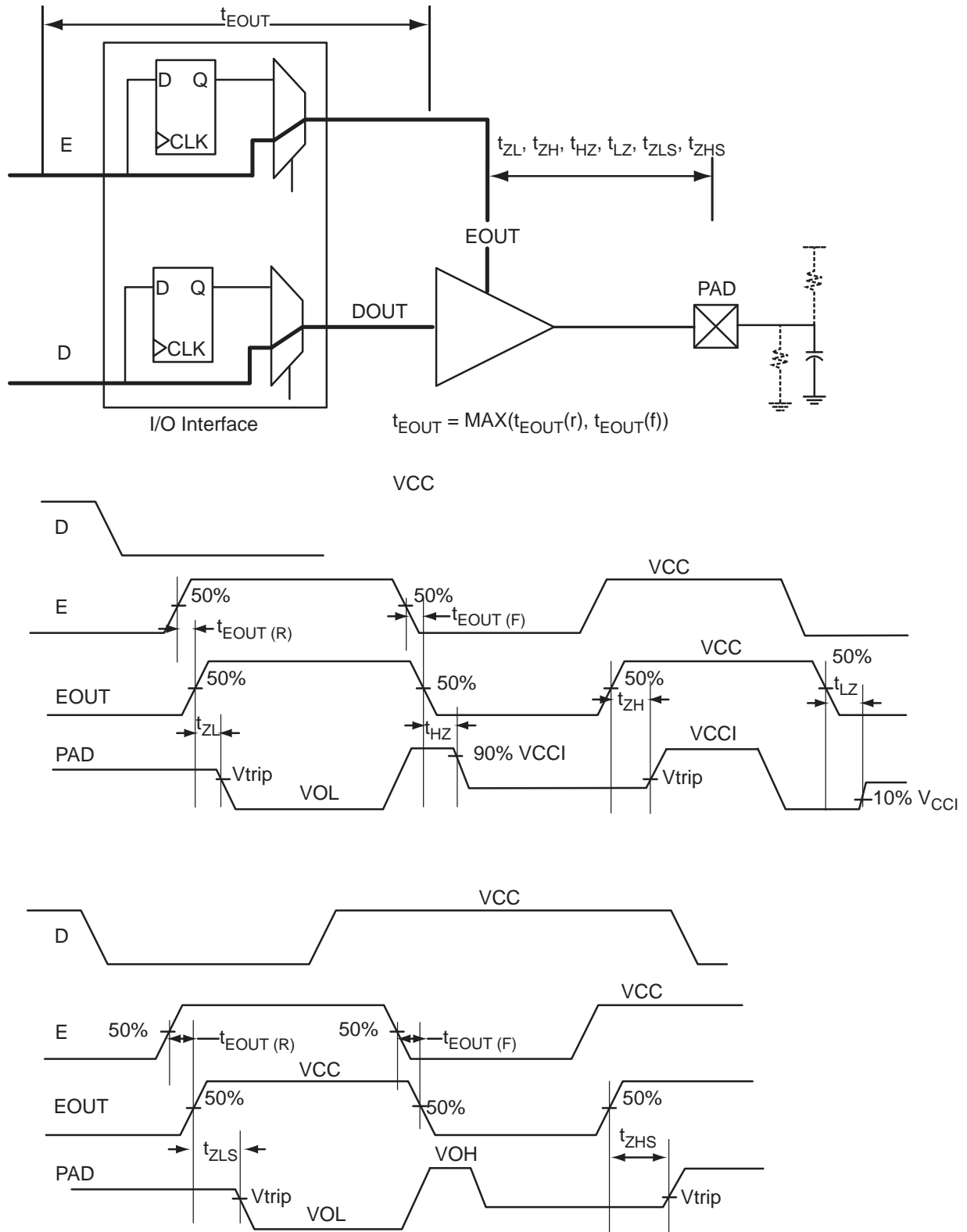


Figure 2-7 • Tristate Output Buffer Timing Model and Delays (example)

## Overview of I/O Performance

### Summary of I/O DC Input and Output Levels – Default I/O Software Settings

**Table 2-24 • Summary of Maximum and Minimum DC Input and Output Levels**  
 Applicable to Military Conditions—Software Default Settings  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| I/O Standard                             | Drive Strength          | Equiv. Software Default Drive Strength Option <sup>1</sup> | Slew Rate | VIL    |             | VIH         |        | VOL         | VOH         | I <sub>OL</sub> <sup>2</sup> | I <sub>OH</sub> <sup>2</sup> |
|--|-------------------------|--|-----------|--------|-------------|-------------|--------|-------------|-------------|------------------------------|------------------------------|
|  |                         |  |           | Min. V | Max. V      | Min. V      | Max. V | Max. V      | Min. V      | mA                           | mA                           |
| 3.3 V LVTTTL / 3.3 V LVCMOS              | 12 mA                   | 12 mA  | High      | -0.3   | 0.8         | 2           | 3.6    | 0.4         | 2.4         | 12                           | 12                           |
| 3.3 V LVCMOS Wide Range <sup>1,3</sup>   | 100 µA                  | 12 mA  | High      | -0.3   | 0.8         | 2           | 3.6    | 0.2         | VCCI - 0.2  | 0.1                          | 0.1                          |
| 2.5 V LVCMOS                             | 12 mA                   | 12 mA  | High      | -0.3   | 0.7         | 1.7         | 3.6    | 0.7         | 1.7         | 12                           | 12                           |
| 1.8 V LVCMOS                             | 12 mA                   | 12 mA  | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 3.6    | 0.45        | VCCI - 0.45 | 12                           | 12                           |
| 1.5 V LVCMOS                             | 12 mA                   | 12 mA  | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 3.6    | 0.25 * VCCI | 0.75 * VCCI | 12                           | 12                           |
| 1.2 V LVCMOS <sup>4,5</sup>              | 2 mA                    | 2 mA   | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 3.6    | 0.25 * VCCI | 0.75 * VCCI | 2                            | 2                            |
| 1.2 V LVCMOS Wide Range <sup>1,4,5</sup> | 100 µA                  | 2 mA   | High      | -0.3   | 0.3 * VCCI  | 0.7 * VCCI  | 3.6    | 0.1         | VCCI - 0.1  | 0.1                          | 0.1                          |
| 3.3 V PCI                                | Per PCI Specification   |  |           |        |             |             |        |             |             |                              |                              |
| 3.3 V PCI-X                              | Per PCI-X Specification |  |           |        |             |             |        |             |             |                              |                              |
| 3.3 V GTL                                | 20 mA <sup>6</sup>      | 20 mA  | High      | -0.3   | VREF - 0.05 | VREF + 0.05 | 3.6    | 0.4         | -           | 20                           | 20                           |
| 2.5 V GTL                                | 20 mA <sup>6</sup>      | 20 mA  | High      | -0.3   | VREF - 0.05 | VREF + 0.05 | 3.6    | 0.4         | -           | 20                           | 20                           |
| 3.3 V GTL+                               | 35 mA                   | 35 mA  | High      | -0.3   | VREF - 0.1  | VREF + 0.1  | 3.6    | 0.6         | -           | 35                           | 35                           |
| 2.5 V GTL+                               | 33 mA                   | 33 mA  | High      | -0.3   | VREF - 0.1  | VREF + 0.1  | 3.6    | 0.6         | -           | 33                           | 33                           |
| HSTL (I)                                 | 8 mA                    | 8 mA   | High      | -0.3   | VREF - 0.1  | VREF + 0.1  | 3.6    | 0.4         | VCCI - 0.4  | 8                            | 8                            |
| HSTL (II)                                | 15 mA <sup>6</sup>      | 15 mA <sup>6</sup>   | High      | -0.3   | VREF - 0.1  | VREF + 0.1  | 3.6    | 0.4         | VCCI - 0.4  | 15                           | 15                           |
| SSTL2 (I)                                | 15 mA                   | 15 mA  | High      | -0.3   | VREF - 0.2  | VREF + 0.2  | 3.6    | 0.54        | VCCI - 0.62 | 15                           | 15                           |
| SSTL2 (II)                               | 18 mA                   | 18 mA  | High      | -0.3   | VREF - 0.2  | VREF + 0.2  | 3.6    | 0.35        | VCCI - 0.43 | 18                           | 18                           |
| SSTL3 (I)                                | 14 mA                   | 14 mA  | High      | -0.3   | VREF - 0.2  | VREF + 0.2  | 3.6    | 0.7         | VCCI - 1.1  | 14                           | 14                           |
| SSTL3 (II)                               | 21 mA                   | 21 mA  | High      | -0.3   | VREF - 0.2  | VREF + 0.2  | 3.6    | 0.5         | VCCI - 0.9  | 21                           | 21                           |

**Notes:**

- Note that 1.2 V LVCMOS and 3.3 V LVCMOS wide range is applicable to 100 µA drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- Currents are measured at 125°C junction temperature.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD-8B specification.
- Applicable to A3PE600L and A3PE3000L devices operating at VCCI ≥ VCC.
- All LVCMOS 1.2 V software macros support LVCMOS 1.2 V wide range as specified in the JESD8-12 specification.
- Output drive strength is below JEDEC specification.
- Output slew rate can be extracted using the IBIS Models.

**Table 2-25 • Summary of Maximum and Minimum DC Input and Output Levels Applicable to Military Conditions—Software Default Settings**  
**Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only**

| I/O Standard                           | Drive Strength           | Equiv. Software Default Drive Strength Option <sup>1</sup> | Slew Rate | VIL    |             | VIH         |        | VOL         | VOH         | I <sub>OL</sub> <sup>2</sup> | I <sub>OH</sub> <sup>2</sup> |
|--|--------------------------|--|-----------|--------|-------------|-------------|--------|-------------|-------------|------------------------------|------------------------------|
|  |                          |  |           | Min. V | Max. V      | Min. V      | Max. V | Max. V      | Min. V      | mA                           | mA                           |
| 3.3 V LVTTTL / 3.3 V LVCMOS            | 12 mA                    | 12 mA  | High      | -0.3   | 0.8         | 2           | 3.6    | 0.4         | 2.4         | 12                           | 12                           |
| 3.3 V LVCMOS Wide Range <sup>1,3</sup> | 100 $\mu$ A              | 12 mA  | High      | -0.3   | 0.8         | 2           | 3.6    | 0.2         | VCCI - 0.2  | 0.1                          | 0.1                          |
| 2.5 V LVCMOS                           | 12 mA                    | 12 mA  | High      | -0.3   | 0.7         | 1.7         | 2.7    | 0.7         | 1.7         | 12                           | 12                           |
| 1.8 V LVCMOS                           | 12 mA                    | 12 mA  | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 1.9    | 0.45        | VCCI - 0.45 | 12                           | 12                           |
| 1.5 V LVCMOS                           | 12 mA                    | 12 mA  | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 1.575  | 0.25 * VCCI | 0.75 * VCCI | 12                           | 12                           |
| 3.3 V PCI                              | Per PCI specifications   |  |           |        |             |             |        |             |             |                              |                              |
| 3.3 V PCI-X                            | Per PCI-X specifications |  |           |        |             |             |        |             |             |                              |                              |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu$ A drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- Currents are measured at 125°C junction temperature.
- Output slew rate can be extracted using the IBIS Models.
- Output drive strength is below JEDEC specification.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD-8B specification.

**Table 2-26 • Summary of Maximum and Minimum DC Input and Output Levels Applicable to Military Conditions—Software Default Settings**  
**Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only**

| I/O Standard                           | Drive Strength           | Equiv. Software Default Drive Strength Option <sup>1</sup> | Slew Rate | VIL    |             | VIH         |        | VOL         | VOH         | I <sub>OL</sub> <sup>2</sup> | I <sub>OH</sub> <sup>2</sup> |
|--|--------------------------|--|-----------|--------|-------------|-------------|--------|-------------|-------------|------------------------------|------------------------------|
|  |                          |  |           | Min. V | Max. V      | Min. V      | Max. V | Max. V      | Min. V      | mA                           | mA                           |
| 3.3 V LVTTTL / 3.3 V LVCMOS            | 12 mA                    | 12 mA  | High      | -0.3   | 0.8         | 2           | 3.6    | 0.4         | 2.4         | 12                           | 12                           |
| 3.3 V LVCMOS Wide Range <sup>1,3</sup> | 100 $\mu$ A              | 12 mA  | High      | -0.3   | 0.8         | 2           | 3.6    | 0.2         | VCCI - 0.2  | 0.1                          | 0.1                          |
| 2.5 V LVCMOS                           | 12 mA                    | 12 mA  | High      | -0.3   | 0.7         | 1.7         | 2.7    | 0.7         | 1.7         | 12                           | 12                           |
| 1.8 V LVCMOS                           | 8 mA                     | 8 mA   | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 1.9    | 0.45        | VCCI - 0.45 | 8                            | 8                            |
| 1.5 V LVCMOS                           | 4 mA                     | 4 mA   | High      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 1.575  | 0.25 * VCCI | 0.75 * VCCI | 4                            | 4                            |
| 3.3 V PCI                              | Per PCI specifications   |  |           |        |             |             |        |             |             |                              |                              |
| 3.3 V PCI-X                            | Per PCI-X specifications |  |           |        |             |             |        |             |             |                              |                              |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu$ A drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- Currents are measured at 125°C junction temperature.
- Output slew rate can be extracted using the IBIS Models.
- Output drive strength is below JEDEC specification.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD-8B specification.

**Table 2-27 • Summary of Maximum and Minimum DC Input Levels  
Applicable to Military Conditions**

| DC I/O Standard                      | Military <sup>1</sup> |                       |
|--------------------------------------|-----------------------|-----------------------|
|                                      | $I_{IL}$ <sup>2</sup> | $I_{IH}$ <sup>3</sup> |
|                                      | $\mu\text{A}$         | $\mu\text{A}$         |
| 3.3 V LVTTTL / 3.3 V LVCMOS          | 15                    | 15                    |
| 3.3 V LVCMOS Wide Range              | 15                    | 15                    |
| 2.5 V LVCMOS                         | 15                    | 15                    |
| 1.8 V LVCMOS                         | 15                    | 15                    |
| 1.5 V LVCMOS                         | 15                    | 15                    |
| 1.2 V LVCMOS <sup>4</sup>            | 15                    | 15                    |
| 1.2 V LVCMOS Wide Range <sup>4</sup> | 15                    | 15                    |
| 3.3 V PCI                            | 15                    | 15                    |
| 3.3 V PCI-X                          | 15                    | 15                    |
| 3.3 V GTL                            | 15                    | 15                    |
| 2.5 V GTL                            | 15                    | 15                    |
| 3.3 V GTL+                           | 15                    | 15                    |
| 2.5 V GTL+                           | 15                    | 15                    |
| HSTL (I)                             | 15                    | 15                    |
| HSTL (II)                            | 15                    | 15                    |
| SSTL2 (I)                            | 15                    | 15                    |
| SSTL2 (II)                           | 15                    | 15                    |
| SSTL3 (I)                            | 15                    | 15                    |
| SSTL3 (II)                           | 15                    | 15                    |

**Notes:**

1. Military temperature range:  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .
2.  $I_{IL}$  is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
3.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
4. Applicable to Military A3PE600L and A3PE3000L devices operating at  $V_{CCI} \geq V_{CC}$ .



## Summary of I/O Timing Characteristics – Default I/O Software Settings

**Table 2-28 • Summary of AC Measuring Points**

| Standard                    | Input/Output Supply Voltage | Input Reference Voltage (VREF_TYP) | Board Termination Voltage (VTT_REF) | Measuring Trip Point (Vtrip) |
|-----------------------------|-----------------------------|------------------------------------|-------------------------------------|------------------------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS | 3.30 V                      | –                                  | –                                   | 1.4 V                        |
| 3.3 V LVCMOS Wide Range     | 3.30 V                      | –                                  | –                                   | 1.4 V                        |
| 2.5 V LVCMOS                | 2.50 V                      | –                                  | –                                   | 1.2 V                        |
| 1.8 V LVCMOS                | 2.50 V                      | –                                  | –                                   | 0.90 V                       |
| 1.5 V LVCMOS                | 1.80 V                      | –                                  | –                                   | 0.75 V                       |
| 1.2 V LVCMOS*               | 1.50 V                      | –                                  | –                                   | 0.6 V                        |
| 1.2 V LVCMOS Wide Range*    | 1.20 V                      | –                                  | –                                   | 0.6 V                        |
| 3.3 V PCI                   | 1.20 V                      | –                                  | –                                   | 0.285 * VCCI (RR)            |
|                             | 3.30 V                      | –                                  | –                                   | 0.615 * VCCI (FF))           |
| 3.3 V PCI-X                 | 3.30 V                      | –                                  | –                                   | 0.285 * VCCI (RR)            |
|                             | 3.30 V                      | –                                  | –                                   | 0.615 * VCCI (FF)            |
| 3.3 V GTL                   | 2.50 V                      | 0.8 V                              | 1.2 V                               | VREF                         |
| 2.5 V GTL                   | 3.30 V                      | 0.8 V                              | 1.2 V                               | VREF                         |
| 3.3 V GTL+                  | 2.50 V                      | 1.0 V                              | 1.5 V                               | VREF                         |
| 2.5 V GTL+                  | 1.50 V                      | 1.0 V                              | 1.5 V                               | VREF                         |
| HSTL (I)                    | 1.50 V                      | 0.75 V                             | 0.75 V                              | VREF                         |
| HSTL (II)                   | 3.30 V                      | 0.75 V                             | 0.75 V                              | VREF                         |
| SSTL2 (I)                   | 3.30 V                      | 1.25 V                             | 1.25 V                              | VREF                         |
| SSTL2 (II)                  | 2.50 V                      | 1.25 V                             | 1.25 V                              | VREF                         |
| SSTL3 (I)                   | 2.50 V                      | 1.5 V                              | 1.485 V                             | VREF                         |
| SSTL3 (II)                  | 2.50 V                      | 1.5 V                              | 1.485 V                             | VREF                         |
| LVDS                        | 3.30 V                      | –                                  | –                                   | Cross point                  |
| LVPECL                      |                             | –                                  | –                                   | Cross point                  |

Note: \*Applicable to A3PE600L and A3PE3000L devices operating at 1.2 V core regions only.

**Table 2-29 • I/O AC Parameter Definitions**

| Parameter         | Parameter Definition  |
|-------------------|---|
| t <sub>DP</sub>   | Data to Pad delay through the Output Buffer                                 |
| t <sub>PY</sub>   | Pad to Data delay through the Input Buffer                                  |
| t <sub>DOUT</sub> | Data to Output Buffer delay through the I/O interface                       |
| t <sub>EOUT</sub> | Enable to Output Buffer Tristate Control delay through the I/O interface    |
| t <sub>DIN</sub>  | Input Buffer to Data delay through the I/O interface                        |
| t <sub>HZ</sub>   | Enable to Pad delay through the Output Buffer—High to Z                     |
| t <sub>ZH</sub>   | Enable to Pad delay through the Output Buffer—Z to High                     |
| t <sub>LZ</sub>   | Enable to Pad delay through the Output Buffer—Low to Z                      |
| t <sub>ZL</sub>   | Enable to Pad delay through the Output Buffer—Z to Low                      |
| t <sub>ZHS</sub>  | Enable to Pad delay through the Output Buffer with delayed enable—Z to High |
| t <sub>ZLS</sub>  | Enable to Pad delay through the Output Buffer with delayed enable—Z to Low  |

## 1.2 V Core Operating Voltage

**Table 2-30 • Summary of I/O Timing Characteristics—Software Default Settings**

 –1 Speed Grade, Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst Case  $V_{CC} = 1.14\text{ V}$ , Worst Case  $V_{CCI}$ 

Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Standard                             | Drive Strength (mA) | Equivalent Software Default Drive Strength Option <sup>1</sup> | Slew Rate | Capacitive Load (pF) <sup>2</sup> | External Resistor ( $\Omega$ ) | $t_{DOUT}$ (ns) | $t_{DP}$ (ns) | $t_{DIN}$ (ns) | $t_{PY}$ (ns) | $t_{PYS}$ (ns) | $t_{EOUT}$ (ns) | $t_{ZL}$ (ns) | $t_{ZH}$ (ns) | $t_{LZ}$ (ns) | $t_{HZ}$ (ns) | $t_{ZLS}$ (ns) | $t_{ZHS}$ (ns) |
|--------------------------------------|---------------------|--|-----------|-----------------------------------|--------------------------------|-----------------|---------------|----------------|---------------|----------------|-----------------|---------------|---------------|---------------|---------------|----------------|----------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS          | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.68            | 2.09          | 0.05           | 1.49          | 2.03           | 0.44            | 2.12          | 1.56          | 2.76          | 3.06          | 3.99           | 3.43           |
| 3.3 V LVCMOS Wide Range <sup>3</sup> | 100 $\mu\text{A}$   | 12 mA  | High      | 5                                 | –                              | 0.68            | 3.01          | 0.04           | 1.86          | 2.69           | 0.44            | 3.01          | 2.22          | 4.03          | 4.42          | 4.89           | 4.09           |
| 2.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.68            | 2.12          | 0.04           | 1.73          | 2.17           | 0.44            | 2.15          | 1.74          | 2.84          | 2.95          | 4.03           | 3.62           |
| 1.8 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.68            | 2.36          | 0.05           | 1.70          | 2.40           | 0.44            | 2.40          | 1.94          | 3.16          | 3.58          | 4.27           | 3.81           |
| 1.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.68            | 2.71          | 0.04           | 1.86          | 2.61           | 0.44            | 2.76          | 2.24          | 3.34          | 3.69          | 4.63           | 4.12           |
| 1.2 V LVCMOS                         | 2 mA                | 2 mA   | High      | 5                                 | –                              | 0.68            | 4.39          | 0.04           | 2.25          | 3.19           | 0.44            | 4.24          | 3.74          | 4.34          | 4.09          | 6.11           | 5.61           |
| 1.2 V LVCOMS Wide Range <sup>4</sup> | 100 $\mu\text{A}$   | 2 mA   | High      | 5                                 | –                              | 0.68            | 4.39          | 0.04           | 2.25          | 3.19           | 0.44            | 4.24          | 3.74          | 4.34          | 4.09          | 6.11           | 5.61           |
| 3.3 V PCI                            | Per PCI spec        | –  | High      | 10                                | 25 <sup>5</sup>                | 0.68            | 2.37          | 0.04           | 2.31          | 3.13           | 0.44            | 2.40          | 1.68          | 2.77          | 3.06          | 4.28           | 3.56           |
| 3.3 V PCI-X                          | Per PCI-X spec      | –  | High      | 10                                | 25 <sup>5</sup>                | 0.68            | 2.37          | 0.04           | 2.31          | 3.13           | 0.44            | 2.40          | 1.68          | 2.77          | 3.06          | 4.28           | 3.56           |
| 3.3 V GTL                            | 20 mA <sup>6</sup>  | 20 mA <sup>6</sup>   | High      | 10                                | 25                             | 0.68            | 1.75          | 0.05           | 1.99          | –              | 0.44            | 1.71          | 1.75          | –             | –             | 3.59           | 3.62           |
| 2.5 V GTL                            | 20 mA <sup>6</sup>  | 20 mA <sup>6</sup>   | High      | 10                                | 25                             | 0.68            | 1.79          | 0.05           | 1.93          | –              | 0.44            | 1.82          | 1.79          | –             | –             | 3.70           | 3.67           |
| 3.3 V GTL+                           | 35 mA               | 35 mA  | High      | 10                                | 25                             | 0.68            | 1.74          | 0.05           | 1.99          | –              | 0.44            | 1.76          | 1.73          | –             | –             | 3.64           | 3.61           |
| 2.5 V GTL+                           | 33 mA               | 33 mA  | High      | 10                                | 25                             | 0.68            | 1.86          | 0.05           | 1.93          | –              | 0.44            | 1.89          | 1.77          | –             | –             | 3.77           | 3.64           |
| HSTL (I)                             | 8 mA                | 8 mA   | High      | 20                                | 25                             | 0.68            | 2.68          | 0.05           | 2.34          | –              | 0.44            | 2.73          | 2.65          | –             | –             | 4.60           | 4.52           |
| HSTL (II)                            | 15 mA <sup>6</sup>  | 15 mA <sup>6</sup>   | High      | 20                                | 50                             | 0.68            | 2.55          | 0.05           | 2.34          | –              | 0.44            | 2.59          | 2.28          | –             | –             | 4.47           | 4.16           |
| SSTL2 (I)                            | 15 mA               | 15 mA  | High      | 30                                | 25                             | 0.68            | 1.80          | 0.05           | 1.78          | –              | 0.44            | 1.82          | 1.55          | –             | –             | 1.82           | 1.55           |
| SSTL2 (II)                           | 15 mA               | 15 mA  | High      | 30                                | 50                             | 0.68            | 1.83          | 0.05           | 1.78          | –              | 0.44            | 1.86          | 1.49          | –             | –             | 1.86           | 1.49           |
| SSTL3 (I)                            | 14 mA               | 14 mA  | High      | 30                                | 25                             | 0.68            | 1.95          | 0.05           | 1.71          | –              | 0.44            | 1.98          | 1.55          | –             | –             | 1.98           | 1.55           |
| SSTL3 (II)                           | 21 mA               | 21 mA  | High      | 30                                | 50                             | 0.68            | 1.75          | 0.05           | 1.71          | –              | 0.44            | 1.77          | 1.41          | –             | –             | 1.77           | 1.41           |
| LVDS                                 | 24 mA               | –  | High      | –                                 | –                              | 0.68            | 1.59          | 0.05           | 2.11          | –              | –               | –             | –             | –             | –             | –              | –              |
| LVPECL                               | 24 mA               | –  | High      | –                                 | –                              | 0.68            | 1.51          | 0.05           | 1.84          | –              | –               | –             | –             | –             | –             | –              | –              |

**Notes:**

- Note that 1.2 V LVCMOS and 3.3 V LVCMOS wide range are applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- Output delays provided in this table were extracted with an output load indicated in the Capacitive Load column. For a specific output load, refer to Designer software.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD8-B specification.
- All LVCMOS 1.2 V software macros support LVCMOS 1.2 V wide range as specified in the JESD8-12 specification.
- Resistance is used to measure I/O propagation delays as defined in PCI specifications. See [Figure 2-15 on page 2-73](#) for connectivity. This resistor is not required during normal operation.
- Output drive strength is below JEDEC specification.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

## 1.5 V Core Voltage

**Table 2-31 • Summary of I/O Timing Characteristics—Software Default Settings**  
 –1 Speed Grade, Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst Case VCCI  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Standard                             | Drive Strength (mA) | Equivalent Software Default Drive Strength Option <sup>1</sup> | Slew Rate | Capacitive Load (pF) <sup>2</sup> | External Resistor ( $\Omega$ ) | $t_{DOUT}$ (ns) | $t_{DP}$ (ns) | $t_{DIN}$ (ns) | $t_{PY}$ (ns) | $t_{PYS}$ (ns) | $t_{EOUT}$ (ns) | $t_{ZL}$ (ns) | $t_{ZH}$ (ns) | $t_{LZ}$ (ns) | $t_{HZ}$ (ns) | $t_{ZLS}$ (ns) | $t_{ZHS}$ (ns) |
|--------------------------------------|---------------------|--|-----------|-----------------------------------|--------------------------------|-----------------|---------------|----------------|---------------|----------------|-----------------|---------------|---------------|---------------|---------------|----------------|----------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS          | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.52            | 1.97          | 0.03           | 1.23          | 1.78           | 0.34            | 1.99          | 1.46          | 2.63          | 2.89          | 3.23           | 2.71           |
| 3.3 V LVCMOS Wide Range <sup>3</sup> | 100 $\mu\text{A}$   | 12 mA  | High      | 5                                 | –                              | 0.52            | 2.89          | 0.03           | 1.61          | 2.44           | 0.34            | 2.88          | 2.12          | 3.89          | 4.25          | 4.12           | 3.36           |
| 2.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.52            | 2.01          | 0.03           | 1.49          | 1.93           | 0.34            | 2.02          | 1.65          | 2.71          | 2.78          | 3.27           | 2.89           |
| 1.8 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.52            | 2.24          | 0.03           | 1.44          | 2.14           | 0.34            | 2.26          | 1.84          | 3.02          | 3.41          | 3.51           | 3.08           |
| 1.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.52            | 2.60          | 0.03           | 1.60          | 2.35           | 0.34            | 2.62          | 2.14          | 3.21          | 3.52          | 3.87           | 3.39           |
| 3.3 V PCI                            | Per PCI spec        | –  | High      | 10                                | 25 <sup>4</sup>                | 0.52            | 2.25          | 0.03           | 2.03          | 2.88           | 0.34            | 2.27          | 1.58          | 2.64          | 2.89          | 3.52           | 2.83           |
| 3.3 V PCI-X                          | Per PCI-X spec      | –  | High      | 10                                | 25 <sup>4</sup>                | 0.52            | 2.25          | 0.03           | 2.03          | 2.88           | 0.34            | 2.27          | 1.58          | 2.64          | 2.89          | 3.52           | 2.83           |
| 3.3 V GTL                            | 20 mA <sup>5</sup>  | 20 mA <sup>5</sup>   | High      | 10                                | 25                             | 0.52            | 1.68          | 0.03           | 1.79          | –              | 0.34            | 1.58          | 1.68          | –             | –             | 2.83           | 2.92           |
| 2.5 V GTL                            | 20 mA <sup>5</sup>  | 20 mA <sup>5</sup>   | High      | 10                                | 25                             | 0.52            | 1.72          | 0.03           | 1.73          | –              | 0.34            | 1.69          | 1.72          | –             | –             | 2.93           | 2.97           |
| 3.3 V GTL+                           | 35 mA               | 35 mA  | High      | 10                                | 25                             | 0.52            | 1.66          | 0.03           | 1.79          | –              | 0.34            | 1.63          | 1.66          | –             | –             | 2.88           | 2.90           |
| 2.5 V GTL+                           | 33 mA               | 33 mA  | High      | 10                                | 25                             | 0.52            | 1.75          | 0.03           | 1.73          | –              | 0.34            | 1.76          | 1.69          | –             | –             | 3.00           | 2.94           |
| HSTL (I)                             | 8 mA                | 8 mA   | High      | 20                                | 25                             | 0.52            | 2.57          | 0.03           | 2.14          | –              | 0.34            | 2.59          | 2.55          | –             | –             | 3.84           | 3.79           |
| HSTL (II)                            | 15 mA <sup>5</sup>  | 15 mA <sup>5</sup>   | High      | 20                                | 50                             | 0.52            | 2.44          | 0.03           | 2.14          | –              | 0.34            | 2.46          | 2.19          | –             | –             | 3.71           | 3.43           |
| SSTL2 (I)                            | 15 mA               | 15 mA  | High      | 30                                | 25                             | 0.52            | 1.68          | 0.03           | 1.58          | –              | 0.34            | 1.69          | 1.46          | –             | –             | 1.69           | 1.46           |
| SSTL2 (II)                           | 18 mA               | 18 mA  | High      | 30                                | 50                             | 0.52            | 1.72          | 0.03           | 1.58          | –              | 0.34            | 1.73          | 1.39          | –             | –             | 1.73           | 1.39           |
| SSTL3 (I)                            | 14 mA               | 14 mA  | High      | 30                                | 25                             | 0.52            | 1.83          | 0.03           | 1.51          | –              | 0.34            | 1.84          | 1.45          | –             | –             | 1.84           | 1.45           |
| SSTL3 (II)                           | 21 mA               | 21 mA  | High      | 30                                | 50                             | 0.52            | 1.63          | 0.03           | 1.51          | –              | 0.34            | 1.64          | 1.31          | –             | –             | 1.64           | 1.31           |
| LVDS                                 | 24 mA               | –  | High      | –                                 | –                              | 0.52            | 1.48          | 0.03           | 1.86          | –              | –               | –             | –             | –             | –             | –              | –              |
| LVPECL                               | 24 mA               | –  | High      | –                                 | –                              | 0.52            | 1.40          | 0.03           | 1.61          | –              | –               | –             | –             | –             | –             | –              | –              |

## Notes:

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- Output delays provided in this table were extracted with an output load indicated in the Capacitive Load column. For a specific output load, refer to Designer software.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD8-B specification.
- Resistance is used to measure I/O propagation delays as defined in PCI specifications. See [Figure 2-15 on page 2-73](#) for connectivity. This resistor is not required during normal operation.
- Output drive strength is below JEDEC specification.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-32 • Summary of I/O Timing Characteristics—Software Default Settings**  
 –1 Speed Grade, Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst Case  $V_{CC} = 1.425\text{ V}$ ,  
 Worst Case  $V_{CCI}$   
 Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only

| I/O Standard                         | Drive Strength (mA) | Equivalent Software Default Drive Strength Option <sup>1</sup> | Slew Rate | Capacitive Load (pF) <sup>2</sup> | External Resistor ( $\Omega$ ) | $t_{DOUT}$ (ns) | $t_{DP}$ (ns) | $t_{DIN}$ (ns) | $t_{PY}$ (ns) | $t_{EOUT}$ (ns) | $t_{ZL}$ (ns) | $t_{ZH}$ (ns) | $t_{LZ}$ (ns) | $t_{HZ}$ (ns) | $t_{ZLS}$ (ns) | $t_{ZHS}$ (ns) |
|--------------------------------------|---------------------|--|-----------|-----------------------------------|--------------------------------|-----------------|---------------|----------------|---------------|-----------------|---------------|---------------|---------------|---------------|----------------|----------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS          | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.54            | 2.24          | 0.04           | 0.95          | 0.39            | 2.28          | 1.70          | 3.00          | 3.35          | 4.38           | 3.79           |
| 3.3 V LVCMOS Wide Range <sup>3</sup> | 100 $\mu\text{A}$   | 12 mA  | High      | 5                                 | –                              | 0.54            | 3.47          | 0.04           | 1.44          | 0.39            | 3.47          | 2.57          | 4.65          | 5.18          | 6.64           | 5.75           |
| 2.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.54            | 2.26          | 0.04           | 1.23          | 0.39            | 2.30          | 1.89          | 3.09          | 3.22          | 4.39           | 3.99           |
| 1.8 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.54            | 2.49          | 0.04           | 1.14          | 0.39            | 2.54          | 2.12          | 3.46          | 3.82          | 4.63           | 4.21           |
| 1.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                              | 0.54            | 2.85          | 0.04           | 1.35          | 0.39            | 2.90          | 2.45          | 3.69          | 3.93          | 4.99           | 4.55           |
| 3.3 V PCI                            | Per PCI spec.       |  | High      | 10                                | 25 <sup>4</sup>                | 0.54            | 2.51          | 0.04           | 0.81          | 0.39            | 2.55          | 1.83          | 3.00          | 3.35          | 4.65           | 3.92           |
| 3.3 V PCI-X                          | Per PCI-X spec.     |  | High      | 10                                | 25 <sup>4</sup>                | 0.54            | 2.51          | 0.04           | 0.78          | 0.39            | 2.55          | 1.83          | 3.00          | 3.35          | 4.65           | 3.92           |
| LVDS                                 | 24 mA               |  | High      | –                                 | –                              | 0.54            | 1.76          | 0.04           | 1.55          | –               | –             | –             | –             | –             | –              | –              |
| LVPECL                               | 24 mA               |  | High      | –                                 | –                              | 0.54            | 1.68          | 0.04           | 1.31          | –               | –             | –             | –             | –             | –              | –              |

**Notes:**

1. Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
2. Output delays provided in this table were extracted with an output load indicated in the Capacitive Load column. For a specific output load, refer to Designer software. Software default load is higher.
3. All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD8-B specification.
4. Resistance is used to measure I/O propagation delays as defined in PCI specifications. See [Figure 2-15 on page 2-73](#) for connectivity. This resistor is not required during normal operation.
5. For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

**Table 2-33 • Summary of I/O Timing Characteristics—Software Default Settings**  
 –1 Speed Grade, Military-Case Conditions: T<sub>J</sub> = 125°C, Worst Case VCC = 1.425 V,  
 Worst Case VCCI  
 Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only

| I/O Standard                         | Drive Strength (mA) | Equivalent Software Default Drive Strength Option <sup>1</sup> | Slew Rate | Capacitive Load (pF) <sup>2</sup> | External Resistor | t <sub>DOUT</sub> (ns) | t <sub>DP</sub> (ns) | t <sub>DIN</sub> (ns) | t <sub>PY</sub> (ns) | t <sub>EOUT</sub> (ns) | t <sub>ZL</sub> (ns) | t <sub>ZH</sub> (ns) | t <sub>LZ</sub> (ns) | t <sub>HZ</sub> (ns) | t <sub>ZLS</sub> (ns) | t <sub>ZHS</sub> (ns) |
|--------------------------------------|---------------------|--|-----------|-----------------------------------|-------------------|------------------------|----------------------|-----------------------|----------------------|------------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS          | 12 mA               | 12 mA  | High      | 5                                 | –                 | 0.54                   | 1.90                 | 0.04                  | 0.94                 | 0.39                   | 1.94                 | 1.47                 | 2.61                 | 3.01                 | 4.03                  | 3.56                  |
| 3.3 V LVCMOS Wide Range <sup>3</sup> | 100 μA              | 12 mA  | High      | 5                                 | –                 | 0.54                   | 2.94                 | 0.04                  | 1.42                 | 0.39                   | 2.94                 | 2.22                 | 4.03                 | 4.66                 | 6.12                  | 5.40                  |
| 2.5 V LVCMOS                         | 12 mA               | 12 mA  | High      | 5                                 | –                 | 0.54                   | 1.94                 | 0.04                  | 1.21                 | 0.39                   | 1.97                 | 1.62                 | 2.64                 | 2.91                 | 4.07                  | 3.71                  |
| 1.8 V LVCMOS                         | 8 mA                | 8 mA   | High      | 5                                 | –                 | 0.54                   | 1.94                 | 0.04                  | 1.21                 | 0.39                   | 1.97                 | 1.62                 | 2.64                 | 2.91                 | 4.07                  | 3.71                  |
| 1.5 V LVCMOS                         | 4 mA                | 4 mA   | High      | 5                                 | –                 | 0.54                   | 2.62                 | 0.04                  | 1.33                 | 0.39                   | 2.67                 | 2.23                 | 2.84                 | 2.93                 | 4.77                  | 4.32                  |
| 3.3 V PCI                            | Per PCI spec.       | –  | High      | 10                                | 25 <sup>4</sup>   | 0.54                   | 2.16                 | 0.04                  | 0.80                 | 0.39                   | 2.20                 | 1.60                 | 2.61                 | 3.01                 | 4.29                  | 3.69                  |
| 3.3 V PCI-X                          | Per PCI-X spec.     | –  | High      | 10                                | 25 <sup>4</sup>   | 0.54                   | 2.16                 | 0.04                  | 0.78                 | 0.39                   | 2.20                 | 1.60                 | 2.61                 | 3.01                 | 4.29                  | 3.69                  |

**Notes:**

1. Note that 3.3 V LVCMOS wide range is applicable to 100 μA drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
2. Output delays provided in this table were extracted with an output load indicated in the Capacitive Load column. For a specific output load, refer to Designer software. Software default load is higher.
3. All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD8-B specification.
4. Resistance is used to measure I/O propagation delays as defined in PCI specifications. See [Figure 2-15 on page 2-73](#) for connectivity. This resistor is not required during normal operation.
5. For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## Detailed I/O DC Characteristics

**Table 2-34 • Input Capacitance**

| Symbol             | Definition                         | Conditions                       | Min. | Max. | Units |
|--------------------|------------------------------------|----------------------------------|------|------|-------|
| C <sub>IN</sub>    | Input capacitance                  | V <sub>IN</sub> = 0, f = 1.0 MHz |      | 8    | pF    |
| C <sub>INCLK</sub> | Input capacitance on the clock pin | V <sub>IN</sub> = 0, f = 1.0 MHz |      | 8    | pF    |

**Table 2-35 • I/O Output Buffer Maximum Resistances <sup>1</sup>**  
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Standard                             | Drive Strength              | R <sub>PULL-DOWN</sub> (Ω) <sup>2</sup> | R <sub>PULL-UP</sub> (Ω) <sup>3</sup> |
|--------------------------------------|-----------------------------|---|---------------------------------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS          | 4 mA                        | 100                                     | 300                                   |
|                                      | 8 mA                        | 50                                      | 150                                   |
|                                      | 12 mA                       | 25                                      | 75                                    |
|                                      | 16 mA                       | 17                                      | 50                                    |
|                                      | 24 mA                       | 11                                      | 33                                    |
| 3.3 V LVCMOS Wide Range              | 100 μA                      | Same as regular 3.3 V LVCMOS            |                                       |
| 2.5 V LVCMOS                         | 4 mA                        | 100                                     | 200                                   |
|                                      | 8 mA                        | 50                                      | 100                                   |
|                                      | 12 mA                       | 25                                      | 50                                    |
|                                      | 16 mA                       | 20                                      | 40                                    |
|                                      | 24 mA                       | 11                                      | 22                                    |
| 1.8 V LVCMOS                         | 2 mA                        | 200                                     | 225                                   |
|                                      | 4 mA                        | 100                                     | 112                                   |
|                                      | 6 mA                        | 50                                      | 56                                    |
|                                      | 8 mA                        | 50                                      | 56                                    |
|                                      | 12 mA                       | 20                                      | 22                                    |
|                                      | 16 mA                       | 20                                      | 22                                    |
| 1.5 V LVCMOS                         | 2 mA                        | 200                                     | 224                                   |
|                                      | 4 mA                        | 100                                     | 112                                   |
|                                      | 6 mA                        | 67                                      | 75                                    |
|                                      | 8 mA                        | 33                                      | 37                                    |
|                                      | 12 mA                       | 33                                      | 37                                    |
| 1.2 V LVCMOS <sup>4</sup>            | 2 mA                        | 158                                     | 158                                   |
| 1.2 V LVCMOS Wide Range <sup>4</sup> | 100 μA                      | 158                                     | 158                                   |
| 3.3 V PCI/PCI-X                      | Per PCI/PCI-X specification | 25                                      | 75                                    |
| 3.3 V GTL                            | 20 mA <sup>5</sup>          | 11                                      | –                                     |
| 2.5 V GTL                            | 20 mA <sup>5</sup>          | 14                                      | –                                     |
| 3.3 V GTL+                           | 35 mA                       | 12                                      | –                                     |
| 2.5 V GTL+                           | 33 mA                       | 15                                      | –                                     |
| HSTL (I)                             | 8 mA                        | 50                                      | 50                                    |
| HSTL (II)                            | 15 mA <sup>5</sup>          | 25                                      | 25                                    |
| SSTL2 (I)                            | 15 mA                       | 27                                      | 31                                    |
| SSTL2 (II)                           | 18 mA                       | 13                                      | 15                                    |
| SSTL3 (I)                            | 14 mA                       | 44                                      | 69                                    |
| SSTL3 (II)                           | 21 mA                       | 18                                      | 32                                    |

**Notes:**

1. These maximum values are provided for informational reasons only. Minimum output buffer resistance values depend on VCCI, drive strength selection, temperature, and process. For board design considerations and detailed output buffer resistances, use the corresponding IBIS models located at <http://www.actel.com/download/ibis/default.aspx>.
2.  $R_{(PULL-DOWN-MAX)} = (VOL_{spec}) / I_{OL_{spec}}$
3.  $R_{(PULL-UP-MAX)} = (VCCI_{max} - VOH_{spec}) / I_{OH_{spec}}$
4. Applicable to A3PE600L and A3PE3000L devices operating in the 1.2 V core range only.
5. Output drive strength is below JEDEC specification.

**Table 2-36 • I/O Output Buffer Maximum Resistances<sup>1</sup>**  
**Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only**

| Standard                    | Drive Strength              | R <sub>PULL-DOWN</sub><br>(Ω) <sup>2</sup> | R <sub>PULL-UP</sub><br>(Ω) <sup>3</sup> |
|-----------------------------|-----------------------------|--|--|
| 3.3 V LVTTTL / 3.3 V LVCMOS | 2 mA                        | 100  | 300                                      |
|                             | 4 mA                        | 100  | 300                                      |
|                             | 6 mA                        | 50   | 150                                      |
|                             | 8 mA                        | 50   | 150                                      |
|                             | 12 mA                       | 25   | 75                                       |
|                             | 16 mA                       | 17   | 50                                       |
|                             | 24 mA                       | 11   | 33                                       |
| 3.3 V LVCMOS Wide Range     | 100 μA                      | Same as regular 3.3 V LVCMOS               |  |
| 2.5 V LVCMOS                | 2 mA                        | 100  | 300                                      |
|                             | 4 mA                        | 100  | 300                                      |
|                             | 6 mA                        | 50   | 150                                      |
|                             | 8 mA                        | 50   | 150                                      |
|                             | 12 mA                       | 25   | 75                                       |
|                             | 16 mA                       | 17   | 50                                       |
|                             | 24 mA                       | 11   | 33                                       |
| 1.8 V LVCMOS                | 2 mA                        | 100  | 200                                      |
|                             | 4 mA                        | 100  | 200                                      |
|                             | 6 mA                        | 50   | 100                                      |
|                             | 8 mA                        | 50   | 100                                      |
|                             | 12 mA                       | 25   | 50                                       |
|                             | 16 mA                       | 20   | 40                                       |
| 1.5 V LVCMOS                | 2 mA                        | 200  | 224                                      |
|                             | 4 mA                        | 100  | 112                                      |
|                             | 6 mA                        | 67   | 75                                       |
|                             | 8 mA                        | 33   | 37                                       |
|                             | 12 mA                       | 33   | 37                                       |
| 3.3 V PCI/PCI-X             | Per PCI/PCI-X specification | 25   | 75                                       |

**Notes:**

1. These maximum values are provided for informational reasons only. Minimum output buffer resistance values depend on  $V_{CC1}$ , drive strength selection, temperature, and process. For board design considerations and detailed output buffer resistances, use the corresponding IBIS models located at <http://www.actel.com/download/ibis/default.aspx>.
2.  $R_{(PULL-DOWN-MAX)} = (VOL_{spec}) / I_{OL_{spec}}$
3.  $R_{(PULL-UP-MAX)} = (VCC1_{max} - VOH_{spec}) / I_{OH_{spec}}$

**Table 2-37 • I/O Output Buffer Maximum Resistances<sup>1</sup>**  
**Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only**

| Standard                    | Drive Strength              | R <sub>PULL-DOWN</sub><br>(Ω) <sup>2</sup> | R <sub>PULL-UP</sub><br>(Ω) <sup>3</sup> |
|-----------------------------|-----------------------------|--|--|
| 3.3 V LVTTTL / 3.3 V LVCMOS | 2 mA                        | 100  | 300                                      |
|                             | 4 mA                        | 100  | 300                                      |
|                             | 6 mA                        | 50   | 150                                      |
|                             | 8 mA                        | 50   | 150                                      |
|                             | 12 mA                       | 25   | 75                                       |
|                             | 16 mA                       | 25   | 75                                       |
| 3.3 V LVCMOS Wide Range     | 100 μA                      | Same as regular 3.3 V LVCMOS               |  |
| 2.5 V LVCMOS                | 2 mA                        | 100  | 200                                      |
|                             | 4 mA                        | 100  | 200                                      |
|                             | 6 mA                        | 50   | 100                                      |
|                             | 8 mA                        | 50   | 100                                      |
|                             | 12 mA                       | 25   | 50                                       |
| 1.8 V LVCMOS                | 2 mA                        | 200  | 225                                      |
|                             | 4 mA                        | 100  | 112                                      |
|                             | 6 mA                        | 50   | 56                                       |
|                             | 8 mA                        | 50   | 56                                       |
| 1.5 V LVCMOS                | 2 mA                        | 200  | 224                                      |
|                             | 4 mA                        | 100  | 112                                      |
| 3.3 V PCI/PCI-X             | Per PCI/PCI-X specification | 25   | 75                                       |

**Notes:**

1. These maximum values are provided for informational reasons only. Minimum output buffer resistance values depend on V<sub>CCI</sub>, drive strength selection, temperature, and process. For board design considerations and detailed output buffer resistances, use the corresponding IBIS models located at <http://www.actel.com/download/ibis/default.aspx>.
2.  $R_{(PULL-DOWN-MAX)} = (VOL_{spec}) / IOL_{spec}$
3.  $R_{(PULL-UP-MAX)} = (VCCImax - VOH_{spec}) / IOH_{spec}$

**Table 2-38 • I/O Weak Pull-Up/Pull-Down Resistances**  
**Minimum and Maximum Weak Pull-Up/Pull-Down Resistance Values**

| VCCI                    | R <sub>(WEAK PULL-UP)</sub> <sup>1</sup><br>(Ω) |       | R <sub>(WEAK PULL-DOWN)</sub> <sup>2</sup><br>(Ω) |       |
|-------------------------|---|-------|---|-------|
|                         | Min.  | Max.  | Min.  | Max.  |
| 3.3 V                   | 10 k  | 95 k  | 13 k  | 45 k  |
| 3.3 V (wide range I/Os) | 10 k  | 95 k  | 13 k  | 45 k  |
| 2.5 V                   | 11 k  | 100 k | 17 k  | 74 k  |
| 1.8 V                   | 19 k  | 85 k  | 23 k  | 110 k |
| 1.5 V                   | 20 k  | 120 k | 17 k  | 156 k |
| 1.2 V                   | 30 k  | 450 k | 25 k  | 300 k |
| 1.2 V (wide range I/Os) | 20 k  | 450 k | 17 k  | 300 k |

**Notes:**

1.  $R_{(WEAK PULL-UP-MAX)} = (VCCImax - VOH_{spec}) / I_{(WEAK PULL-UP-MIN)}$
2.  $R_{(WEAK PULL-DOWN-MAX)} = (VOL_{spec}) / I_{(WEAK PULL-UP-MIN)}$



**Table 2-39 • I/O Short Currents IOSH/IOSL**  
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

|                             | Drive Strength              | $I_{OSL}$ (mA) <sup>1</sup>                | $I_{OSH}$ (mA) <sup>1</sup> |
|-----------------------------|-----------------------------|--|-----------------------------|
| 3.3 V LVTTTL / 3.3 V LVCMOS | 4 mA                        | 25   | 27                          |
|                             | 8 mA                        | 51   | 54                          |
|                             | 12 mA                       | 103  | 109                         |
|                             | 16 mA                       | 132  | 127                         |
|                             | 24 mA                       | 268  | 181                         |
| 3.3 V LVCMOS Wide Range     | 100 $\mu$ A                 | Same specification as regular LVCMOS 3.3 V |                             |
| 2.5 V LVCMOS                | 4 mA                        | 16   | 18                          |
|                             | 8 mA                        | 32   | 37                          |
|                             | 12 mA                       | 65   | 74                          |
|                             | 16 mA                       | 83   | 87                          |
|                             | 24 mA                       | 169  | 124                         |
| 1.8 V LVCMOS                | 2 mA                        | 9  | 11                          |
|                             | 4 mA                        | 17   | 22                          |
|                             | 6 mA                        | 35   | 44                          |
|                             | 8 mA                        | 45   | 51                          |
|                             | 12 mA                       | 91   | 74                          |
|                             | 16 mA                       | 91   | 74                          |
| 1.5 V LVCMOS                | 2 mA                        | 13   | 16                          |
|                             | 4 mA                        | 25   | 33                          |
|                             | 6 mA                        | 32   | 39                          |
|                             | 8 mA                        | 66   | 55                          |
|                             | 12 mA                       | 66   | 55                          |
| 1.2 V LVCMOS                | 2 mA                        | TBD  | TBD                         |
| 1.2 V LVCMOS Wide Range     | 100 $\mu$ A                 | TBD  | TBD                         |
| 3.3 V PCI/PCIX              | Per PCI/PCI-X specification | Per PCI Curves                             |                             |
| 3.3 V GTL                   | 20 mA <sup>2</sup>          | 268  | 181                         |
| 2.5 V GTL                   | 20 mA <sup>2</sup>          | 169  | 124                         |
| 3.3 V GTL+                  | 35 mA                       | 268  | 181                         |
| 2.5 V GTL+                  | 33 mA                       | 169  | 124                         |
| HSTL (I)                    | 8 mA                        | 32   | 39                          |
| HSTL (II)                   | 15 mA <sup>2</sup>          | 66   | 55                          |
| SSTL2 (I)                   | 15 mA                       | 83   | 87                          |
| SSTL2 (II)                  | 18 mA                       | 169  | 124                         |
| SSTL3 (I)                   | 14 mA                       | 51   | 54                          |
| SSTL3 (II)                  | 21 mA                       | 103  | 109                         |

**Notes:**

1.  $T_J = 100^\circ\text{C}$
2. Output drive strength is below JEDEC specification.

**Table 2-40 • I/O Short Currents IOSH/IOSL**  
**Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only**

|                            | Drive Strength              | I <sub>OSL</sub> (mA)*                     | I <sub>OSH</sub> (mA)* |
|----------------------------|-----------------------------|--|------------------------|
| 3.3 V LVTTTL / 3.3V LVCMOS | 2 mA                        | 25   | 27                     |
|                            | 4 mA                        | 25   | 27                     |
|                            | 6 mA                        | 51   | 54                     |
|                            | 8 mA                        | 51   | 54                     |
|                            | 12 mA                       | 103  | 109                    |
|                            | 16 mA                       | 132  | 127                    |
|                            | 24 mA                       | 268  | 181                    |
| 3.3 V LVCMOS Wide Range    | 100 $\mu$ A                 | Same specification as regular LVCMOS 3.3 V |                        |
| 2.5 V LVCMOS               | 2 mA                        | 16   | 18                     |
|                            | 4 mA                        | 16   | 18                     |
|                            | 6 mA                        | 32   | 37                     |
|                            | 8 mA                        | 32   | 37                     |
|                            | 12 mA                       | 65   | 74                     |
|                            | 16 mA                       | 83   | 87                     |
|                            | 24 mA                       | 169  | 124                    |
| 1.8 V LVCMOS               | 2 mA                        | 9  | 11                     |
|                            | 4 mA                        | 17   | 22                     |
|                            | 6 mA                        | 35   | 44                     |
|                            | 8 mA                        | 45   | 51                     |
|                            | 12 mA                       | 91   | 74                     |
|                            | 16 mA                       | 91   | 74                     |
| 1.5 V LVCMOS               | 2 mA                        | 13   | 16                     |
|                            | 4 mA                        | 25   | 33                     |
|                            | 6 mA                        | 32   | 39                     |
|                            | 8 mA                        | 66   | 55                     |
|                            | 12 mA                       | 66   | 55                     |
| 3.3 V PCI/PCI-X            | Per PCI/PCI-X specification | 103  | 109                    |

 Note: \*T<sub>J</sub> = 100°C

**Table 2-41 • I/O Short Currents IOSH/IOSL**  
**Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only**

|                            | Drive Strength              | I <sub>OSL</sub> (mA)*                     | I <sub>OSH</sub> (mA)* |
|----------------------------|-----------------------------|--|------------------------|
| 3.3 V LVTTTL / 3.3V LVCMOS | 2mA                         | 25   | 27                     |
|                            | 4mA                         | 25   | 27                     |
|                            | 6mA                         | 51   | 54                     |
|                            | 8mA                         | 51   | 54                     |
|                            | 12mA                        | 103  | 109                    |
|                            | 16mA                        | 103  | 109                    |
| 3.3 V LVCMOS Wide Range    | 100 $\mu$ A                 | Same specification as regular LVCMOS 3.3 V |                        |
| 2.5 V LVCMOS               | 2mA                         | 16   | 18                     |
|                            | 4mA                         | 16   | 18                     |
|                            | 6mA                         | 32   | 37                     |
|                            | 8mA                         | 32   | 37                     |
|                            | 12mA                        | 65   | 74                     |
| 1.8 V LVCMOS               | 2mA                         | 9  | 11                     |
|                            | 4mA                         | 17   | 22                     |
|                            | 6mA                         | 35   | 44                     |
|                            | 8mA                         | 35   | 44                     |
| 1.5V LVCMOS                | 2mA                         | 13   | 16                     |
|                            | 4mA                         | 25   | 33                     |
| 3.3 V PCI/PCI-X            | Per PCI/PCI-X specification | 103  | 109                    |

Note: \* $T_J = 100^\circ\text{C}$

**Table 2-42 • Schmitt Trigger Input Hysteresis, Hysteresis Voltage Value (typical) for Schmitt Mode Input Buffers Applicable to A3PE600L and A3PE3000L Only**

| Input Buffer Configuration                           | Hysteresis Value (typical) |
|--|----------------------------|
| 3.3 V LVTTTL/LVCMOS/PCI/PCI-X (Schmitt trigger mode) | 240 mV                     |
| 2.5 V LVCMOS (Schmitt trigger mode)                  | 140 mV                     |
| 1.8 V LVCMOS (Schmitt trigger mode)                  | 80 mV                      |
| 1.5 V LVCMOS (Schmitt trigger mode)                  | 60 mV                      |
| 1.2 V LVCMOS (Schmitt trigger mode)                  | 40 mV                      |

The length of time an I/O can withstand I<sub>OSH</sub>/I<sub>OSL</sub> events depends on the junction temperature. The reliability data below is based on a 3.3 V, 12 mA I/O setting, which is the worst case for this type of analysis.

For example, at 110°C, the short current condition would have to be sustained for more than three months to cause a reliability concern. The I/O design does not contain any short circuit protection, but such protection would only be needed in extremely prolonged stress conditions.

**Table 2-43 • Duration of Short Circuit Event before Failure**

| Temperature | Time before Failure |
|-------------|---------------------|
| -50°C       | > 20 years          |
| -40°C       | > 20 years          |
| 0°C         | > 20 years          |
| 25°C        | > 20 years          |
| 70°C        | 5 years             |
| 85°C        | 2 years             |
| 100°C       | 6 months            |
| 110°C       | 3 months            |
| 125°C       | 1 month             |

**Table 2-44 • I/O Input Rise Time, Fall Time, and Related I/O Reliability**

| Input Buffer                  | Input Rise/Fall Time (min.) | Input Rise/Fall Time (max.) | Reliability      |
|-------------------------------|-----------------------------|-----------------------------|------------------|
| LVTTTL/LVCMOS                 | No requirement              | 10 ns *                     | 20 years (110°C) |
| LVDS/B-LVDS/<br>M-LVDS/LVPECL | No requirement              | 10 ns *                     | 10 years (100°C) |

*Note:* \*The maximum input rise/fall time is related to the noise induced in the input buffer trace. If the noise is low, the rise time and fall time of input buffers can be increased beyond the maximum value. The longer the rise/fall times, the more susceptible the input signal is to the board noise. Microsemi recommends signal integrity evaluation/characterization of the system to ensure that there is no excessive noise coupling into input signals.

## Single-Ended I/O Characteristics

### 3.3 V LVTTTL / 3.3 V LVCMOS

Low-Voltage Transistor–Transistor Logic (LVTTTL) is a general-purpose standard (EIA/JESD) for 3.3 V applications. It uses an LVTTTL input buffer and push-pull output buffer.

**Table 2-45 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| 3.3 V LVTTTL /<br>3.3 V LVCMOS | VIL       |           | VIH       |           | VOL       | VOH       | IOL | IOH | IOSL                    | IOSH                    | IIL <sup>1</sup> | IIH <sup>2</sup> |
|--------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----|-----|-------------------------|-------------------------|------------------|------------------|
|                                | Min.<br>V | Max.<br>V | Min.<br>V | Max.<br>V | Max.<br>V | Min.<br>V | mA  | mA  | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>  | μA <sup>4</sup>  |
| 4 mA                           | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 4   | 4   | 25                      | 27                      | 15               | 15               |
| 8 mA                           | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 8   | 8   | 51                      | 54                      | 15               | 15               |
| 12 mA                          | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 12  | 12  | 103                     | 109                     | 15               | 15               |
| 16 mA                          | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 16  | 16  | 132                     | 127                     | 15               | 15               |
| 24 mA                          | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 24  | 24  | 268                     | 181                     | 15               | 15               |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operation conditions where  $-0.3V < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-46 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only

| 3.3 V LVTTTL /<br>3.3 V LVCMOS | VIL       |           | VIH       |           | VOL       | VOH       | IOL | IOH | IOSL                    | IOSH                    | IIL <sup>1</sup> | IIH <sup>2</sup> |
|--------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----|-----|-------------------------|-------------------------|------------------|------------------|
|                                | Min.<br>V | Max.<br>V | Min.<br>V | Max.<br>V | Max.<br>V | Min.<br>V | mA  | mA  | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>  | μA <sup>4</sup>  |
| 2 mA                           | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 2   | 2   | 25                      | 27                      | 15               | 15               |
| 4 mA                           | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 4   | 4   | 25                      | 27                      | 15               | 15               |
| 6 mA                           | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 6   | 6   | 51                      | 54                      | 15               | 15               |
| 8 mA                           | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 8   | 8   | 51                      | 54                      | 15               | 15               |
| 12 mA                          | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 12  | 12  | 103                     | 109                     | 15               | 15               |
| 16 mA                          | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 16  | 16  | 132                     | 127                     | 15               | 15               |
| 24 mA                          | -0.3      | 0.8       | 2         | 3.6       | 0.4       | 2.4       | 24  | 24  | 268                     | 181                     | 15               | 15               |

**Notes:**

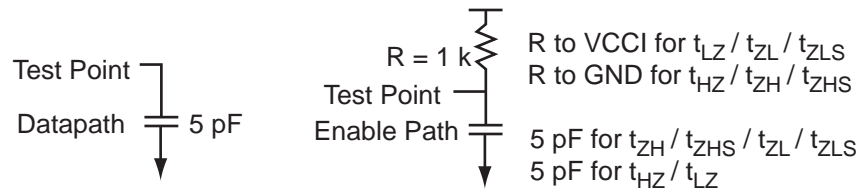
1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operation conditions where  $-0.3V < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-47 • Minimum and Maximum DC Input and Output Levels**  
 Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only

| 3.3 V LVTTTL /<br>3.3 V LVCMOS | VIL    |        | VIH    |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|--------------------------------|--------|--------|--------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|                                | Min. V | Max. V | Min. V | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA                           | -0.3   | 0.8    | 2      | 3.6    | 0.4    | 2.4    | 2               | 2               | 25                   | 27                   | 15                           | 15                           |
| 4 mA                           | -0.3   | 0.8    | 2      | 3.6    | 0.4    | 2.4    | 4               | 4               | 25                   | 27                   | 15                           | 15                           |
| 6 mA                           | -0.3   | 0.8    | 2      | 3.6    | 0.4    | 2.4    | 6               | 6               | 51                   | 54                   | 15                           | 15                           |
| 8 mA                           | -0.3   | 0.8    | 2      | 3.6    | 0.4    | 2.4    | 8               | 8               | 51                   | 54                   | 15                           | 15                           |
| 12 mA                          | -0.3   | 0.8    | 2      | 3.6    | 0.4    | 2.4    | 12              | 12              | 103                  | 109                  | 15                           | 15                           |
| 16 mA                          | -0.3   | 0.8    | 2      | 3.6    | 0.4    | 2.4    | 16              | 16              | 103                  | 109                  | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3V < V_{IN} < V_{IL}$ .
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.


**Figure 2-8 • AC Loading**
**Table 2-48 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 3.3            | 1.4                  | -              | 5                      |

Note: \*Measuring point = V<sub>trip</sub>. See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-49 • 3.3 V LVTTTL / 3.3 V LVCMOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 3.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.80       | 6.04     | 0.05      | 1.75     | 2.38      | 0.52       | 6.14     | 4.84     | 2.68     | 2.43     | 8.35      | 7.05      | ns    |
|                | -1          | 0.68       | 5.13     | 0.05      | 1.49     | 2.03      | 0.44       | 5.22     | 4.12     | 2.28     | 2.07     | 7.10      | 6.00      | ns    |
| 8 mA           | Std.        | 0.80       | 4.93     | 0.05      | 1.75     | 2.38      | 0.52       | 5.02     | 4.14     | 3.02     | 3.05     | 7.22      | 6.34      | ns    |
|                | -1          | 0.68       | 4.20     | 0.05      | 1.49     | 2.03      | 0.44       | 4.27     | 3.52     | 2.57     | 2.59     | 6.14      | 5.40      | ns    |
| 12 mA          | Std.        | 0.80       | 4.15     | 0.05      | 1.75     | 2.38      | 0.52       | 4.22     | 3.61     | 3.25     | 3.43     | 6.43      | 5.81      | ns    |
|                | -1          | 0.68       | 3.53     | 0.05      | 1.49     | 2.03      | 0.44       | 3.59     | 3.07     | 2.76     | 2.92     | 5.47      | 4.95      | ns    |
| 16 mA          | Std.        | 0.80       | 3.93     | 0.05      | 1.75     | 2.38      | 0.52       | 3.99     | 3.49     | 3.29     | 3.54     | 6.20      | 5.70      | ns    |
|                | -1          | 0.68       | 3.34     | 0.05      | 1.49     | 2.03      | 0.44       | 3.40     | 2.97     | 2.80     | 3.01     | 5.27      | 4.85      | ns    |
| 24 mA          | Std.        | 0.80       | 3.81     | 0.05      | 1.75     | 2.38      | 0.52       | 3.87     | 3.51     | 3.36     | 3.94     | 6.08      | 5.71      | ns    |
|                | -1          | 0.68       | 3.24     | 0.05      | 1.49     | 2.03      | 0.44       | 3.30     | 2.98     | 2.86     | 3.35     | 5.17      | 4.86      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-50 • 3.3 V LVTTTL / 3.3 V LVCMOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 3.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.80       | 3.40     | 0.05      | 1.75     | 2.38      | 0.52       | 3.45     | 2.60     | 2.68     | 2.58     | 5.66      | 4.81      | ns    |
|                | -1          | 0.68       | 2.89     | 0.05      | 1.49     | 2.03      | 0.44       | 2.94     | 2.21     | 2.28     | 2.19     | 4.81      | 4.09      | ns    |
| 8 mA           | Std.        | 0.80       | 2.79     | 0.05      | 1.75     | 2.38      | 0.52       | 2.84     | 2.08     | 3.02     | 3.19     | 5.04      | 4.29      | ns    |
|                | -1          | 0.68       | 2.38     | 0.05      | 1.49     | 2.03      | 0.44       | 2.41     | 1.77     | 2.57     | 2.72     | 4.29      | 3.65      | ns    |
| 12 mA          | Std.        | 0.80       | 2.45     | 0.05      | 1.75     | 2.38      | 0.52       | 2.49     | 1.83     | 3.25     | 3.59     | 4.70      | 4.04      | ns    |
|                | -1          | 0.68       | 2.09     | 0.05      | 1.49     | 2.03      | 0.44       | 2.12     | 1.56     | 2.76     | 3.06     | 3.99      | 3.43      | ns    |
| 16 mA          | Std.        | 0.80       | 2.40     | 0.05      | 1.75     | 2.38      | 0.52       | 2.43     | 1.79     | 3.30     | 3.70     | 4.64      | 3.99      | ns    |
|                | -1          | 0.68       | 2.04     | 0.05      | 1.49     | 2.03      | 0.44       | 2.07     | 1.52     | 2.81     | 3.15     | 3.95      | 3.40      | ns    |
| 24 mA          | Std.        | 0.80       | 2.42     | 0.05      | 1.75     | 2.38      | 0.52       | 2.46     | 1.72     | 3.37     | 4.10     | 4.66      | 3.93      | ns    |
|                | -1          | 0.68       | 2.06     | 0.05      | 1.49     | 2.03      | 0.44       | 2.09     | 1.47     | 2.86     | 3.49     | 3.97      | 3.34      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**1.5 V DC Core Voltage**

**Table 2-51 • 3.3 V LVTTTL / 3.3 V LVCMOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 3.0\text{ V}$   
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.61       | 5.90     | 0.04      | 1.45     | 2.09      | 0.40       | 5.98     | 4.73     | 2.52     | 2.24     | 7.45      | 6.19      | ns    |
|                | -1          | 0.52       | 5.02     | 0.03      | 1.23     | 1.78      | 0.34       | 5.09     | 4.02     | 2.15     | 1.90     | 6.34      | 5.27      | ns    |
| 8 mA           | Std.        | 0.61       | 4.80     | 0.04      | 1.45     | 2.09      | 0.40       | 4.86     | 4.02     | 2.87     | 2.85     | 6.32      | 5.49      | ns    |
|                | -1          | 0.52       | 4.08     | 0.03      | 1.23     | 1.78      | 0.34       | 4.13     | 3.42     | 2.44     | 2.43     | 5.38      | 4.67      | ns    |
| 12 mA          | Std.        | 0.61       | 4.02     | 0.04      | 1.45     | 2.09      | 0.40       | 4.06     | 3.49     | 3.09     | 3.23     | 5.53      | 4.96      | ns    |
|                | -1          | 0.52       | 3.42     | 0.03      | 1.23     | 1.78      | 0.34       | 3.46     | 2.97     | 2.63     | 2.75     | 4.70      | 4.22      | ns    |
| 16 mA          | Std.        | 0.61       | 3.79     | 0.04      | 1.45     | 2.09      | 0.40       | 3.84     | 3.38     | 3.14     | 3.34     | 5.30      | 4.84      | ns    |
|                | -1          | 0.52       | 3.23     | 0.03      | 1.23     | 1.78      | 0.34       | 3.26     | 2.87     | 2.67     | 2.84     | 4.51      | 4.12      | ns    |
| 24 mA          | Std.        | 0.61       | 3.67     | 0.04      | 1.45     | 2.09      | 0.40       | 3.72     | 3.39     | 3.20     | 3.74     | 5.18      | 4.86      | ns    |
|                | -1          | 0.52       | 3.13     | 0.03      | 1.23     | 1.78      | 0.34       | 3.16     | 2.88     | 2.72     | 3.18     | 4.41      | 4.13      | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-52 • 3.3 V LVTTTL / 3.3 V LVCMOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 3.0\text{ V}$   
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.61       | 3.26     | 0.04      | 1.45     | 2.09      | 0.40       | 3.30     | 2.48     | 2.52     | 2.38     | 4.76      | 3.95      | ns    |
|                | -1          | 0.52       | 2.77     | 0.03      | 1.23     | 1.78      | 0.34       | 2.80     | 2.11     | 2.15     | 2.03     | 4.05      | 3.36      | ns    |
| 8 mA           | Std.        | 0.61       | 2.66     | 0.04      | 1.45     | 2.09      | 0.40       | 2.68     | 1.97     | 2.87     | 3.00     | 4.15      | 3.43      | ns    |
|                | -1          | 0.52       | 2.26     | 0.03      | 1.23     | 1.78      | 0.34       | 2.28     | 1.67     | 2.44     | 2.55     | 3.53      | 2.92      | ns    |
| 12 mA          | Std.        | 0.61       | 2.32     | 0.04      | 1.45     | 2.09      | 0.40       | 2.33     | 1.72     | 3.09     | 3.40     | 3.80      | 3.18      | ns    |
|                | -1          | 0.52       | 1.97     | 0.03      | 1.23     | 1.78      | 0.34       | 1.99     | 1.46     | 2.63     | 2.89     | 3.23      | 2.71      | ns    |
| 16 mA          | Std.        | 0.61       | 2.26     | 0.04      | 1.45     | 2.09      | 0.40       | 2.28     | 1.67     | 3.15     | 3.51     | 3.74      | 3.14      | ns    |
|                | -1          | 0.52       | 1.92     | 0.03      | 1.23     | 1.78      | 0.34       | 1.94     | 1.42     | 2.68     | 2.98     | 3.18      | 2.67      | ns    |
| 24 mA          | Std.        | 0.61       | 2.28     | 0.04      | 1.45     | 2.09      | 0.40       | 2.30     | 1.61     | 3.21     | 3.90     | 3.77      | 3.07      | ns    |
|                | -1          | 0.52       | 1.94     | 0.03      | 1.23     | 1.78      | 0.34       | 1.96     | 1.37     | 2.73     | 3.32     | 3.20      | 2.61      | ns    |

**Notes:**

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.



**Table 2-53 • 3.3 V LVTTTL / 3.3 V LVCMOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 6.25     | 0.05      | 1.12     | 0.45       | 6.37     | 5.29     | 2.91     | 2.70     | 8.83      | 7.75      | ns    |
|                | -1          | 0.54       | 5.32     | 0.04      | 0.95     | 0.39       | 5.42     | 4.50     | 2.47     | 2.30     | 7.51      | 6.59      | ns    |
| 6 mA           | Std.        | 0.63       | 5.25     | 0.05      | 1.12     | 0.45       | 5.35     | 4.58     | 3.28     | 3.34     | 7.81      | 7.04      | ns    |
|                | -1          | 0.54       | 4.47     | 0.04      | 0.95     | 0.39       | 4.55     | 3.90     | 2.79     | 2.85     | 6.65      | 5.99      | ns    |
| 8 mA           | Std.        | 0.63       | 5.25     | 0.05      | 1.12     | 0.45       | 5.35     | 4.58     | 3.28     | 3.34     | 7.81      | 7.04      | ns    |
|                | -1          | 0.54       | 4.47     | 0.04      | 0.95     | 0.39       | 4.55     | 3.90     | 2.79     | 2.85     | 6.65      | 5.99      | ns    |
| 12 mA          | Std.        | 0.63       | 4.50     | 0.05      | 1.12     | 0.45       | 4.59     | 4.05     | 3.53     | 3.76     | 7.05      | 6.51      | ns    |
|                | -1          | 0.54       | 3.83     | 0.04      | 0.95     | 0.39       | 3.90     | 3.45     | 3.00     | 3.20     | 5.99      | 5.54      | ns    |
| 16 mA          | Std.        | 0.63       | 4.27     | 0.05      | 1.12     | 0.45       | 4.35     | 3.93     | 3.58     | 3.86     | 6.81      | 6.39      | ns    |
|                | -1          | 0.54       | 3.63     | 0.04      | 0.95     | 0.39       | 3.70     | 3.34     | 3.05     | 3.29     | 5.79      | 5.43      | ns    |
| 24 mA          | Std.        | 0.63       | 4.14     | 0.05      | 1.12     | 0.45       | 4.22     | 3.97     | 3.65     | 4.27     | 6.68      | 6.43      | ns    |
|                | -1          | 0.54       | 3.53     | 0.04      | 0.95     | 0.39       | 3.59     | 3.38     | 3.10     | 3.63     | 5.68      | 5.47      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-54 • 3.3 V LVTTTL / 3.3 V LVCMOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 3.55     | 0.05      | 1.12     | 0.45       | 3.62     | 2.79     | 2.91     | 2.87     | 6.07      | 5.25      | ns    |
|                | -1          | 0.54       | 3.02     | 0.04      | 0.95     | 0.39       | 3.08     | 2.37     | 2.48     | 2.44     | 5.17      | 4.46      | ns    |
| 6 mA           | Std.        | 0.63       | 2.95     | 0.05      | 1.12     | 0.45       | 3.00     | 2.25     | 3.28     | 3.52     | 5.46      | 4.71      | ns    |
|                | -1          | 0.54       | 2.51     | 0.04      | 0.95     | 0.39       | 2.55     | 1.91     | 2.79     | 3.00     | 4.65      | 4.01      | ns    |
| 8 mA           | Std.        | 0.63       | 2.95     | 0.05      | 1.12     | 0.45       | 3.00     | 2.25     | 3.28     | 3.52     | 5.46      | 4.71      | ns    |
|                | -1          | 0.54       | 2.51     | 0.04      | 0.95     | 0.39       | 2.55     | 1.91     | 2.79     | 3.00     | 4.65      | 4.01      | ns    |
| 12 mA          | Std.        | 0.63       | 2.64     | 0.05      | 1.12     | 0.45       | 2.68     | 1.99     | 3.53     | 3.94     | 5.14      | 4.45      | ns    |
|                | -1          | 0.54       | 2.24     | 0.04      | 0.95     | 0.39       | 2.28     | 1.70     | 3.00     | 3.35     | 4.38      | 3.79      | ns    |
| 16 mA          | Std.        | 0.63       | 2.58     | 0.05      | 1.12     | 0.45       | 2.63     | 1.95     | 3.59     | 4.05     | 5.09      | 4.41      | ns    |
|                | -1          | 0.54       | 2.20     | 0.04      | 0.95     | 0.39       | 2.24     | 1.66     | 3.05     | 3.44     | 4.33      | 3.75      | ns    |
| 24 mA          | Std.        | 0.63       | 2.61     | 0.05      | 1.12     | 0.45       | 2.66     | 1.89     | 3.66     | 4.46     | 5.12      | 4.35      | ns    |
|                | -1          | 0.54       | 2.22     | 0.04      | 0.95     | 0.39       | 2.26     | 1.61     | 3.11     | 3.80     | 4.35      | 3.70      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-55 • 3.3 V LVTTTL / 3.3 V LVCMOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 5.64     | 0.05      | 1.10     | 0.45       | 5.74     | 4.78     | 2.50     | 2.43     | 8.20      | 7.24      | ns    |
|                | -1          | 0.54       | 4.79     | 0.04      | 0.94     | 0.39       | 4.88     | 4.06     | 2.13     | 2.07     | 6.98      | 6.16      | ns    |
| 6 mA           | Std.        | 0.63       | 4.64     | 0.05      | 1.10     | 0.45       | 4.73     | 4.16     | 2.84     | 3.01     | 7.19      | 6.62      | ns    |
|                | -1          | 0.54       | 3.95     | 0.04      | 0.94     | 0.39       | 4.02     | 3.54     | 2.42     | 2.56     | 6.11      | 5.63      | ns    |
| 8 mA           | Std.        | 0.63       | 4.64     | 0.05      | 1.10     | 0.45       | 4.73     | 4.16     | 2.84     | 3.01     | 7.19      | 6.62      | ns    |
|                | -1          | 0.54       | 3.95     | 0.04      | 0.94     | 0.39       | 4.02     | 3.54     | 2.42     | 2.56     | 6.11      | 5.63      | ns    |
| 12 mA          | Std.        | 0.63       | 3.94     | 0.05      | 1.10     | 0.45       | 4.01     | 3.67     | 3.07     | 3.39     | 6.47      | 6.13      | ns    |
|                | -1          | 0.54       | 3.35     | 0.04      | 0.94     | 0.39       | 3.41     | 3.12     | 2.61     | 2.88     | 5.51      | 5.21      | ns    |
| 16 mA          | Std.        | 0.63       | 3.94     | 0.05      | 1.10     | 0.45       | 4.01     | 3.67     | 3.07     | 3.39     | 6.47      | 6.13      | ns    |
|                | -1          | 0.54       | 3.35     | 0.04      | 0.94     | 0.39       | 3.41     | 3.12     | 2.61     | 2.88     | 5.51      | 5.21      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-56 • 3.3 V LVTTTL / 3.3 V LVCMOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 3.07     | 0.05      | 1.10     | 0.45       | 3.13     | 2.46     | 2.50     | 2.57     | 5.59      | 4.91      | ns    |
|                | -1          | 0.54       | 2.61     | 0.04      | 0.94     | 0.39       | 2.66     | 2.09     | 2.13     | 2.19     | 4.75      | 4.18      | ns    |
| 6 mA           | Std.        | 0.63       | 2.51     | 0.05      | 1.10     | 0.45       | 2.55     | 1.97     | 2.84     | 3.16     | 5.01      | 4.43      | ns    |
|                | -1          | 0.54       | 2.13     | 0.04      | 0.94     | 0.39       | 2.17     | 1.67     | 2.41     | 2.69     | 4.26      | 3.76      | ns    |
| 8 mA           | Std.        | 0.63       | 2.51     | 0.05      | 1.10     | 0.45       | 2.55     | 1.97     | 2.84     | 3.16     | 5.01      | 4.43      | ns    |
|                | -1          | 0.54       | 2.13     | 0.04      | 0.94     | 0.39       | 2.17     | 1.67     | 2.41     | 2.69     | 4.26      | 3.76      | ns    |
| 12 mA          | Std.        | 0.63       | 2.24     | 0.05      | 1.10     | 0.45       | 2.28     | 1.72     | 3.07     | 3.54     | 4.74      | 4.18      | ns    |
|                | -1          | 0.54       | 1.90     | 0.04      | 0.94     | 0.39       | 1.94     | 1.47     | 2.61     | 3.01     | 4.03      | 3.56      | ns    |
| 16 mA          | Std.        | 0.63       | 2.24     | 0.05      | 1.10     | 0.45       | 2.28     | 1.72     | 3.07     | 3.54     | 4.74      | 4.18      | ns    |
|                | -1          | 0.54       | 1.90     | 0.04      | 0.94     | 0.39       | 1.94     | 1.47     | 2.61     | 3.01     | 4.03      | 3.56      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

### 3.3 V LVCMOS Wide Range

**Table 2-57 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| 3.3 V LVCMOS Wide Range | Equiv. Software Default Drive Strength Option <sup>1</sup> | VIL    |        | VIH    |        | VOL    | VOH        | IOL | IOH | IOSL                 | IOSH                 | IIL <sup>2</sup> | IIH <sup>3</sup> |
|-------------------------|--|--------|--------|--------|--------|--------|------------|-----|-----|----------------------|----------------------|------------------|------------------|
|                         |  | Min. V | Max. V | Min. V | Max. V | Max. V | Min. V     | μA  | μA  | Max. mA <sup>4</sup> | Max. mA <sup>4</sup> | μA <sup>5</sup>  | μA <sup>5</sup>  |
| 100 μA                  | 2 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 25                   | 27                   | 15               | 15               |
| 100 μA                  | 4 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 25                   | 27                   | 15               | 15               |
| 100 μA                  | 6 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 51                   | 54                   | 15               | 15               |
| 100 μA                  | 12 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 103                  | 109                  | 15               | 15               |
| 100 μA                  | 16 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 132                  | 127                  | 15               | 15               |
| 100 μA                  | 24 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 268                  | 181                  | 15               | 15               |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100 μA drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < V<sub>IL</sub>.
- I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < V<sub>CCI</sub>. Input current is larger when operating outside recommended ranges
- Currents are measured at 125°C junction temperature.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD8-A specification.
- Software default selection highlighted in gray.

**Table 2-58 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Advanced I/O Banks

| 3.3 V LVCMOS Wide Range | Equiv. Software Default Drive Strength Option <sup>1</sup> | VIL    |        | VIH    |        | VOL    | VOH        | IOL | IOH | IOSL                 | IOSH                 | IIL <sup>2</sup> | IIH <sup>3</sup> |
|-------------------------|--|--------|--------|--------|--------|--------|------------|-----|-----|----------------------|----------------------|------------------|------------------|
|                         |  | Min. V | Max. V | Min. V | Max. V | Max. V | Min. V     | μA  | μA  | Max. mA <sup>4</sup> | Max. mA <sup>4</sup> | μA <sup>5</sup>  | μA <sup>5</sup>  |
| 100 μA                  | 2 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 25                   | 27                   | 15               | 15               |
| 100 μA                  | 4 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 25                   | 27                   | 15               | 15               |
| 100 μA                  | 6 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 51                   | 54                   | 15               | 15               |
| 100 μA                  | 8 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 51                   | 54                   | 15               | 15               |
| 100 μA                  | 12 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 103                  | 109                  | 15               | 15               |
| 100 μA                  | 16 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100 | 100 | 132                  | 127                  | 15               | 15               |

**Notes:**

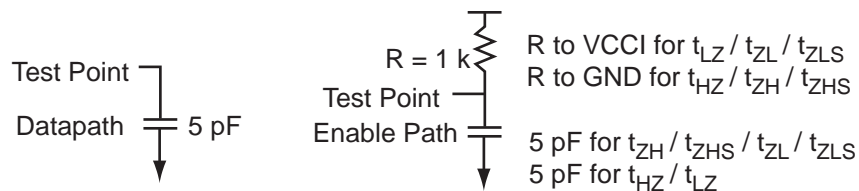
- Note that 3.3 V LVCMOS wide range is applicable to 100 μA drive strength only. The configuration will NOT operate at the equivalent software default drive strength. These values are for Normal Ranges ONLY.
- I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < V<sub>IL</sub>.
- I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < V<sub>CCI</sub>. Input current is larger when operating outside recommended ranges
- Currents are measured at 125°C junction temperature.
- All LVCMOS 3.3 V software macros support LVCMOS 3.3 V wide range as specified in the JESD8-A specification.
- Software default selection highlighted in gray.

**Table 2-59 • Minimum and Maximum DC Input and Output Levels**  
 Applicable to Standard Plus I/O Banks

| 3.3 V LVC MOS Wide Range | Equiv. Software Default Drive Strength Option <sup>1</sup> | VIL    |        | VIH    |        | VOL    | VOH        | IOL           | IOH           | IOSL                 | IOSH                 | IIL <sup>2</sup>           | IIH <sup>3</sup>           |
|--------------------------|--|--------|--------|--------|--------|--------|------------|---------------|---------------|----------------------|----------------------|----------------------------|----------------------------|
|                          |  | Min. V | Max. V | Min. V | Max. V | Max. V | Min. V     | $\mu\text{A}$ | $\mu\text{A}$ | Max. mA <sup>4</sup> | Max. mA <sup>4</sup> | $\mu\text{A}$ <sub>5</sub> | $\mu\text{A}$ <sub>5</sub> |
| 100 $\mu\text{A}$        | 2 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100           | 100           | 25                   | 27                   | 15                         | 15                         |
| 100 $\mu\text{A}$        | 4 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100           | 100           | 25                   | 27                   | 15                         | 15                         |
| 100 $\mu\text{A}$        | 6 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100           | 100           | 51                   | 54                   | 15                         | 15                         |
| 100 $\mu\text{A}$        | 8 mA   | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100           | 100           | 51                   | 54                   | 15                         | 15                         |
| 100 $\mu\text{A}$        | 12 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100           | 100           | 103                  | 109                  | 15                         | 15                         |
| 100 $\mu\text{A}$        | 16 mA  | -0.3   | 0.8    | 2      | 3.6    | 0.2    | VCCI - 0.2 | 100           | 100           | 132                  | 127                  | 15                         | 15                         |

**Notes:**

- Note that 3.3 V LVC MOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- $I_{IL}$  is the input leakage current per I/O pin over recommended operation conditions where  $-0.3 \text{ V} < V_{IN} < V_{IL}$ .
- $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
- Currents are measured at 125°C junction temperature.
- All LVC MOS 3.3 V software macros support LVC MOS 3.3 V wide range as specified in the JESD8-A specification.
- Software default selection highlighted in gray.


**Figure 2-9 • AC Loading**
**Table 2-60 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 3.3            | 1.4                  | -              | 5                      |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-61 • 3.3 V LVCMOS Wide Range Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 2.7 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|--|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.80       | 9.08     | 0.05      | 2.18     | 3.16      | 0.52       | 9.08     | 7.17     | 3.85     | 3.40     | 11.28     | 9.38      | ns    |
|                   |  | -1          | 0.68       | 7.72     | 0.05      | 1.86     | 2.69      | 0.44       | 7.72     | 6.10     | 3.28     | 2.89     | 9.60      | 7.98      | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.80       | 7.37     | 0.05      | 2.18     | 3.16      | 0.52       | 7.37     | 6.10     | 4.38     | 4.35     | 9.58      | 8.31      | ns    |
|                   |  | -1          | 0.68       | 6.27     | 0.05      | 1.86     | 2.69      | 0.44       | 6.27     | 5.19     | 3.73     | 3.70     | 8.15      | 7.07      | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.80       | 6.17     | 0.05      | 2.18     | 3.16      | 0.52       | 6.17     | 5.30     | 4.73     | 4.94     | 8.37      | 7.51      | ns    |
|                   |  | -1          | 0.68       | 5.24     | 0.05      | 1.86     | 2.69      | 0.44       | 5.24     | 4.51     | 4.03     | 4.20     | 7.12      | 6.38      | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.80       | 5.82     | 0.05      | 2.18     | 3.16      | 0.52       | 5.82     | 5.12     | 4.80     | 5.11     | 8.03      | 7.33      | ns    |
|                   |  | -1          | 0.68       | 4.95     | 0.05      | 1.86     | 2.69      | 0.44       | 4.95     | 4.36     | 4.09     | 4.34     | 6.83      | 6.23      | ns    |
| 100 $\mu\text{A}$ | 24 mA  | Std.        | 0.80       | 5.64     | 0.05      | 2.18     | 3.16      | 0.52       | 5.64     | 5.14     | 4.90     | 5.72     | 7.85      | 7.35      | ns    |
|                   |  | -1          | 0.68       | 4.80     | 0.05      | 1.86     | 2.69      | 0.44       | 4.80     | 4.38     | 4.17     | 4.87     | 6.67      | 6.25      | ns    |

#### Notes:

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges ONLY.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-62 • 3.3 V LVCMOS Wide Range High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 2.7 V  
 Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|--|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.80       | 5.00     | 0.05      | 2.18     | 3.16      | 0.52       | 5.00     | 3.77     | 3.85     | 3.62     | 7.21      | 5.97      | ns    |
|                   |  | -1          | 0.68       | 4.25     | 0.05      | 1.86     | 2.69      | 0.44       | 4.25     | 3.21     | 3.28     | 3.08     | 6.13      | 5.08      | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.80       | 4.07     | 0.05      | 2.18     | 3.16      | 0.52       | 4.07     | 2.98     | 4.38     | 4.57     | 6.27      | 5.19      | ns    |
|                   |  | -1          | 0.68       | 3.46     | 0.05      | 1.86     | 2.69      | 0.44       | 3.46     | 2.54     | 3.73     | 3.89     | 5.33      | 4.41      | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.80       | 3.54     | 0.05      | 2.18     | 3.16      | 0.52       | 3.54     | 2.60     | 4.73     | 5.19     | 5.74      | 4.81      | ns    |
|                   |  | -1          | 0.68       | 3.01     | 0.05      | 1.86     | 2.69      | 0.44       | 3.01     | 2.22     | 4.03     | 4.42     | 4.89      | 4.09      | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.80       | 3.45     | 0.05      | 2.18     | 3.16      | 0.52       | 3.45     | 2.54     | 4.82     | 5.36     | 5.66      | 4.74      | ns    |
|                   |  | -1          | 0.68       | 2.94     | 0.05      | 1.86     | 2.69      | 0.44       | 2.94     | 2.16     | 4.10     | 4.56     | 4.81      | 4.03      | ns    |
| 100 $\mu\text{A}$ | 24 mA  | Std.        | 0.80       | 3.49     | 0.05      | 2.18     | 3.16      | 0.52       | 3.49     | 2.44     | 4.91     | 5.98     | 5.69      | 4.64      | ns    |
|                   |  | -1          | 0.68       | 2.97     | 0.05      | 1.86     | 2.69      | 0.44       | 2.97     | 2.07     | 4.18     | 5.08     | 4.84      | 3.95      | ns    |

#### Notes:

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- For specific junction temperature and voltage supply levels, refer to the [Table 2-5 on page 2-8](#) for derating values.
- Software default selection highlighted in gray.

**1.5 V DC Core Voltage**

**Table 2-63 • 3.3 V LVCMOS Wide Range Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.7 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>PYS</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------------|--|-------------|-------------------|-----------------|------------------|-----------------|------------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.61              | 8.94            | 0.04             | 1.90            | 2.87             | 0.40              | 8.92            | 7.06            | 3.69            | 3.20            | 10.39            | 8.53             | ns    |
|                   |  | -1          | 0.52              | 7.61            | 0.03             | 1.61            | 2.44             | 0.34              | 7.59            | 6.01            | 3.14            | 2.72            | 8.84             | 7.25             | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.61              | 7.24            | 0.04             | 1.90            | 2.87             | 0.40              | 7.22            | 5.99            | 4.23            | 4.15            | 8.68             | 7.45             | ns    |
|                   |  | -1          | 0.52              | 6.16            | 0.03             | 1.61            | 2.44             | 0.34              | 6.14            | 5.10            | 3.60            | 3.53            | 7.39             | 6.34             | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.61              | 6.03            | 0.04             | 1.90            | 2.87             | 0.40              | 6.01            | 5.19            | 4.58            | 4.74            | 7.47             | 6.65             | ns    |
|                   |  | -1          | 0.52              | 5.13            | 0.03             | 1.61            | 2.44             | 0.34              | 5.11            | 4.41            | 3.89            | 4.03            | 6.36             | 5.66             | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.61              | 5.68            | 0.04             | 1.90            | 2.87             | 0.40              | 5.66            | 5.01            | 4.65            | 4.91            | 7.13             | 6.47             | ns    |
|                   |  | -1          | 0.52              | 4.83            | 0.03             | 1.61            | 2.44             | 0.34              | 4.82            | 4.26            | 3.95            | 4.18            | 6.06             | 5.51             | ns    |
| 100 $\mu\text{A}$ | 24 mA  | Std.        | 0.61              | 5.50            | 0.04             | 1.90            | 2.87             | 0.40              | 5.48            | 5.03            | 4.74            | 5.53            | 6.95             | 6.49             | ns    |
|                   |  | -1          | 0.52              | 4.68            | 0.03             | 1.61            | 2.44             | 0.34              | 4.66            | 4.28            | 4.04            | 4.70            | 5.91             | 5.52             | ns    |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges ONLY.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-64 • 3.3 V LVCMOS Wide Range High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.7 V  
 Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>PYS</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------------|--|-------------|-------------------|-----------------|------------------|-----------------|------------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.61              | 4.86            | 0.04             | 1.90            | 2.87             | 0.40              | 4.84            | 3.65            | 3.69            | 3.43            | 6.31             | 5.12             | ns    |
|                   |  | -1          | 0.52              | 4.14            | 0.03             | 1.61            | 2.44             | 0.34              | 4.12            | 3.11            | 3.14            | 2.91            | 5.37             | 4.35             | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.61              | 3.93            | 0.04             | 1.90            | 2.87             | 0.40              | 3.91            | 2.87            | 4.23            | 4.38            | 5.37             | 4.33             | ns    |
|                   |  | -1          | 0.52              | 3.34            | 0.03             | 1.61            | 2.44             | 0.34              | 3.33            | 2.44            | 3.60            | 3.72            | 4.57             | 3.68             | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.61              | 3.40            | 0.04             | 1.90            | 2.87             | 0.40              | 3.38            | 2.49            | 4.58            | 4.99            | 4.85             | 3.95             | ns    |
|                   |  | -1          | 0.52              | 2.89            | 0.03             | 1.61            | 2.44             | 0.34              | 2.88            | 2.12            | 3.89            | 4.25            | 4.12             | 3.36             | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.61              | 3.31            | 0.04             | 1.90            | 2.87             | 0.40              | 3.29            | 2.42            | 4.66            | 5.16            | 4.76             | 3.89             | ns    |
|                   |  | -1          | 0.52              | 2.82            | 0.03             | 1.61            | 2.44             | 0.34              | 2.80            | 2.06            | 3.96            | 4.39            | 4.05             | 3.31             | ns    |
| 100 $\mu\text{A}$ | 24 mA  | Std.        | 0.61              | 3.35            | 0.04             | 1.90            | 2.87             | 0.40              | 3.33            | 2.32            | 4.76            | 5.78            | 4.80             | 3.79             | ns    |
|                   |  | -1          | 0.52              | 2.85            | 0.03             | 1.61            | 2.44             | 0.34              | 2.83            | 1.98            | 4.05            | 4.92            | 4.08             | 3.22             | ns    |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-65 • 3.3 V LVCMOS Wide Range Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.7 V  
 Applicable to Advanced I/O Banks

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|--|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.63       | 9.67     | 0.05      | 1.70     | 0.45       | 9.67     | 8.03     | 4.50     | 4.18     | 13.40     | 11.77     | ns    |
|                   |  | -1          | 0.54       | 8.22     | 0.04      | 1.44     | 0.39       | 8.22     | 6.83     | 3.83     | 3.55     | 11.40     | 10.01     | ns    |
| 100 $\mu\text{A}$ | 6 mA   | Std.        | 0.63       | 8.13     | 0.05      | 1.70     | 0.45       | 8.13     | 6.95     | 5.07     | 5.17     | 11.86     | 10.69     | ns    |
|                   |  | -1          | 0.54       | 6.91     | 0.04      | 1.44     | 0.39       | 6.91     | 5.92     | 4.31     | 4.40     | 10.09     | 9.09      | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.63       | 8.13     | 0.05      | 1.70     | 0.45       | 8.13     | 6.95     | 5.07     | 5.17     | 11.86     | 10.69     | ns    |
|                   |  | -1          | 0.54       | 6.91     | 0.04      | 1.44     | 0.39       | 6.91     | 5.92     | 4.31     | 4.40     | 10.09     | 9.09      | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.63       | 6.96     | 0.05      | 1.70     | 0.45       | 6.96     | 6.15     | 5.45     | 5.81     | 10.70     | 9.89      | ns    |
|                   |  | -1          | 0.54       | 5.92     | 0.04      | 1.44     | 0.39       | 5.92     | 5.24     | 4.64     | 4.94     | 9.10      | 8.41      | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.63       | 6.61     | 0.05      | 1.70     | 0.45       | 6.61     | 5.96     | 5.54     | 5.97     | 10.34     | 9.70      | ns    |
|                   |  | -1          | 0.54       | 5.62     | 0.04      | 1.44     | 0.39       | 5.62     | 5.07     | 4.71     | 5.08     | 8.80      | 8.25      | ns    |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges ONLY.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-66 • 3.3 V LVCMOS Wide Range High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.7 V  
 Applicable to Advanced I/O Banks

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|--|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.63       | 5.49     | 0.05      | 1.70     | 0.45       | 5.49     | 4.23     | 4.51     | 4.44     | 9.22      | 7.97      | ns    |
|                   |  | -1          | 0.54       | 4.67     | 0.04      | 1.44     | 0.39       | 4.57     | 3.60     | 3.83     | 3.78     | 7.84      | 6.78      | ns    |
| 100 $\mu\text{A}$ | 6 mA   | Std.        | 0.63       | 4.56     | 0.05      | 1.70     | 0.45       | 4.56     | 3.42     | 5.08     | 5.45     | 8.29      | 7.15      | ns    |
|                   |  | -1          | 0.54       | 3.88     | 0.04      | 1.44     | 0.39       | 3.88     | 2.91     | 4.32     | 4.64     | 7.05      | 6.08      | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.63       | 4.56     | 0.05      | 1.70     | 0.45       | 4.56     | 3.42     | 5.08     | 5.45     | 8.29      | 7.15      | ns    |
|                   |  | -1          | 0.54       | 3.88     | 0.04      | 1.44     | 0.39       | 3.88     | 2.91     | 4.32     | 4.64     | 7.05      | 6.08      | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.63       | 4.08     | 0.05      | 1.70     | 0.45       | 4.08     | 3.03     | 5.46     | 6.09     | 7.81      | 6.76      | ns    |
|                   |  | -1          | 0.54       | 3.47     | 0.04      | 1.44     | 0.39       | 3.47     | 2.57     | 4.65     | 5.18     | 6.64      | 5.75      | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.63       | 4.00     | 0.05      | 1.70     | 0.45       | 4.00     | 2.96     | 5.55     | 6.26     | 7.73      | 6.69      | ns    |
|                   |  | -1          | 0.54       | 3.40     | 0.04      | 1.44     | 0.39       | 3.40     | 2.51     | 4.72     | 5.32     | 6.58      | 5.69      | ns    |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-67 • 3.3 V LVCMOS Wide Range Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.7 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|--|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.63       | 8.71     | 0.05      | 1.67     | 0.45       | 8.71     | 7.25     | 3.87     | 3.76     | 12.45     | 10.99     | ns    |
|                   |  | -1          | 0.54       | 7.41     | 0.04      | 1.42     | 0.39       | 7.41     | 6.17     | 3.29     | 3.19     | 10.59     | 9.35      | ns    |
| 100 $\mu\text{A}$ | 6 mA   | Std.        | 0.63       | 7.17     | 0.05      | 1.67     | 0.45       | 7.17     | 6.31     | 4.39     | 4.66     | 10.91     | 10.04     | ns    |
|                   |  | -1          | 0.54       | 6.10     | 0.04      | 1.42     | 0.39       | 6.10     | 5.37     | 3.73     | 3.96     | 9.28      | 8.54      | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.63       | 7.17     | 0.05      | 1.67     | 0.45       | 7.17     | 6.31     | 4.39     | 4.66     | 10.91     | 10.04     | ns    |
|                   |  | -1          | 0.54       | 6.10     | 0.04      | 1.42     | 0.39       | 6.10     | 5.37     | 3.73     | 3.96     | 9.28      | 8.54      | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.63       | 6.09     | 0.05      | 1.67     | 0.45       | 6.09     | 5.57     | 4.75     | 5.24     | 9.83      | 9.31      | ns    |
|                   |  | -1          | 0.54       | 5.18     | 0.04      | 1.42     | 0.39       | 5.18     | 4.74     | 4.04     | 4.46     | 8.36      | 7.92      | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.63       | 6.09     | 0.05      | 1.67     | 0.45       | 6.09     | 5.57     | 4.75     | 5.24     | 9.83      | 9.31      | ns    |
|                   |  | -1          | 0.54       | 5.18     | 0.04      | 1.42     | 0.39       | 5.18     | 4.74     | 4.04     | 4.46     | 8.36      | 7.92      | ns    |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges ONLY.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-68 • 3.3 V LVCMOS Wide Range High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.7 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength    | Equiv. Software Default Drive Strength Option <sup>1</sup> | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|--|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | 4 mA   | Std.        | 0.63       | 4.75     | 0.05      | 1.67     | 0.45       | 4.75     | 3.73     | 3.87     | 3.97     | 8.48      | 7.46      | ns    |
|                   |  | -1          | 0.54       | 4.04     | 0.04      | 1.42     | 0.39       | 4.04     | 3.17     | 3.29     | 3.38     | 7.21      | 6.35      | ns    |
| 100 $\mu\text{A}$ | 6 mA   | Std.        | 0.63       | 3.87     | 0.05      | 1.67     | 0.45       | 3.87     | 2.98     | 4.38     | 4.89     | 7.61      | 6.72      | ns    |
|                   |  | -1          | 0.54       | 3.30     | 0.04      | 1.42     | 0.39       | 3.30     | 2.54     | 3.73     | 4.16     | 6.47      | 5.72      | ns    |
| 100 $\mu\text{A}$ | 8 mA   | Std.        | 0.63       | 3.87     | 0.05      | 1.67     | 0.45       | 3.87     | 2.98     | 4.38     | 4.89     | 7.61      | 6.72      | ns    |
|                   |  | -1          | 0.54       | 3.30     | 0.04      | 1.42     | 0.39       | 3.30     | 2.54     | 3.73     | 4.16     | 6.47      | 5.72      | ns    |
| 100 $\mu\text{A}$ | 12 mA  | Std.        | 0.63       | 3.46     | 0.05      | 1.67     | 0.45       | 3.46     | 2.61     | 4.74     | 5.48     | 7.19      | 6.35      | ns    |
|                   |  | -1          | 0.54       | 2.94     | 0.04      | 1.42     | 0.3        | 2.94     | 2.22     | 4.03     | 4.66     | 6.12      | 5.40      | ns    |
| 100 $\mu\text{A}$ | 16 mA  | Std.        | 0.63       | 3.46     | 0.05      | 1.67     | 0.45       | 3.46     | 2.61     | 4.74     | 5.48     | 7.19      | 6.35      | ns    |
|                   |  | -1          | 0.54       | 2.94     | 0.04      | 1.42     | 0.39       | 2.94     | 2.22     | 4.03     | 4.66     | 6.12      | 5.40      | ns    |

**Notes:**

- Note that 3.3 V LVCMOS wide range is applicable to 100  $\mu\text{A}$  drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.



## 2.5 V LVCMOS

Low-Voltage CMOS for 2.5 V is an extension of the LVCMOS standard (JESD8-5) used for general-purpose 2.5 V applications. It uses a 5 V-tolerant input buffer and push-pull output buffer.

**Table 2-69 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| 2.5 V LVCMOS | VIL    |        | VIH    |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|--------------|--------|--------|--------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|              | Min. V | Max. V | Min. V | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 4 mA         | -0.3   | 0.7    | 1.7    | 3.6    | 0.7    | 1.7    | 4               | 4               | 16                   | 18                   | 15                           | 15                           |
| 8 mA         | -0.3   | 0.7    | 1.7    | 3.6    | 0.7    | 1.7    | 8               | 8               | 32                   | 37                   | 15                           | 15                           |
| 12 mA        | -0.3   | 0.7    | 1.7    | 3.6    | 0.7    | 1.7    | 12              | 12              | 65                   | 74                   | 15                           | 15                           |
| 16 mA        | -0.3   | 0.7    | 1.7    | 3.6    | 0.7    | 1.7    | 16              | 16              | 83                   | 87                   | 15                           | 15                           |
| 24 mA        | -0.3   | 0.7    | 1.7    | 3.6    | 0.7    | 1.7    | 24              | 24              | 169                  | 124                  | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < V<sub>IL</sub>.
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < V<sub>CCI</sub>. Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-70 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Advanced I/O Banks

| 2.5 V LVCMOS | VIL    |        | VIH    |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|--------------|--------|--------|--------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|              | Min. V | Max. V | Min. V | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA         | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 2               | 2               | 16                   | 18                   | 15                           | 15                           |
| 4 mA         | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 4               | 4               | 16                   | 18                   | 15                           | 15                           |
| 6 mA         | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 6               | 6               | 32                   | 37                   | 15                           | 15                           |
| 8 mA         | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 8               | 8               | 32                   | 37                   | 15                           | 15                           |
| 12 mA        | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 12              | 12              | 65                   | 74                   | 15                           | 15                           |
| 16 mA        | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 16              | 16              | 83                   | 87                   | 15                           | 15                           |
| 24 mA        | -0.3   | 0.7    | 1.7    | 2.7    | 0.7    | 1.7    | 24              | 24              | 169                  | 124                  | 15                           | 15                           |

**Notes:**

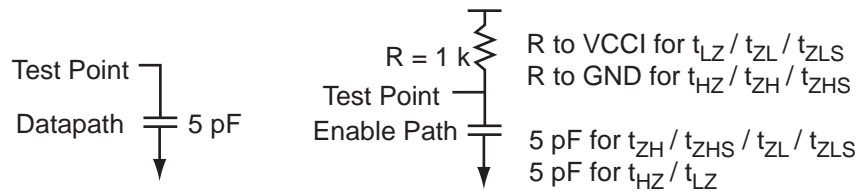
1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < V<sub>IL</sub>.
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < V<sub>CCI</sub>. Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-71 • Minimum and Maximum DC Input and Output Levels**  
 Applicable to Standard Plus I/O Banks for A3P250 and A3P1000 Only

| 2.5 V<br>LVCMOS | VIL       |           | VIH       |           | VOL       | VOH       | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>        | I <sub>OSH</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V | Min.<br>V | Max.<br>V | Max.<br>V | Min.<br>V | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>5</sup>              |
| 2 mA            | -0.3      | 0.7       | 1.7       | 2.7       | 0.7       | 1.7       | 2               | 2               | 16                      | 18                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.7       | 1.7       | 2.7       | 0.7       | 1.7       | 4               | 4               | 16                      | 18                      | 15                           | 15                           |
| 6 mA            | -0.3      | 0.7       | 1.7       | 2.7       | 0.7       | 1.7       | 6               | 6               | 32                      | 37                      | 15                           | 15                           |
| 8 mA            | -0.3      | 0.7       | 1.7       | 2.7       | 0.7       | 1.7       | 8               | 8               | 32                      | 37                      | 15                           | 15                           |
| 12 mA           | -0.3      | 0.7       | 1.7       | 2.7       | 0.7       | 1.7       | 12              | 12              | 65                      | 74                      | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.


**Figure 2-10 • AC Loading**
**Table 2-72 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 2.5            | 1.2                  | –              | 5                      |

Note: \*Measuring point = V<sub>trip</sub>. See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-73 • 2.5 V LVC MOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 2.3 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.80       | 6.87     | 0.05      | 2.04     | 2.56      | 0.52       | 6.99     | 5.83     | 2.70     | 2.19     | 9.20      | 8.03      | ns    |
|                | -1          | 0.68       | 5.84     | 0.05      | 1.73     | 2.17      | 0.44       | 5.95     | 4.96     | 2.29     | 1.86     | 7.82      | 6.83      | ns    |
| 8 mA           | Std.        | 0.80       | 5.62     | 0.05      | 2.04     | 2.56      | 0.52       | 5.72     | 4.94     | 3.08     | 2.90     | 7.92      | 7.14      | ns    |
|                | -1          | 0.68       | 4.78     | 0.05      | 1.73     | 2.17      | 0.44       | 4.86     | 4.20     | 2.62     | 2.47     | 6.74      | 6.08      | ns    |
| 12 mA          | Std.        | 0.80       | 4.73     | 0.05      | 2.04     | 2.56      | 0.52       | 4.81     | 4.30     | 3.34     | 3.38     | 7.01      | 6.50      | ns    |
|                | -1          | 0.68       | 4.02     | 0.05      | 1.73     | 2.17      | 0.44       | 4.09     | 3.65     | 2.84     | 2.87     | 5.97      | 5.53      | ns    |
| 16 mA          | Std.        | 0.80       | 4.46     | 0.05      | 2.04     | 2.56      | 0.52       | 4.53     | 4.16     | 3.39     | 3.50     | 6.74      | 6.36      | ns    |
|                | -1          | 0.68       | 3.79     | 0.05      | 1.73     | 2.17      | 0.44       | 3.86     | 3.54     | 2.89     | 2.98     | 5.73      | 5.41      | ns    |
| 24 mA          | Std.        | 0.80       | 4.34     | 0.05      | 2.04     | 2.56      | 0.52       | 4.41     | 4.17     | 3.47     | 3.96     | 6.62      | 6.38      | ns    |
|                | -1          | 0.68       | 3.69     | 0.05      | 1.73     | 2.17      | 0.44       | 3.75     | 3.55     | 2.95     | 3.96     | 5.63      | 5.43      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-74 • 2.5 V LVC MOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 2.3 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.80       | 3.51     | 0.05      | 2.04     | 2.56      | 0.52       | 3.56     | 3.13     | 2.70     | 2.27     | 5.77      | 5.33      | ns    |
|                | -1          | 0.68       | 2.98     | 0.05      | 1.73     | 2.17      | 0.44       | 3.03     | 2.66     | 2.29     | 1.93     | 4.91      | 4.53      | ns    |
| 8 mA           | Std.        | 0.80       | 2.87     | 0.05      | 2.04     | 2.56      | 0.52       | 2.92     | 2.40     | 3.08     | 3.01     | 5.12      | 4.61      | ns    |
|                | -1          | 0.68       | 2.44     | 0.05      | 1.73     | 2.17      | 0.44       | 2.48     | 2.05     | 2.62     | 2.56     | 4.36      | 3.92      | ns    |
| 12 mA          | Std.        | 0.80       | 2.50     | 0.05      | 2.04     | 2.56      | 0.52       | 2.53     | 2.05     | 3.34     | 3.47     | 4.74      | 4.25      | ns    |
|                | -1          | 0.68       | 2.12     | 0.05      | 1.73     | 2.17      | 0.44       | 2.15     | 1.74     | 2.84     | 2.95     | 4.03      | 3.62      | ns    |
| 16 mA          | Std.        | 0.80       | 2.43     | 0.05      | 2.04     | 2.56      | 0.52       | 2.47     | 1.98     | 3.39     | 3.59     | 4.67      | 4.19      | ns    |
|                | -1          | 0.68       | 2.07     | 0.05      | 1.73     | 2.17      | 0.44       | 2.10     | 1.69     | 2.89     | 3.06     | 3.97      | 3.56      | ns    |
| 24 mA          | Std.        | 0.80       | 2.44     | 0.05      | 2.04     | 2.56      | 0.52       | 2.48     | 1.90     | 3.47     | 4.08     | 4.68      | 4.10      | ns    |
|                | -1          | 0.68       | 2.08     | 0.05      | 1.73     | 2.17      | 0.44       | 2.11     | 1.61     | 2.95     | 3.47     | 3.98      | 3.49      | ns    |

#### Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**1.5 V DC Core Voltage**
**Table 2-75 • 2.5 V LVCMOS Low Slew**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 2.3\text{ V}$** 
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.61       | 6.73     | 0.04      | 1.75     | 2.26      | 0.40       | 6.83     | 5.71     | 2.54     | 1.99     | 8.30      | 7.18      | ns    |
|                | -1          | 0.52       | 5.73     | 0.03      | 1.49     | 1.93      | 0.34       | 5.81     | 4.86     | 2.16     | 1.69     | 7.06      | 6.10      | ns    |
| 8 mA           | Std.        | 0.61       | 5.48     | 0.04      | 1.75     | 2.26      | 0.40       | 5.56     | 4.82     | 2.92     | 2.71     | 7.02      | 6.29      | ns    |
|                | -1          | 0.52       | 4.66     | 0.03      | 1.49     | 1.93      | 0.34       | 4.73     | 4.10     | 2.48     | 2.30     | 5.98      | 5.35      | ns    |
| 12 mA          | Std.        | 0.61       | 4.59     | 0.04      | 1.75     | 2.26      | 0.40       | 4.65     | 4.18     | 3.18     | 3.18     | 6.12      | 5.65      | ns    |
|                | -1          | 0.52       | 3.91     | 0.03      | 1.49     | 1.93      | 0.34       | 3.96     | 3.56     | 2.71     | 2.70     | 5.20      | 4.80      | ns    |
| 16 mA          | Std.        | 0.61       | 4.32     | 0.04      | 1.75     | 2.26      | 0.40       | 4.38     | 4.04     | 3.24     | 3.31     | 5.84      | 5.51      | ns    |
|                | -1          | 0.52       | 3.68     | 0.03      | 1.49     | 1.93      | 0.34       | 3.72     | 3.44     | 2.75     | 2.81     | 4.97      | 4.69      | ns    |
| 24 mA          | Std.        | 0.61       | 4.20     | 0.04      | 1.75     | 2.26      | 0.40       | 4.26     | 4.06     | 3.31     | 3.76     | 5.72      | 5.52      | ns    |
|                | -1          | 0.52       | 3.58     | 0.03      | 1.49     | 1.93      | 0.34       | 3.62     | 3.45     | 2.82     | 3.20     | 4.87      | 4.70      | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-76 • 2.5 V LVCMOS High Slew**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 2.3\text{ V}$** 
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.61       | 3.37     | 0.04      | 1.75     | 2.26      | 0.40       | 3.41     | 3.01     | 2.54     | 2.08     | 4.87      | 4.48      | ns    |
|                | -1          | 0.52       | 2.87     | 0.03      | 1.49     | 1.93      | 0.34       | 2.90     | 2.56     | 2.16     | 1.77     | 4.14      | 3.81      | ns    |
| 8 mA           | Std.        | 0.61       | 2.74     | 0.04      | 1.75     | 2.26      | 0.40       | 2.76     | 2.29     | 2.92     | 2.82     | 4.23      | 3.75      | ns    |
|                | -1          | 0.52       | 2.33     | 0.03      | 1.49     | 1.93      | 0.34       | 2.35     | 1.95     | 2.48     | 2.40     | 3.60      | 3.19      | ns    |
| 12 mA          | Std.        | 0.61       | 2.36     | 0.04      | 1.75     | 2.26      | 0.40       | 2.38     | 1.93     | 3.18     | 3.27     | 3.84      | 3.40      | ns    |
|                | -1          | 0.52       | 2.01     | 0.03      | 1.49     | 1.93      | 0.34       | 2.02     | 1.65     | 2.71     | 2.78     | 3.27      | 2.89      | ns    |
| 16 mA          | Std.        | 0.61       | 2.29     | 0.04      | 1.75     | 2.26      | 0.40       | 2.31     | 1.87     | 3.24     | 3.40     | 3.77      | 3.33      | ns    |
|                | -1          | 0.52       | 1.95     | 0.03      | 1.49     | 1.93      | 0.34       | 1.96     | 1.59     | 2.75     | 2.89     | 3.21      | 2.84      | ns    |
| 24 mA          | Std.        | 0.61       | 2.31     | 0.04      | 1.75     | 2.26      | 0.40       | 2.32     | 1.78     | 3.31     | 3.89     | 3.79      | 3.25      | ns    |
|                | -1          | 0.52       | 1.96     | 0.03      | 1.49     | 1.93      | 0.34       | 1.98     | 1.52     | 2.82     | 3.31     | 3.22      | 2.76      | ns    |

**Notes:**

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-77 • 2.5 V LVC MOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.3 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 7.07     | 0.05      | 1.44     | 0.45       | 7.20     | 6.32     | 2.95     | 2.43     | 9.66      | 8.78      | ns    |
|                | -1          | 0.54       | 6.02     | 0.04      | 1.23     | 0.39       | 6.13     | 5.38     | 2.51     | 2.06     | 8.22      | 7.47      | ns    |
| 6 mA           | Std.        | 0.63       | 5.91     | 0.05      | 1.44     | 0.45       | 6.02     | 5.42     | 3.35     | 3.18     | 8.48      | 7.88      | ns    |
|                | -1          | 0.54       | 5.03     | 0.04      | 1.23     | 0.39       | 5.12     | 4.61     | 2.85     | 2.70     | 7.21      | 6.70      | ns    |
| 8 mA           | Std.        | 0.63       | 5.91     | 0.05      | 1.44     | 0.45       | 6.02     | 5.42     | 3.35     | 3.18     | 8.48      | 7.88      | ns    |
|                | -1          | 0.54       | 5.03     | 0.04      | 1.23     | 0.39       | 5.12     | 4.61     | 2.85     | 2.70     | 7.21      | 6.70      | ns    |
| 12 mA          | Std.        | 0.63       | 5.05     | 0.05      | 1.44     | 0.45       | 5.15     | 4.79     | 3.63     | 3.66     | 7.61      | 7.25      | ns    |
|                | -1          | 0.54       | 4.30     | 0.04      | 1.23     | 0.39       | 4.38     | 4.07     | 3.09     | 3.11     | 6.47      | 6.17      | ns    |
| 16 mA          | Std.        | 0.63       | 4.78     | 0.05      | 1.44     | 0.45       | 4.86     | 4.65     | 3.70     | 3.78     | 7.32      | 7.10      | ns    |
|                | -1          | 0.54       | 4.06     | 0.04      | 1.23     | 0.39       | 4.14     | 3.95     | 3.14     | 3.22     | 6.23      | 6.04      | ns    |
| 24 mA          | Std.        | 0.63       | 4.71     | 0.05      | 1.44     | 0.45       | 4.73     | 4.71     | 3.78     | 4.26     | 7.19      | 7.17      | ns    |
|                | -1          | 0.54       | 4.01     | 0.04      | 1.23     | 0.39       | 4.03     | 4.01     | 3.21     | 3.62     | 6.12      | 6.10      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-78 • 2.5 V LVC MOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.3 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 3.63     | 0.05      | 1.44     | 0.45       | 3.70     | 3.34     | 2.94     | 2.53     | 6.16      | 5.80      | ns    |
|                | -1          | 0.54       | 3.09     | 0.04      | 1.23     | 0.39       | 3.15     | 2.84     | 2.51     | 2.16     | 5.24      | 4.94      | ns    |
| 6 mA           | Std.        | 0.63       | 2.99     | 0.05      | 1.44     | 0.45       | 3.04     | 2.59     | 3.35     | 3.30     | 5.50      | 5.05      | ns    |
|                | -1          | 0.54       | 2.54     | 0.04      | 1.23     | 0.39       | 2.59     | 2.20     | 2.85     | 2.81     | 4.68      | 4.30      | ns    |
| 8 mA           | Std.        | 0.63       | 2.99     | 0.05      | 1.44     | 0.45       | 3.04     | 2.59     | 3.35     | 3.30     | 5.50      | 5.05      | ns    |
|                | -1          | 0.54       | 2.54     | 0.04      | 1.23     | 0.39       | 2.59     | 2.20     | 2.85     | 2.81     | 4.68      | 4.30      | ns    |
| 12 mA          | Std.        | 0.63       | 2.65     | 0.05      | 1.44     | 0.45       | 2.70     | 2.23     | 3.63     | 3.78     | 5.16      | 4.69      | ns    |
|                | -1          | 0.54       | 2.26     | 0.04      | 1.23     | 0.39       | 2.30     | 1.89     | 3.09     | 3.22     | 4.39      | 3.99      | ns    |
| 16 mA          | Std.        | 0.63       | 2.59     | 0.05      | 1.44     | 0.45       | 2.64     | 2.16     | 3.70     | 3.90     | 5.10      | 4.62      | ns    |
|                | -1          | 0.54       | 2.21     | 0.04      | 1.23     | 0.39       | 2.25     | 1.83     | 3.15     | 3.32     | 4.34      | 3.93      | ns    |
| 24 mA          | Std.        | 0.63       | 2.61     | 0.05      | 1.44     | 0.45       | 2.66     | 2.08     | 3.78     | 4.40     | 5.12      | 4.54      | ns    |
|                | -1          | 0.54       | 2.22     | 0.04      | 1.23     | 0.39       | 2.26     | 1.77     | 3.22     | 3.74     | 4.35      | 3.87      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-79 • 2.5 V LVC MOS Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.3 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 6.45     | 0.05      | 1.43     | 0.45       | 6.56     | 5.71     | 2.48     | 2.19     | 9.02      | 8.17      | ns    |
|                | -1          | 0.54       | 5.48     | 0.04      | 1.21     | 0.39       | 5.58     | 4.86     | 2.11     | 1.86     | 7.68      | 6.95      | ns    |
| 6 mA           | Std.        | 0.63       | 5.28     | 0.05      | 1.43     | 0.45       | 5.38     | 4.92     | 2.85     | 2.88     | 7.84      | 7.38      | ns    |
|                | -1          | 0.54       | 4.50     | 0.04      | 1.21     | 0.39       | 4.58     | 4.19     | 2.42     | 2.45     | 6.67      | 6.28      | ns    |
| 8 mA           | Std.        | 0.63       | 5.28     | 0.05      | 1.43     | 0.45       | 5.38     | 4.92     | 2.85     | 2.88     | 7.84      | 7.38      | ns    |
|                | -1          | 0.54       | 4.50     | 0.04      | 1.21     | 0.39       | 4.58     | 4.19     | 2.42     | 2.45     | 6.67      | 6.28      | ns    |
| 12 mA          | Std.        | 0.63       | 4.48     | 0.05      | 1.43     | 0.45       | 4.56     | 4.35     | 3.11     | 3.31     | 7.02      | 6.81      | ns    |
|                | -1          | 0.54       | 3.81     | 0.04      | 1.21     | 0.39       | 3.88     | 3.70     | 2.65     | 2.82     | 5.97      | 5.79      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-80 • 2.5 V LVC MOS High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.3 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 4 mA           | Std.        | 0.63       | 3.18     | 0.05      | 1.43     | 0.45       | 3.23     | 2.92     | 2.48     | 2.28     | 5.69      | 5.38      | ns    |
|                | -1          | 0.54       | 2.70     | 0.04      | 1.21     | 0.39       | 2.75     | 2.48     | 2.11     | 1.94     | 4.84      | 4.58      | ns    |
| 6 mA           | Std.        | 0.63       | 2.57     | 0.05      | 1.43     | 0.45       | 2.62     | 2.24     | 2.84     | 2.98     | 5.08      | 4.70      | ns    |
|                | -1          | 0.54       | 2.19     | 0.04      | 1.21     | 0.39       | 2.23     | 1.90     | 2.42     | 2.54     | 4.32      | 4.00      | ns    |
| 8 mA           | Std.        | 0.63       | 2.57     | 0.05      | 1.43     | 0.45       | 2.62     | 2.24     | 2.84     | 2.98     | 5.08      | 4.70      | ns    |
|                | -1          | 0.54       | 2.19     | 0.04      | 1.21     | 0.39       | 2.23     | 1.90     | 2.42     | 2.54     | 4.32      | 4.00      | ns    |
| 12 mA          | Std.        | 0.63       | 2.28     | 0.05      | 1.43     | 0.45       | 2.32     | 1.90     | 3.11     | 3.42     | 4.78      | 4.36      | ns    |
|                | -1          | 0.54       | 1.94     | 0.04      | 1.21     | 0.39       | 1.97     | 1.62     | 2.64     | 2.91     | 4.07      | 3.71      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## 1.8 V LVCMOS

Low-voltage CMOS for 1.8 V is an extension of the LVCMOS standard (JESD8-5) used for general-purpose 1.8 V applications. It uses a 1.8 V input buffer and a push-pull output buffer.

**Table 2-81 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| 1.8 V<br>LVCMOS | VIL       |             | VIH         |           | VOL       | VOH         | IO <sub>L</sub> | IO <sub>H</sub> | IOS <sub>L</sub>        | IOS <sub>H</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-------------|-------------|-----------|-----------|-------------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V | Min.<br>V   | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.45      | VCCI - 0.45 | 2               | 2               | 9                       | 11                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.45      | VCCI - 0.45 | 4               | 4               | 17                      | 22                      | 15                           | 15                           |
| 6 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.45      | VCCI - 0.45 | 6               | 6               | 35                      | 44                      | 15                           | 15                           |
| 8 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.45      | VCCI - 0.45 | 8               | 8               | 45                      | 51                      | 15                           | 15                           |
| 12 mA           | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.45      | VCCI - 0.45 | 12              | 12              | 91                      | 74                      | 15                           | 15                           |
| 16 mA           | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.45      | VCCI - 0.45 | 16              | 16              | 91                      | 74                      | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-82 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Advanced I/O Banks

| 1.8 V<br>LVCMOS | VIL       |             | VIH         |           | VOL       | VOH         | IO <sub>L</sub> | IO <sub>H</sub> | IOS <sub>L</sub>        | IOS <sub>H</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-------------|-------------|-----------|-----------|-------------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V | Min.<br>V   | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 2               | 2               | 9                       | 11                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 4               | 4               | 17                      | 22                      | 15                           | 15                           |
| 6 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 6               | 6               | 35                      | 44                      | 15                           | 15                           |
| 8 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 8               | 8               | 45                      | 51                      | 15                           | 15                           |
| 12 mA           | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 12              | 12              | 91                      | 74                      | 15                           | 15                           |
| 16 mA           | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 16              | 16              | 91                      | 74                      | 15                           | 15                           |

**Notes:**

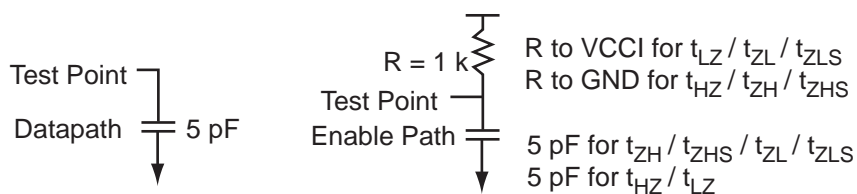
1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-83 • Minimum and Maximum DC Input and Output Levels**  
 Applicable to Standard Plus I/O I/O Banks

| 1.8 V<br>LVCMOS | VIL       |             | VIH         |           | VOL       | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>        | I <sub>OSH</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-------------|-------------|-----------|-----------|-------------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V | Min.<br>V   | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 2               | 2               | 9                       | 11                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 4               | 4               | 17                      | 22                      | 15                           | 15                           |
| 6 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 6               | 6               | 35                      | 44                      | 15                           | 15                           |
| 8 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.9       | 0.45      | VCCI - 0.45 | 8               | 8               | 35                      | 44                      | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.


**Figure 2-11 • AC Loading**
**Table 2-84 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 1.8            | 0.9                  | -              | 5                      |

Note: \*Measuring point = V<sub>trip</sub>. See Table 2-28 on page 2-27 for a complete table of trip points.



## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-85 • 1.8 V LVC MOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.7 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.80       | 9.16     | 0.05      | 2.00     | 2.82      | 0.52       | 9.32     | 7.69     | 2.77     | 1.20     | 11.53     | 9.89      | ns    |
|                | -1          | 0.68       | 7.79     | 0.05      | 1.70     | 2.40      | 0.44       | 7.93     | 6.54     | 2.36     | 1.02     | 9.81      | 8.42      | ns    |
| 4 mA           | Std.        | 0.80       | 7.55     | 0.05      | 2.00     | 2.82      | 0.52       | 7.68     | 6.48     | 3.23     | 2.76     | 9.88      | 8.68      | ns    |
|                | -1          | 0.68       | 6.42     | 0.05      | 1.70     | 2.40      | 0.44       | 6.53     | 5.51     | 2.75     | 2.35     | 8.41      | 7.38      | ns    |
| 6 mA           | Std.        | 0.80       | 6.40     | 0.05      | 2.00     | 2.82      | 0.52       | 6.51     | 5.65     | 3.54     | 3.34     | 8.71      | 7.85      | ns    |
|                | -1          | 0.68       | 5.44     | 0.05      | 1.70     | 2.40      | 0.44       | 5.54     | 4.80     | 3.01     | 2.84     | 7.41      | 6.68      | ns    |
| 8 mA           | Std.        | 0.80       | 6.01     | 0.05      | 2.00     | 2.82      | 0.52       | 6.12     | 5.48     | 3.61     | 3.50     | 8.32      | 7.69      | ns    |
|                | -1          | 0.68       | 5.11     | 0.05      | 1.70     | 2.40      | 0.44       | 5.20     | 4.66     | 3.07     | 2.98     | 7.08      | 6.54      | ns    |
| 12 mA          | Std.        | 0.80       | 5.90     | 0.05      | 2.00     | 2.82      | 0.52       | 6.00     | 5.49     | 3.71     | 4.08     | 8.21      | 7.70      | ns    |
|                | -1          | 0.68       | 5.02     | 0.05      | 1.70     | 2.40      | 0.44       | 5.11     | 4.67     | 3.16     | 3.47     | 6.98      | 6.55      | ns    |
| 16 mA          | Std.        | 0.80       | 5.90     | 0.05      | 2.00     | 2.82      | 0.52       | 6.00     | 5.49     | 3.71     | 4.08     | 8.21      | 7.70      | ns    |
|                | -1          | 0.68       | 5.02     | 0.05      | 1.70     | 2.40      | 0.44       | 5.11     | 4.67     | 3.16     | 3.47     | 6.98      | 6.55      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-86 • 1.8 V LVC MOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.7 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.80       | 4.14     | 0.05      | 2.00     | 2.82      | 0.52       | 4.21     | 4.05     | 2.76     | 1.23     | 6.42      | 6.26      | ns    |
|                | -1          | 0.68       | 3.52     | 0.05      | 1.70     | 2.40      | 0.44       | 3.58     | 3.45     | 2.35     | 1.04     | 5.46      | 5.32      | ns    |
| 4 mA           | Std.        | 0.80       | 3.36     | 0.05      | 2.00     | 2.82      | 0.52       | 3.41     | 3.01     | 3.22     | 2.85     | 5.62      | 5.21      | ns    |
|                | -1          | 0.68       | 2.86     | 0.05      | 1.70     | 2.40      | 0.44       | 2.90     | 2.56     | 2.74     | 2.42     | 4.78      | 4.43      | ns    |
| 6 mA           | Std.        | 0.80       | 2.88     | 0.05      | 2.00     | 2.82      | 0.52       | 2.93     | 2.49     | 3.54     | 3.43     | 5.13      | 4.70      | ns    |
|                | -1          | 0.68       | 2.45     | 0.05      | 1.70     | 2.40      | 0.44       | 2.49     | 2.12     | 3.01     | 2.92     | 4.36      | 3.99      | ns    |
| 8 mA           | Std.        | 0.80       | 2.79     | 0.05      | 2.00     | 2.82      | 0.52       | 2.83     | 2.40     | 3.60     | 3.59     | 5.04      | 4.60      | ns    |
|                | -1          | 0.68       | 2.37     | 0.05      | 1.70     | 2.40      | 0.44       | 2.41     | 2.04     | 3.06     | 3.05     | 4.29      | 3.91      | ns    |
| 12 mA          | Std.        | 0.80       | 2.78     | 0.05      | 2.00     | 2.82      | 0.52       | 2.82     | 2.28     | 3.71     | 4.21     | 5.02      | 4.48      | ns    |
|                | -1          | 0.68       | 2.36     | 0.05      | 1.70     | 2.40      | 0.44       | 2.40     | 1.94     | 3.16     | 3.58     | 4.27      | 3.81      | ns    |
| 16 mA          | Std.        | 0.80       | 2.78     | 0.05      | 2.00     | 2.82      | 0.52       | 2.82     | 2.28     | 3.71     | 4.21     | 5.02      | 4.48      | ns    |
|                | -1          | 0.68       | 2.36     | 0.05      | 1.70     | 2.40      | 0.44       | 2.40     | 1.94     | 3.16     | 3.58     | 4.27      | 3.81      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**1.5 V DC Core Voltage**
**Table 2-87 • 1.8 V LVCMOS Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 1.7\text{ V}$   
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.61       | 9.02     | 0.04      | 1.69     | 2.52      | 0.40       | 9.17     | 7.57     | 2.61     | 1.01     | 10.63     | 9.04      | ns    |
|                | -1          | 0.52       | 7.68     | 0.03      | 1.44     | 2.14      | 0.34       | 7.80     | 6.44     | 2.22     | 0.86     | 9.04      | 7.69      | ns    |
| 4 mA           | Std.        | 0.61       | 7.41     | 0.04      | 1.69     | 2.52      | 0.40       | 7.52     | 6.36     | 3.07     | 2.56     | 8.99      | 7.83      | ns    |
|                | -1          | 0.52       | 6.30     | 0.03      | 1.44     | 2.14      | 0.34       | 6.40     | 5.41     | 2.62     | 2.18     | 7.64      | 6.66      | ns    |
| 6 mA           | Std.        | 0.61       | 6.26     | 0.04      | 1.69     | 2.52      | 0.40       | 6.35     | 5.53     | 3.38     | 3.14     | 7.82      | 7.00      | ns    |
|                | -1          | 0.52       | 5.33     | 0.03      | 1.44     | 2.14      | 0.34       | 5.40     | 4.71     | 2.88     | 2.67     | 6.65      | 5.95      | ns    |
| 8 mA           | Std.        | 0.61       | 5.88     | 0.04      | 1.69     | 2.52      | 0.40       | 5.96     | 5.37     | 3.45     | 3.30     | 7.42      | 6.83      | ns    |
|                | -1          | 0.52       | 5.00     | 0.03      | 1.44     | 2.14      | 0.34       | 5.07     | 4.57     | 2.94     | 2.81     | 6.32      | 5.81      | ns    |
| 12 mA          | Std.        | 0.61       | 5.76     | 0.04      | 1.69     | 2.52      | 0.40       | 5.85     | 5.38     | 3.55     | 3.88     | 7.31      | 6.84      | ns    |
|                | -1          | 0.52       | 4.90     | 0.03      | 1.44     | 2.14      | 0.34       | 4.97     | 4.57     | 3.02     | 3.30     | 6.22      | 5.82      | ns    |
| 16 mA          | Std.        | 0.61       | 5.76     | 0.04      | 1.69     | 2.52      | 0.40       | 5.85     | 5.38     | 3.55     | 3.88     | 7.31      | 6.84      | ns    |
|                | -1          | 0.52       | 4.90     | 0.03      | 1.44     | 2.14      | 0.34       | 4.97     | 4.57     | 3.02     | 3.30     | 6.22      | 5.82      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-88 • 1.8 V LVCMOS High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 1.7\text{ V}$   
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.61       | 4.01     | 0.04      | 1.69     | 2.52      | 0.40       | 4.06     | 3.94     | 2.60     | 1.03     | 5.52      | 5.40      | ns    |
|                | -1          | 0.52       | 3.41     | 0.03      | 1.44     | 2.14      | 0.34       | 3.45     | 3.35     | 2.21     | 0.88     | 4.70      | 4.60      | ns    |
| 4 mA           | Std.        | 0.61       | 3.22     | 0.04      | 1.69     | 2.52      | 0.40       | 3.26     | 2.89     | 3.07     | 2.65     | 4.72      | 4.36      | ns    |
|                | -1          | 0.52       | 2.74     | 0.03      | 1.44     | 2.14      | 0.34       | 2.77     | 2.46     | 2.61     | 2.26     | 4.02      | 3.71      | ns    |
| 6 mA           | Std.        | 0.61       | 2.74     | 0.04      | 1.69     | 2.52      | 0.40       | 2.77     | 2.38     | 3.38     | 3.23     | 4.23      | 3.84      | ns    |
|                | -1          | 0.52       | 2.33     | 0.03      | 1.44     | 2.14      | 0.34       | 2.36     | 2.02     | 2.88     | 2.75     | 3.60      | 3.27      | ns    |
| 8 mA           | Std.        | 0.61       | 2.65     | 0.04      | 1.69     | 2.52      | 0.40       | 2.68     | 2.28     | 3.45     | 3.40     | 4.14      | 3.75      | ns    |
|                | -1          | 0.52       | 2.26     | 0.03      | 1.44     | 2.14      | 0.34       | 2.28     | 1.94     | 2.93     | 2.89     | 3.52      | 3.19      | ns    |
| 12 mA          | Std.        | 0.61       | 2.64     | 0.04      | 1.69     | 2.52      | 0.40       | 2.66     | 2.16     | 3.55     | 4.01     | 4.13      | 3.63      | ns    |
|                | -1          | 0.52       | 2.24     | 0.03      | 1.44     | 2.14      | 0.34       | 2.26     | 1.84     | 3.02     | 3.41     | 3.51      | 3.08      | ns    |
| 16 mA          | Std.        | 0.61       | 2.64     | 0.04      | 1.69     | 2.52      | 0.40       | 2.66     | 2.16     | 3.55     | 4.01     | 4.13      | 3.63      | ns    |
|                | -1          | 0.52       | 2.24     | 0.03      | 1.44     | 2.14      | 0.34       | 2.26     | 1.84     | 3.02     | 3.41     | 3.51      | 3.08      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-89 • 1.8 V LVC MOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.7 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 9.50     | 0.05      | 1.44     | 0.45       | 9.68     | 8.31     | 3.06     | 1.76     | 12.14     | 10.77     | ns    |
|                | -1          | 0.54       | 8.08     | 0.04      | 1.23     | 0.39       | 8.23     | 7.07     | 2.60     | 1.50     | 10.32     | 9.16      | ns    |
| 4 mA           | Std.        | 0.63       | 7.80     | 0.05      | 1.44     | 0.45       | 7.95     | 7.06     | 3.55     | 3.01     | 10.41     | 9.52      | ns    |
|                | -1          | 0.54       | 6.64     | 0.04      | 1.23     | 0.39       | 6.76     | 6.00     | 3.02     | 2.56     | 8.85      | 8.10      | ns    |
| 6 mA           | Std.        | 0.63       | 6.70     | 0.05      | 1.44     | 0.45       | 6.82     | 6.25     | 3.89     | 3.60     | 9.28      | 8.70      | ns    |
|                | -1          | 0.54       | 5.70     | 0.04      | 1.23     | 0.39       | 5.80     | 5.31     | 3.31     | 3.06     | 7.90      | 7.40      | ns    |
| 8 mA           | Std.        | 0.63       | 6.31     | 0.05      | 1.44     | 0.45       | 6.43     | 6.07     | 3.97     | 3.75     | 8.89      | 8.53      | ns    |
|                | -1          | 0.54       | 5.37     | 0.04      | 1.23     | 0.39       | 5.47     | 5.17     | 3.37     | 3.19     | 7.56      | 7.26      | ns    |
| 12 mA          | Std.        | 0.63       | 6.18     | 0.05      | 1.44     | 0.45       | 6.30     | 6.15     | 4.08     | 4.34     | 8.76      | 8.61      | ns    |
|                | -1          | 0.54       | 5.26     | 0.04      | 1.23     | 0.39       | 5.36     | 5.23     | 3.47     | 3.70     | 7.45      | 7.32      | ns    |
| 16 mA          | Std.        | 0.63       | 6.18     | 0.05      | 1.44     | 0.45       | 6.30     | 6.15     | 4.08     | 4.34     | 8.76      | 8.61      | ns    |
|                | -1          | 0.54       | 5.26     | 0.04      | 1.23     | 0.39       | 5.36     | 5.23     | 3.47     | 3.70     | 7.45      | 7.32      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-90 • 1.8 V LVC MOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.7 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 4.40     | 0.05      | 1.34     | 0.45       | 4.48     | 4.30     | 3.05     | 1.82     | 6.94      | 6.76      | ns    |
|                | -1          | 0.54       | 3.74     | 0.04      | 1.14     | 0.39       | 3.81     | 3.66     | 2.59     | 1.55     | 5.90      | 5.75      | ns    |
| 4 mA           | Std.        | 0.63       | 3.44     | 0.05      | 1.34     | 0.45       | 3.50     | 3.23     | 3.54     | 3.12     | 5.96      | 5.69      | ns    |
|                | -1          | 0.54       | 2.92     | 0.04      | 1.14     | 0.39       | 2.98     | 2.75     | 3.01     | 2.66     | 5.07      | 4.84      | ns    |
| 6 mA           | Std.        | 0.63       | 3.02     | 0.05      | 1.34     | 0.45       | 3.07     | 2.70     | 3.88     | 3.72     | 5.53      | 5.16      | ns    |
|                | -1          | 0.54       | 2.57     | 0.04      | 1.14     | 0.39       | 2.61     | 2.30     | 3.30     | 3.16     | 4.71      | 4.39      | ns    |
| 8 mA           | Std.        | 0.63       | 2.94     | 0.05      | 1.34     | 0.45       | 2.99     | 2.60     | 3.96     | 3.87     | 5.45      | 5.06      | ns    |
|                | -1          | 0.54       | 2.50     | 0.04      | 1.14     | 0.39       | 2.54     | 2.21     | 3.37     | 3.30     | 4.64      | 4.31      | ns    |
| 12 mA          | Std.        | 0.63       | 2.93     | 0.05      | 1.34     | 0.45       | 2.98     | 2.49     | 4.07     | 4.49     | 5.44      | 4.95      | ns    |
|                | -1          | 0.54       | 2.49     | 0.04      | 1.14     | 0.39       | 2.54     | 2.12     | 3.46     | 3.82     | 4.63      | 4.21      | ns    |
| 16 mA          | Std.        | 0.63       | 2.93     | 0.05      | 1.34     | 0.45       | 2.98     | 2.49     | 4.07     | 4.49     | 5.44      | 4.95      | ns    |
|                | -1          | 0.54       | 2.49     | 0.04      | 1.14     | 0.39       | 2.54     | 2.12     | 3.46     | 3.82     | 4.63      | 4.21      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-91 • 1.8 V LVC MOS Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.7 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 8.81     | 0.05      | 1.43     | 0.45       | 8.98     | 7.51     | 2.48     | 1.61     | 11.44     | 9.97      | ns    |
|                | -1          | 0.54       | 7.50     | 0.04      | 1.21     | 0.39       | 7.64     | 6.39     | 2.11     | 1.37     | 9.73      | 8.48      | ns    |
| 4 mA           | Std.        | 0.63       | 7.10     | 0.05      | 1.43     | 0.45       | 7.23     | 6.43     | 2.92     | 2.75     | 9.69      | 8.89      | ns    |
|                | -1          | 0.54       | 6.04     | 0.04      | 1.21     | 0.39       | 6.15     | 5.47     | 2.48     | 2.34     | 8.24      | 7.56      | ns    |
| 6 mA           | Std.        | 0.63       | 6.06     | 0.05      | 1.43     | 0.45       | 6.17     | 5.68     | 3.23     | 3.29     | 8.63      | 8.14      | ns    |
|                | -1          | 0.54       | 5.16     | 0.04      | 1.21     | 0.39       | 5.25     | 4.84     | 2.75     | 2.80     | 7.34      | 6.93      | ns    |
| 8 mA           | Std.        | 0.63       | 6.06     | 0.05      | 1.43     | 0.45       | 6.17     | 5.68     | 3.23     | 3.29     | 8.63      | 8.14      | ns    |
|                | -1          | 0.54       | 5.16     | 0.04      | 1.21     | 0.39       | 5.25     | 4.84     | 2.75     | 2.80     | 7.34      | 6.93      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-92 • 1.8 V LVC MOS High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.7 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 3.94     | 0.05      | 1.32     | 0.45       | 4.01     | 3.72     | 2.47     | 1.67     | 6.47      | 6.18      | ns    |
|                | -1          | 0.54       | 3.35     | 0.04      | 1.12     | 0.39       | 3.41     | 3.16     | 2.10     | 1.42     | 5.51      | 5.26      | ns    |
| 4 mA           | Std.        | 0.63       | 3.03     | 0.05      | 1.32     | 0.45       | 3.09     | 2.75     | 2.91     | 2.86     | 5.55      | 5.21      | ns    |
|                | -1          | 0.54       | 2.58     | 0.04      | 1.12     | 0.39       | 2.63     | 2.34     | 2.48     | 2.44     | 4.72      | 4.43      | ns    |
| 6 mA           | Std.        | 0.63       | 2.65     | 0.05      | 1.32     | 0.45       | 2.70     | 2.27     | 3.22     | 3.41     | 5.16      | 4.73      | ns    |
|                | -1          | 0.54       | 2.26     | 0.04      | 1.12     | 0.39       | 2.30     | 1.93     | 2.74     | 2.90     | 4.39      | 4.02      | ns    |
| 8 mA           | Std.        | 0.63       | 2.65     | 0.05      | 1.32     | 0.45       | 2.70     | 2.27     | 3.22     | 3.41     | 5.16      | 4.73      | ns    |
|                | -1          | 0.54       | 2.26     | 0.04      | 1.12     | 0.39       | 2.30     | 1.93     | 2.74     | 2.90     | 4.39      | 4.02      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

### 1.5 V LVCMOS (JESD8-11)

Low-Voltage CMOS for 1.5 V is an extension of the LVCMOS standard (JESD8-5) used for general-purpose 1.5 V applications. It uses a 1.5 V input buffer and a push-pull output buffer.

**Table 2-93 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| 1.5 V<br>LVCMOS | VIL       |             | VIH         |           | VOL         | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>        | I <sub>OSH</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-------------|-------------|-----------|-------------|-------------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V   | Min.<br>V   | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.25 * VCCI | 0.75 * VCCI | 2               | 2               | 13                      | 16                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.25 * VCCI | 0.75 * VCCI | 4               | 4               | 25                      | 33                      | 15                           | 15                           |
| 6 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.25 * VCCI | 0.75 * VCCI | 6               | 6               | 32                      | 39                      | 15                           | 15                           |
| 8 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.25 * VCCI | 0.75 * VCCI | 8               | 8               | 66                      | 55                      | 15                           | 15                           |
| 12 mA           | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 3.6       | 0.25 * VCCI | 0.75 * VCCI | 12              | 12              | 66                      | 55                      | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < V<sub>IL</sub>.
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < V<sub>CCI</sub>. Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-94 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only

| 1.5 V<br>LVCMOS | VIL       |             | VIH         |           | V <sub>OL</sub> | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>        | I <sub>OSH</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-------------|-------------|-----------|-----------------|-------------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V       | Min.<br>V   | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI     | 0.75 * VCCI | 2               | 2               | 13                      | 16                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI     | 0.75 * VCCI | 4               | 4               | 25                      | 33                      | 15                           | 15                           |
| 6 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI     | 0.75 * VCCI | 6               | 6               | 32                      | 39                      | 15                           | 15                           |
| 8 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI     | 0.75 * VCCI | 8               | 8               | 66                      | 55                      | 15                           | 15                           |
| 12 mA           | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI     | 0.75 * VCCI | 12              | 12              | 66                      | 55                      | 15                           | 15                           |

**Notes:**

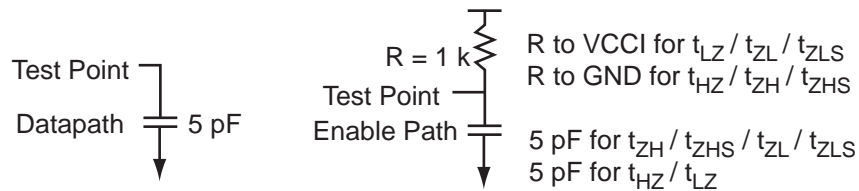
1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < V<sub>IL</sub>.
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < V<sub>CCI</sub>. Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.

**Table 2-95 • Minimum and Maximum DC Input and Output Levels**  
 Applicable to Standard Plus I/O Banks

| 1.5 V<br>LVCMOS | VIL       |             | VIH         |           | VOL         | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>        | I <sub>OSH</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------|-----------|-------------|-------------|-----------|-------------|-------------|-----------------|-----------------|-------------------------|-------------------------|------------------------------|------------------------------|
|                 | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V   | Min.<br>V   | mA              | mA              | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 2 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI | 0.75 * VCCI | 2               | 2               | 13                      | 16                      | 15                           | 15                           |
| 4 mA            | -0.3      | 0.35 * VCCI | 0.65 * VCCI | 1.575     | 0.25 * VCCI | 0.75 * VCCI | 4               | 4               | 25                      | 33                      | 15                           | 15                           |

**Notes:**

1. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Software default selection highlighted in gray.


**Figure 2-12 • AC Loading**
**Table 2-96 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 1.5            | 0.75                 | –              | 5                      |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-97 • 1.5 V LVC MOS Low Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.4 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.80       | 9.53     | 0.05      | 2.19     | 3.06      | 0.52       | 9.69     | 7.88     | 3.38     | 2.67     | 11.90     | 10.09     | ns    |
|                | -1          | 0.68       | 8.10     | 0.05      | 1.86     | 2.61      | 0.44       | 8.25     | 6.71     | 2.87     | 2.27     | 10.12     | 8.58      | ns    |
| 4 mA           | Std.        | 0.80       | 8.14     | 0.05      | 2.19     | 3.06      | 0.52       | 8.28     | 6.89     | 3.74     | 3.34     | 10.49     | 9.09      | ns    |
|                | -1          | 0.68       | 6.93     | 0.05      | 1.86     | 2.61      | 0.44       | 7.05     | 5.86     | 3.18     | 2.84     | 8.92      | 7.74      | ns    |
| 6 mA           | Std.        | 0.80       | 7.64     | 0.05      | 2.19     | 3.06      | 0.52       | 7.78     | 6.70     | 3.82     | 3.52     | 9.98      | 8.91      | ns    |
|                | -1          | 0.68       | 6.50     | 0.05      | 1.86     | 2.61      | 0.44       | 6.61     | 5.70     | 3.25     | 2.99     | 8.49      | 7.58      | ns    |
| 8 mA           | Std.        | 0.80       | 7.55     | 0.05      | 2.19     | 3.06      | 0.52       | 7.68     | 6.71     | 3.41     | 4.19     | 9.88      | 8.91      | ns    |
|                | -1          | 0.68       | 6.42     | 0.05      | 1.86     | 2.61      | 0.44       | 6.53     | 5.71     | 2.90     | 3.56     | 8.41      | 7.58      | ns    |
| 12 mA          | Std.        | 0.80       | 7.55     | 0.05      | 2.19     | 3.06      | 0.52       | 7.68     | 6.71     | 3.41     | 4.19     | 9.88      | 8.91      | ns    |
|                | -1          | 0.68       | 6.42     | 0.05      | 1.86     | 2.61      | 0.44       | 6.53     | 5.71     | 2.90     | 3.56     | 8.41      | 7.58      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-98 • 1.5 V LVC MOS High Slew**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.4 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.80       | 3.91     | 0.05      | 2.19     | 3.06      | 0.52       | 3.98     | 3.54     | 3.37     | 2.78     | 6.18      | 5.75      | ns    |
|                | -1          | 0.68       | 3.33     | 0.05      | 1.86     | 2.61      | 0.44       | 3.38     | 3.01     | 2.86     | 2.36     | 5.26      | 4.89      | ns    |
| 4 mA           | Std.        | 0.80       | 3.34     | 0.05      | 2.19     | 3.06      | 0.52       | 3.39     | 2.90     | 3.73     | 3.45     | 5.60      | 5.11      | ns    |
|                | -1          | 0.68       | 2.84     | 0.05      | 1.86     | 2.61      | 0.44       | 2.88     | 2.47     | 3.17     | 2.93     | 4.76      | 4.35      | ns    |
| 6 mA           | Std.        | 0.80       | 3.23     | 0.05      | 2.19     | 3.06      | 0.52       | 3.28     | 2.78     | 3.81     | 3.64     | 5.48      | 4.99      | ns    |
|                | -1          | 0.68       | 2.74     | 0.05      | 1.86     | 2.61      | 0.44       | 2.79     | 2.37     | 3.24     | 3.09     | 4.66      | 4.24      | ns    |
| 8 mA           | Std.        | 0.80       | 3.19     | 0.05      | 2.19     | 3.06      | 0.52       | 3.24     | 2.63     | 3.93     | 4.33     | 5.45      | 4.84      | ns    |
|                | -1          | 0.68       | 2.71     | 0.05      | 1.86     | 2.61      | 0.44       | 2.76     | 2.24     | 3.34     | 3.69     | 4.63      | 4.12      | ns    |
| 12 mA          | Std.        | 0.80       | 3.19     | 0.05      | 2.19     | 3.06      | 0.52       | 3.24     | 2.63     | 3.93     | 4.33     | 5.45      | 4.84      | ns    |
|                | -1          | 0.68       | 2.71     | 0.05      | 1.86     | 2.61      | 0.44       | 2.76     | 2.24     | 3.34     | 3.69     | 4.63      | 4.12      | ns    |

#### Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**1.5 V DC Core Voltage**
**Table 2-99 • 1.5 V LVC MOS Low Slew**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 1.4\text{ V}$** 
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.61       | 9.39     | 0.04      | 1.88     | 2.77      | 0.40       | 9.54     | 7.77     | 3.22     | 2.47     | 11.00     | 9.24      | ns    |
|                | -1          | 0.52       | 7.99     | 0.03      | 1.60     | 2.35      | 0.34       | 8.11     | 6.61     | 2.74     | 2.10     | 9.36      | 7.86      | ns    |
| 4 mA           | Std.        | 0.61       | 8.01     | 0.04      | 1.88     | 2.77      | 0.40       | 8.13     | 6.77     | 3.58     | 3.14     | 9.59      | 8.24      | ns    |
|                | -1          | 0.52       | 6.81     | 0.03      | 1.60     | 2.35      | 0.34       | 6.91     | 5.76     | 3.05     | 2.67     | 8.16      | 7.01      | ns    |
| 6 mA           | Std.        | 0.61       | 7.51     | 0.04      | 1.88     | 2.77      | 0.40       | 7.62     | 6.59     | 3.66     | 3.32     | 9.09      | 8.05      | ns    |
|                | -1          | 0.52       | 6.39     | 0.03      | 1.60     | 2.35      | 0.34       | 6.48     | 5.60     | 3.12     | 2.83     | 7.73      | 6.85      | ns    |
| 8 mA           | Std.        | 0.61       | 7.41     | 0.04      | 1.88     | 2.77      | 0.40       | 7.52     | 6.59     | 3.41     | 3.99     | 8.99      | 8.06      | ns    |
|                | -1          | 0.52       | 6.30     | 0.03      | 1.60     | 2.35      | 0.34       | 6.40     | 5.61     | 2.90     | 3.40     | 7.64      | 6.85      | ns    |
| 12 mA          | Std.        | 0.61       | 7.41     | 0.04      | 1.88     | 2.77      | 0.40       | 7.52     | 6.59     | 3.41     | 3.99     | 8.99      | 8.06      | ns    |
|                | -1          | 0.52       | 6.30     | 0.03      | 1.60     | 2.35      | 0.34       | 6.40     | 5.61     | 2.90     | 3.40     | 7.64      | 6.85      | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-100 • 1.5 V LVC MOS High Slew**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ , Worst-Case  $V_{CCI} = 1.4\text{ V}$** 
**Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$          | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|-------------------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.61       | 3.78     | 0.04      | 1.88     | 2.77      | 0.40       | 3.82     | 3.43     | 3.21 <sup>1</sup> | 2.58     | 5.29      | 4.89      | ns    |
|                | -1          | 0.52       | 3.21     | 0.03      | 1.60     | 2.35      | 0.34       | 3.25     | 2.92     | 2.73              | 2.20     | 4.50      | 4.16      | ns    |
| 4 mA           | Std.        | 0.61       | 3.20     | 0.04      | 1.88     | 2.77      | 0.40       | 3.23     | 2.79     | 3.57              | 3.25     | 4.70      | 4.25      | ns    |
|                | -1          | 0.52       | 2.72     | 0.03      | 1.60     | 2.35      | 0.34       | 2.75     | 2.37     | 3.04              | 2.77     | 4.00      | 3.62      | ns    |
| 6 mA           | Std.        | 0.61       | 3.09     | 0.04      | 1.88     | 2.77      | 0.40       | 3.12     | 2.67     | 3.65              | 3.44     | 4.59      | 4.13      | ns    |
|                | -1          | 0.52       | 2.63     | 0.03      | 1.60     | 2.35      | 0.34       | 2.65     | 2.27     | 3.11              | 2.93     | 3.90      | 3.52      | ns    |
| 8 mA           | Std.        | 0.61       | 3.05     | 0.04      | 1.88     | 2.77      | 0.40       | 3.09     | 2.52     | 3.77              | 4.14     | 4.55      | 3.98      | ns    |
|                | -1          | 0.52       | 2.60     | 0.03      | 1.60     | 2.35      | 0.34       | 2.62     | 2.14     | 3.21              | 3.52     | 3.87      | 3.39      | ns    |
| 12 mA          | Std.        | 0.61       | 3.05     | 0.04      | 1.88     | 2.77      | 0.40       | 3.09     | 2.52     | 3.77              | 4.14     | 4.55      | 3.98      | ns    |
|                | -1          | 0.52       | 2.60     | 0.03      | 1.60     | 2.35      | 0.34       | 2.62     | 2.14     | 3.21              | 3.52     | 3.87      | 3.39      | ns    |

**Notes:**

- Software default selection highlighted in gray.
- For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.



**Table 2-101 • 1.5 V LVC MOS Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.4 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 9.78     | 0.05      | 1.44     | 0.45       | 9.96     | 8.57     | 3.74     | 2.91     | 12.42     | 11.03     | ns    |
|                | -1          | 0.54       | 8.32     | 0.04      | 1.23     | 0.39       | 8.47     | 7.29     | 3.18     | 2.47     | 10.56     | 9.38      | ns    |
| 4 mA           | Std.        | 0.63       | 8.44     | 0.05      | 1.44     | 0.45       | 8.60     | 7.59     | 4.12     | 3.60     | 11.06     | 10.05     | ns    |
|                | -1          | 0.54       | 7.18     | 0.04      | 1.23     | 0.39       | 7.32     | 6.46     | 3.51     | 3.06     | 9.41      | 8.55      | ns    |
| 6 mA           | Std.        | 0.63       | 7.95     | 0.05      | 1.44     | 0.45       | 8.10     | 7.39     | 4.21     | 3.78     | 10.56     | 9.85      | ns    |
|                | -1          | 0.54       | 6.77     | 0.04      | 1.23     | 0.39       | 6.89     | 6.29     | 3.58     | 3.21     | 8.98      | 8.38      | ns    |
| 8 mA           | Std.        | 0.63       | 7.84     | 0.05      | 1.44     | 0.45       | 7.98     | 7.47     | 4.35     | 4.45     | 10.44     | 9.92      | ns    |
|                | -1          | 0.54       | 6.67     | 0.04      | 1.23     | 0.39       | 6.79     | 6.35     | 3.70     | 3.79     | 8.88      | 8.44      | ns    |
| 12 mA          | Std.        | 0.63       | 7.84     | 0.05      | 1.44     | 0.45       | 7.98     | 7.47     | 4.35     | 4.45     | 10.44     | 9.92      | ns    |
|                | -1          | 0.54       | 6.67     | 0.04      | 1.23     | 0.39       | 6.79     | 6.35     | 3.70     | 3.79     | 8.88      | 8.44      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-102 • 1.5 V LVC MOS High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.4 V  
 Applicable to Advanced I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 3.98     | 0.05      | 1.58     | 0.45       | 4.06     | 3.80     | 3.73     | 3.04     | 6.52      | 6.26      | ns    |
|                | -1          | 0.54       | 3.39     | 0.04      | 1.35     | 0.39       | 3.45     | 3.23     | 3.17     | 2.59     | 5.54      | 5.32      | ns    |
| 4 mA           | Std.        | 0.63       | 3.47     | 0.05      | 1.58     | 0.45       | 3.53     | 3.15     | 4.11     | 3.74     | 5.99      | 5.61      | ns    |
|                | -1          | 0.54       | 2.95     | 0.04      | 1.35     | 0.39       | 3.01     | 2.68     | 3.50     | 3.18     | 5.10      | 4.77      | ns    |
| 6 mA           | Std.        | 0.63       | 3.37     | 0.05      | 1.58     | 0.45       | 3.43     | 3.02     | 4.20     | 3.92     | 5.89      | 5.48      | ns    |
|                | -1          | 0.54       | 2.87     | 0.04      | 1.35     | 0.39       | 2.92     | 2.57     | 3.57     | 3.33     | 5.01      | 4.66      | ns    |
| 8 mA           | Std.        | 0.63       | 3.35     | 0.05      | 1.58     | 0.45       | 3.41     | 2.88     | 4.34     | 4.62     | 5.87      | 5.34      | ns    |
|                | -1          | 0.54       | 2.85     | 0.04      | 1.35     | 0.39       | 2.90     | 2.45     | 3.69     | 3.93     | 4.99      | 4.55      | ns    |
| 12 mA          | Std.        | 0.63       | 3.35     | 0.05      | 1.58     | 0.45       | 3.41     | 2.88     | 4.34     | 4.62     | 5.87      | 5.34      | ns    |
|                | -1          | 0.54       | 2.85     | 0.04      | 1.35     | 0.39       | 2.90     | 2.45     | 3.69     | 3.93     | 4.99      | 4.55      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-103 • 1.5 V LVC MOS Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.4 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 8.94     | 0.05      | 1.43     | 0.45       | 9.11     | 7.80     | 2.99     | 2.67     | 11.57     | 10.26     | ns    |
|                | -1          | 0.54       | 7.61     | 0.04      | 1.21     | 0.39       | 7.75     | 6.64     | 2.54     | 2.27     | 9.84      | 8.73      | ns    |
| 4 mA           | Std.        | 0.63       | 7.68     | 0.05      | 1.43     | 0.45       | 7.83     | 6.91     | 3.34     | 3.30     | 10.29     | 9.37      | ns    |
|                | -1          | 0.54       | 6.54     | 0.04      | 1.21     | 0.39       | 6.66     | 5.88     | 2.84     | 2.80     | 8.75      | 7.97      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-104 • 1.5 V LVC MOS High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 1.4 V  
 Applicable to Standard Plus I/O Banks

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.63       | 3.55     | 0.05      | 1.56     | 0.45       | 3.61     | 3.22     | 2.98     | 2.80     | 6.07      | 5.68      | ns    |
|                | -1          | 0.54       | 3.02     | 0.04      | 1.33     | 0.39       | 3.07     | 2.74     | 2.54     | 2.39     | 5.16      | 4.83      | ns    |
| 4 mA           | Std.        | 0.63       | 3.09     | 0.05      | 1.56     | 0.45       | 3.14     | 2.62     | 3.34     | 3.44     | 5.60      | 5.08      | ns    |
|                | -1          | 0.54       | 2.62     | 0.04      | 1.33     | 0.39       | 2.67     | 2.23     | 2.84     | 2.93     | 4.77      | 4.32      | ns    |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## 1.2 V LVCMOS (JESD8-12A)

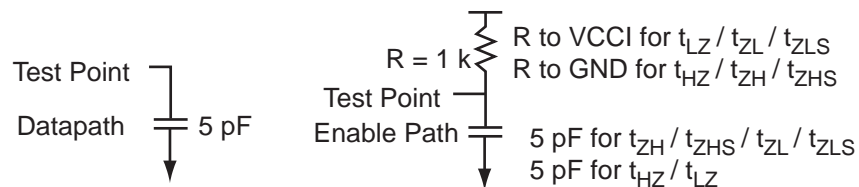
Low-Voltage CMOS for 1.2 V complies with the LVCMOS standard JESD8-12A for general purpose 1.2 V applications. It uses a 1.2 V input buffer and a push-pull output buffer.

**Table 2-105 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| 1.2 V LVCMOS <sup>1</sup> | VIL    |             | VIH         |        | VOL         | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSH</sub>     | I <sub>OSL</sub>     | I <sub>IL</sub> <sup>2</sup> | I <sub>IH</sub> <sup>3</sup> |
|---------------------------|--------|-------------|-------------|--------|-------------|-------------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|                           | Min. V | Max. V      | Min. V      | Max. V | Max. V      | Min. V      | mA              | mA              | Max. <sup>4</sup> mA | Max. <sup>4</sup> mA | μA <sup>5</sup>              | μA <sup>5</sup>              |
| 2 mA                      | -0.3   | 0.35 * VCCI | 0.65 * VCCI | 3.6    | 0.25 * VCCI | 0.75 * VCCI | 2               | 2               | TBD                  | TBD                  | 15                           | 15                           |

**Notes:**

1. Applicable to A3PE600L and A3PE3000L devices only.
2. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
3. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
4. Currents are measured at 100°C junction temperature and maximum voltage.
5. Currents are measured at 125°C junction temperature.
6. Software default selection highlighted in gray.



**Figure 2-13 • AC Loading**

**Table 2-106 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 1.2            | 0.6                  | –              | 5                      |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

#### 1.2 V DC Core Voltage

**Table 2-107 • 1.2 V LVC MOS Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.4 V  
 Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 2 mA           | Std.        | 0.80       | 12.61    | 0.05      | 2.65     | 3.75      | 0.52       | 12.10    | 9.50     | 5.11     | 4.66     | 14.31     | 11.71     | ns    |
|                | -1          | 0.68       | 10.72    | 0.05      | 2.25     | 3.19      | 0.44       | 10.30    | 8.08     | 4.35     | 3.97     | 12.17     | 9.96      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-108 • 1.2 V LVC MOS High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.4 V  
 Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| Drive Strength | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Unit s |
|----------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|--------|
| 2 mA           | Std.        | 0.80       | 5.16     | 0.05      | 2.65     | 3.75      | 0.52       | 4.98     | 4.39     | 5.10     | 4.81     | 7.19      | 6.60      | ns     |
|                | -1          | 0.68       | 4.39     | 0.05      | 2.25     | 3.19      | 0.44       | 4.24     | 3.74     | 4.34     | 4.09     | 6.11      | 5.61      | ns     |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

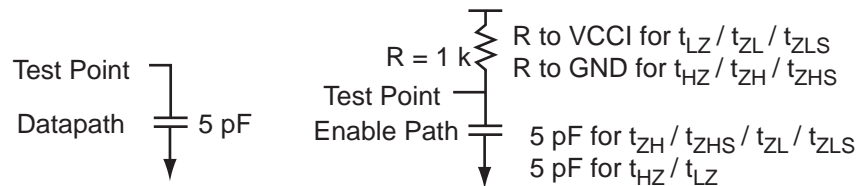
## 1.2 V LVCMOS Wide Range

**Table 2-109 • Minimum and Maximum DC Input and Output Levels**  
Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Operating at 1.2 V Core Voltage

| 1.2 V LVCMOS Wide Range <sup>1</sup> | Equiv. Software Default Drive Strength Option <sup>2</sup> | VIL    |            | VIH        |        | VOL         | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSH</sub>     | I <sub>OSL</sub>     | I <sub>IL</sub> <sup>3</sup> | I <sub>IH</sub> <sup>4</sup> |
|--------------------------------------|--|--------|------------|------------|--------|-------------|-------------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|                                      |  | Min. V | Max. V     | Min. V     | Max. V | Max. V      | Min. V      | μA              | μA              | Max. mA <sup>5</sup> | Max. mA <sup>5</sup> | μA <sup>6</sup>              | μA <sup>6</sup>              |
| 100 μA                               | 2 mA   | -0.3   | 0.3 * VCCI | 0.7 * VCCI | 3.6    | 0.25 * VCCI | 0.75 * VCCI | 100             | 100             | TBD                  | TBD                  | 15                           | 15                           |

**Notes:**

1. Applicable to A3PE600L and A3PE3000L devices only.
2. Note that 1.2 V LVCMOS wide range is applicable to 100 μA drive strength only. The configuration will not operate at the equivalent software default drive strength. These values are for normal ranges only.
3. I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where -0.3 V < V<sub>IN</sub> < VIL.
4. I<sub>IH</sub> is the input leakage current per I/O pin over recommended operating conditions V<sub>IH</sub> < V<sub>IN</sub> < VCCI. Input current is larger when operating outside recommended ranges
5. Currents are measured at 100°C junction temperature and maximum voltage.
6. Currents are measured at 125°C junction temperature.
7. Software default selection highlighted in gray.



**Figure 2-14 • AC Loading**

**Table 2-110 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|----------------|------------------------|
| 0             | 1.2            | 0.6                  | -              | 5                      |

Note: \*Measuring point = V<sub>trip</sub>. See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-111 • 1.2 V LVC MOS Wide Range Low Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.4 V  
 Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| Drive Strength    | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| 100 $\mu\text{A}$ | Std.        | 0.80       | 12.61    | 0.05      | 2.65     | 3.75      | 0.52       | 12.10    | 9.50     | 5.11     | 4.66     | 14.31     | 11.71     | ns    |
|                   | -1          | 0.68       | 10.72    | 0.05      | 2.25     | 3.19      | 0.44       | 10.30    | 8.08     | 4.35     | 3.97     | 12.17     | 9.96      | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-112 • 1.2 V LVC MOS Wide Range High Slew**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 1.4 V  
 Applicable to Pro I/O Banks for A3PE600L and A3PE3000L Only

| Drive Strength    | Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{PYS}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Unit s |
|-------------------|-------------|------------|----------|-----------|----------|-----------|------------|----------|----------|----------|----------|-----------|-----------|--------|
| 100 $\mu\text{A}$ | Std.        | 0.80       | 5.16     | 0.05      | 2.65     | 3.75      | 0.52       | 4.98     | 4.39     | 5.10     | 4.81     | 7.19      | 6.60      | ns     |
|                   | -1          | 0.68       | 4.39     | 0.05      | 2.25     | 3.19      | 0.44       | 4.24     | 3.74     | 4.34     | 4.09     | 6.11      | 5.61      | ns     |

Notes:

1. Software default selection highlighted in gray.
2. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

### 3.3 V PCI, 3.3 V PCI-X

Peripheral Component Interface for 3.3 V standard specifies support for 33 MHz and 66 MHz PCI Bus applications.

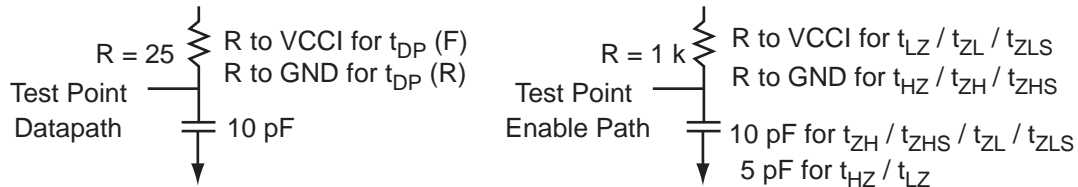
**Table 2-113 • Minimum and Maximum DC Input and Output Levels**

| 3.3 V PCI/PCI-X       | VIL            |        | VIH    |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|-----------------------|----------------|--------|--------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|                       | Min. V         | Max. V | Min. V | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| Per PCI specification | Per PCI curves |        |        |        |        |        |                 |                 |                      |                      | 15                           | 15                           |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.

AC loadings are defined per the PCI/PCI-X specifications for the database; Microsemi loadings for enable path characterization are described in [Figure 2-15](#).



**Figure 2-15 • AC Loading**

AC loadings are defined per PCI/PCI-X specifications for the datapath; Microsemi loading for tristate is described in [Table 2-114](#).

**Table 2-114 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V)   | VREF (Typ) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|--|----------------|------------------------|
| 0             | 3.3            | 0.285 * VCCI for t <sub>DP(R)</sub><br>0.615 * VCCI for t <sub>DP(F)</sub> |                | 10                     |

*Note:* \*Measuring point =  $V_{trip}$ . See [Table 2-28](#) on page 2-27 for a complete table of trip points.

### Timing Characteristics

#### 1.2 V DC Core Voltage

**Table 2-115 • 3.3 V PCI/PCI-X**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 3.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>PYS</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|------------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.78            | 0.05             | 2.71            | 3.68             | 0.52              | 2.83            | 1.97            | 3.26            | 3.59            | 5.03             | 4.18             | ns    |
| -1          | 0.68              | 2.37            | 0.05             | 2.31            | 3.13             | 0.44              | 2.40            | 1.68            | 2.77            | 3.06            | 4.28             | 3.56             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

#### 1.5 V DC Core Voltage

**Table 2-116 • 3.3 V PCI/PCI-X**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>PYS</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|------------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 2.65            | 0.04             | 2.39            | 3.38             | 0.40              | 2.67            | 1.86            | 3.10            | 3.40            | 4.14             | 3.33             | ns    |
| -1          | 0.52              | 2.25            | 0.03             | 2.03            | 2.88             | 0.34              | 2.27            | 1.58            | 2.64            | 2.89            | 3.52             | 2.83             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-117 • 3.3 V PCI/PCI-X**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Advanced I/O Banks

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.63              | 2.95            | 0.05             | 0.95            | 0.45              | 3.00            | 2.15            | 3.53            | 3.94            | 5.46             | 4.61             | ns    |
| -1          | 0.54              | 2.51            | 0.04             | 0.81            | 0.39              | 2.55            | 1.83            | 3.00            | 3.35            | 4.65             | 3.92             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-118 • 3.3 V PCI/PCI-X**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Standard Plus I/O Banks

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.63              | 2.54            | 0.05             | 0.94            | 0.45              | 2.59            | 1.87            | 3.07            | 3.54            | 5.04             | 4.33             | ns    |
| -1          | 0.54              | 2.16            | 0.04             | 0.80            | 0.39              | 2.20            | 1.60            | 2.61            | 3.01            | 4.29             | 3.69             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.



## Voltage-Referenced I/O Characteristics

### 3.3 V GTL

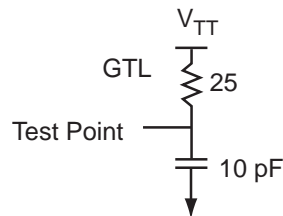
Gunning Transceiver Logic is a high-speed bus standard (JEDEC8-3). It provides a differential amplifier input buffer and an open-drain output buffer. The  $V_{CCI}$  pin should be connected to 3.3 V.

**Table 2-119 • Minimum and Maximum DC Input and Output Levels**

| 3.3 V GTL<br>Drive<br>Strength | VIL       |             | VIH         |           | VOL       | VOH       | IOL | IOH | I <sub>OSL</sub>        | I <sub>OSH</sub>        | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|--------------------------------|-----------|-------------|-------------|-----------|-----------|-----------|-----|-----|-------------------------|-------------------------|------------------------------|------------------------------|
|                                | Min.<br>V | Max.<br>V   | Min.<br>V   | Max.<br>V | Max.<br>V | Min.<br>V | mA  | mA  | Max.<br>mA <sup>3</sup> | Max.<br>mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 20 mA <sup>5</sup>             | -0.3      | VREF - 0.05 | VREF + 0.05 | 3.6       | 0.4       | -         | 20  | 20  | 268                     | 181                     | 15                           | 15                           |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Output drive strength is below JEDEC specification.



**Figure 2-16 • AC Loading**

**Table 2-120 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.05   | VREF + 0.05    | 0.8                  | 0.8             | 1.2            | 10                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-121 • 3.3 V GTL**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 3.0 V, VREF = 0.8 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.05            | 0.05             | 2.34            | 0.52              | 2.01            | 2.05            | -               | -               | 4.22             | 4.26             | ns    |
| -1          | 0.68              | 1.75            | 0.05             | 1.99            | 0.44              | 1.71            | 1.75            | -               | -               | 3.59             | 3.62             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-122 • 3.3 V GTL****Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ ,****Worst-Case  $V_{CCI} = 3.0\text{ V}$ ,  $V_{REF} = 0.8\text{ V}$** **Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| Std.        | 0.61       | 1.97     | 0.04      | 2.11     | 0.40       | 1.86     | 1.97     | –        | –        | 3.32      | 3.43      | ns    |
| –1          | 0.52       | 1.68     | 0.03      | 1.79     | 0.34       | 1.58     | 1.68     | –        | –        | 2.83      | 2.92      | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

## 2.5 V GTL

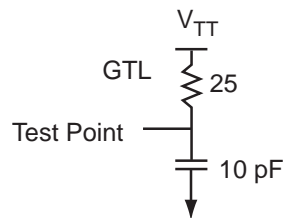
Gunning Transceiver Logic is a high-speed bus standard (JESD8-3). It provides a differential amplifier input buffer and an open-drain output buffer. The  $V_{CCI}$  pin should be connected to 2.5 V.

**Table 2-123 • Minimum and Maximum DC Input and Output Levels**

| 2.5 V GTL          | VIL    |             | VIH         |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|--------------------|--------|-------------|-------------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
| Drive Strength     | Min. V | Max. V      | Min. V      | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 20 mA <sup>5</sup> | -0.3   | VREF - 0.05 | VREF + 0.05 | 3.6    | 0.4    | -      | 20              | 20              | 169                  | 124                  | 15                           | 15                           |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Output drive strength is below JEDEC specification.



**Figure 2-17 • AC Loading**

**Table 2-124 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | V <sub>TT</sub> (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------------------|------------------------|
| VREF - 0.05   | VREF + 0.05    | 0.8                  | 0.8             | 1.2                        | 10                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-125 • 2.5 V GTL**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 3.0 V, VREF = 0.8 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.11            | 0.05             | 2.26            | 0.52              | 2.14            | 2.11            | -               | -               | 4.34             | 4.31             | ns    |
| -1          | 0.68              | 1.79            | 0.05             | 1.93            | 0.44              | 1.82            | 1.79            | -               | -               | 3.70             | 3.68             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-126 • 2.5 V GTL**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V,  
Worst-Case VCCI = 3.0 V, VREF = 0.8 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 2.02            | 0.04             | 2.04            | 0.40              | 1.98            | 2.02            | -               | -               | 3.45             | 3.49             | ns    |
| -1          | 0.52              | 1.72            | 0.03             | 1.73            | 0.34              | 1.69            | 1.72            | -               | -               | 2.93             | 2.97             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

### 3.3 V GTL+

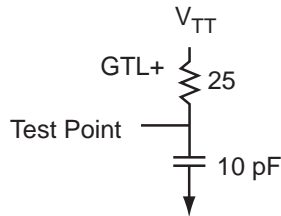
Gunning Transceiver Logic Plus is a high-speed bus standard (JESD8-3). It provides a differential amplifier input buffer and an open-drain output buffer. The VCCI pin should be connected to 3.3 V.

**Table 2-127 • Minimum and Maximum DC Input and Output Levels**

| 3.3 V GTL+     | VIL    |            | VIH        |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|----------------|--------|------------|------------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
| Drive Strength | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 35 mA          | -0.3   | VREF - 0.1 | VREF + 0.1 | 3.6    | 0.6    | -      | 35              | 35              | 268                  | 181                  | 15                           | 15                           |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.



**Figure 2-18 • AC Loading**

**Table 2-128 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.1    | VREF + 0.1     | 1.0                  | 1.0             | 1.5            | 10                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-129 • 3.3 V GTL+**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
 Worst-Case VCCI = 3.0 V, VREF = 1.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.04            | 0.05             | 2.34            | 0.52              | 2.07            | 2.03            | -               | -               | 4.28             | 4.24             | ns    |
| -1          | 0.68              | 1.74            | 0.05             | 1.99            | 0.44              | 1.76            | 1.73            | -               | -               | 3.64             | 3.61             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-130 • 3.3 V GTL+**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V,  
 Worst-Case VCCI = 3.0 V, VREF = 1.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 1.95            | 0.04             | 2.11            | 0.40              | 1.92            | 1.95            | -               | -               | 3.38             | 3.41             | ns    |
| -1          | 0.52              | 1.66            | 0.03             | 1.79            | 0.34              | 1.63            | 1.66            | -               | -               | 2.88             | 2.90             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## 2.5 V GTL+

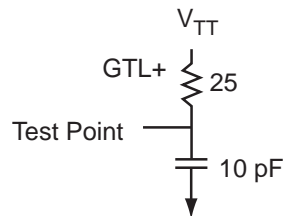
Gunning Transceiver Logic Plus is a high-speed bus standard (JESD8-3). It provides a differential amplifier input buffer and an open-drain output buffer. The  $V_{CCI}$  pin should be connected to 2.5 V.

**Table 2-131 • Minimum and Maximum DC Input and Output Levels**

| 2.5 V GTL+ | VIL    |            | VIH        |        | VOL    | VOH    | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|------------|--------|------------|------------|--------|--------|--------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|            | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 33 mA      | -0.3   | VREF - 0.1 | VREF + 0.1 | 3.6    | 0.6    | -      | 33              | 33              | 169                  | 124                  | 15                           | 15                           |

Notes:

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.



**Figure 2-19 • AC Loading**

**Table 2-132 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.1    | VREF + 0.1     | 1.0                  | 1.0             | 1.5            | 10                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-133 • 2.5 V GTL+**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 2.3 V, VREF = 1.0 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.19            | 0.05             | 2.27            | 0.52              | 2.22            | 2.08            | -               | -               | 4.43             | 4.28             | ns    |
| -1          | 0.68              | 1.86            | 0.05             | 1.93            | 0.44              | 1.89            | 1.77            | -               | -               | 3.77             | 3.64             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-134 • 2.5 V GTL+**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V,  
Worst-Case VCCI = 2.3 V, VREF = 1.0 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 2.05            | 0.04             | 2.04            | 0.40              | 2.07            | 1.99            | -               | -               | 3.53             | 3.46             | ns    |
| -1          | 0.52              | 1.75            | 0.03             | 1.73            | 0.34              | 1.76            | 1.69            | -               | -               | 3.00             | 2.94             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## HSTL Class I

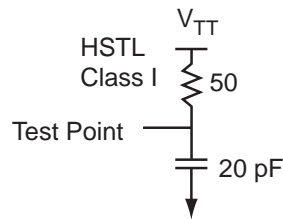
High-Speed Transceiver Logic is a general-purpose high-speed 1.5 V bus standard (EIA/JESD8-6). Military ProASIC3E devices support Class I. This provides a differential amplifier input buffer and a push-pull output buffer.

**Table 2-135 • Minimum and Maximum DC Input and Output Levels**

| HSTL Class I<br>Drive Strength | VIL    |            | VIH        |        | VOL    | VOH        | IOL | IOH | IOSL                 | IOSH                 | IIL <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|--------------------------------|--------|------------|------------|--------|--------|------------|-----|-----|----------------------|----------------------|------------------|------------------------------|
|                                | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V     | mA  | mA  | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>  | μA <sup>4</sup>              |
| 8 mA                           | -0.3   | VREF - 0.1 | VREF + 0.1 | 3.6    | 0.4    | VCCI - 0.4 | 8   | 8   | 32                   | 39                   | 15               | 15                           |

**Notes:**

- $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3 \text{ V} < V_{IN} < V_{IL}$ .
- $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
- Currents are measured at 100°C junction temperature and maximum voltage.
- Currents are measured at 125°C junction temperature.



**Figure 2-20 • AC Loading**

**Table 2-136 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.1    | VREF + 0.1     | 0.75                 | 0.75            | 0.75           | 20                     |

*Note:* \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

**Table 2-137 • HSTL Class I**

**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 1.4 V, VREF = 0.75 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 3.15            | 0.05             | 2.76            | 0.52              | 3.20            | 3.11            | –               | –               | 5.41             | 5.32             | ns    |
| -1          | 0.68              | 2.68            | 0.05             | 2.34            | 0.44              | 2.73            | 2.65            | –               | –               | 4.60             | 4.52             | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-138 • HSTL Class I**

**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V,  
Worst-Case VCCI = 1.4 V, VREF = 0.75 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 3.02            | 0.04             | 2.52            | 0.40              | 3.05            | 3.00            | –               | –               | 4.51             | 4.46             | ns    |
| -1          | 0.52              | 2.57            | 0.03             | 2.14            | 0.34              | 2.59            | 2.55            | –               | –               | 3.84             | 3.79             | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## HSTL Class II

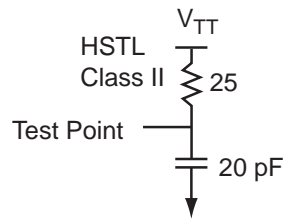
High-Speed Transceiver Logic is a general-purpose high-speed 1.5 V bus standard (EIA/JESD8-6). Military ProASIC3E devices support Class II. This provides a differential amplifier input buffer and a push-pull output buffer.

**Table 2-139 • Minimum and Maximum DC Input and Output Levels**

| HSTL Class II      | VIL    |            | VIH        |        | VOL    | VOH        | IOL | IOH | IOSL                 | IOSH                 | IL <sup>1</sup> | IH <sup>2</sup> |
|--------------------|--------|------------|------------|--------|--------|------------|-----|-----|----------------------|----------------------|-----------------|-----------------|
| Drive Strength     | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V     | mA  | mA  | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup> | μA <sup>4</sup> |
| 15 mA <sup>5</sup> | -0.3   | VREF - 0.1 | VREF + 0.1 | 3.6    | 0.4    | VCCI - 0.4 | 15  | 15  | 66                   | 55                   | 15              | 15              |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3 \text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.
5. Output drive strength is below JEDEC specification.



**Figure 2-21 • AC Loading**

**Table 2-140 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.1    | VREF + 0.1     | 0.75                 | 0.75            | 0.75           | 20                     |

Note: \*Measuring point = Vtrip. See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

**Table 2-141 • HSTL Class II**

**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 1.4 V, VREF = 0.75 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 3.00            | 0.05             | 2.76            | 0.52              | 3.05            | 2.69            | -               | -               | 5.25             | 4.89             | ns    |
| -1          | 0.68              | 2.55            | 0.05             | 2.34            | 0.44              | 2.59            | 2.28            | -               | -               | 4.47             | 4.16             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-142 • HSTL Class II****Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$ ,****Worst-Case  $V_{CCI} = 1.4\text{ V}$ ,  $V_{REF} = 0.75\text{ V}$** **Applicable to Pro I/Os for A3PE600L and A3PE3000L Only**

| Speed Grade | $t_{DOUT}$ | $t_{DP}$ | $t_{DIN}$ | $t_{PY}$ | $t_{EOUT}$ | $t_{ZL}$ | $t_{ZH}$ | $t_{LZ}$ | $t_{HZ}$ | $t_{ZLS}$ | $t_{ZHS}$ | Units |
|-------------|------------|----------|-----------|----------|------------|----------|----------|----------|----------|-----------|-----------|-------|
| Std.        | 0.61       | 2.86     | 0.04      | 2.52     | 0.40       | 2.89     | 2.57     | –        | –        | 4.36      | 4.04      | ns    |
| –1          | 0.52       | 2.44     | 0.03      | 2.14     | 0.34       | 2.46     | 2.19     | –        | –        | 3.71      | 3.43      | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.



## SSTL2 Class I

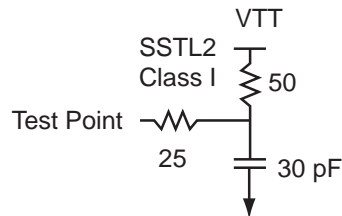
Stub-Speed Terminated Logic for 2.5 V memory bus standard (JESD8-9). Military ProASIC3E devices support Class I. This provides a differential amplifier input buffer and a push-pull output buffer.

**Table 2-143 • Minimum and Maximum DC Input and Output Levels**

| SSTL2 Class I | VIL    |            | VIH        |        | VOL    | VOH         | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|---------------|--------|------------|------------|--------|--------|-------------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|               | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V      | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 15 mA         | -0.3   | VREF - 0.2 | VREF + 0.2 | 3.6    | 0.54   | VCCI - 0.62 | 15              | 15              | 83                   | 87                   | 15                           | 15                           |

Notes:

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.



**Figure 2-22 • AC Loading**

**Table 2-144 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.2    | VREF + 0.2     | 1.25                 | 1.25            | 1.25           | 30                     |

Note: \*Measuring point = Vtrip. See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-145 • SSTL2 Class I**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 2.3 V, VREF = 1.25 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.11            | 0.05             | 2.09            | 0.52              | 2.14            | 1.83            | –               | –               | 2.14             | 1.83             | ns    |
| -1          | 0.68              | 1.80            | 0.05             | 1.78            | 0.44              | 1.82            | 1.55            | –               | –               | 1.82             | 1.55             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-146 • SSTL2 Class I**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , V<sub>CC</sub> = 1.425 V,  
Worst-Case VCCI = 2.3 V, VREF = 1.25 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 1.98            | 0.04             | 1.85            | 0.40              | 1.99            | 1.71            | –               | –               | 1.99             | 1.71             | ns    |
| -1          | 0.52              | 1.68            | 0.03             | 1.58            | 0.34              | 1.69            | 1.46            | –               | –               | 1.69             | 1.46             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## SSTL2 Class II

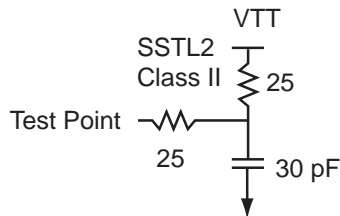
Stub-Speed Terminated Logic for 2.5 V memory bus standard (JESD8-9). Military ProASIC3E devices support Class II. This provides a differential amplifier input buffer and a push-pull output buffer.

**Table 2-147 • Minimum and Maximum DC Input and Output Levels**

| SSTL2 Class II<br>Drive Strength | VIL    |            | VIH        |        | VOL    | VOH         | IOL | IOH | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|----------------------------------|--------|------------|------------|--------|--------|-------------|-----|-----|----------------------|----------------------|------------------------------|------------------------------|
|                                  | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V      | mA  | mA  | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 18 mA                            | -0.3   | VREF - 0.2 | VREF + 0.2 | 3.6    | 0.35   | VCCI - 0.43 | 18  | 18  | 169                  | 124                  | 15                           | 15                           |

**Notes:**

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.



**Figure 2-23 • AC Loading**

**Table 2-148 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.2    | VREF + 0.2     | 1.25                 | 1.25            | 1.25           | 30                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-149 • SSTL2 Class II**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 2.3 V, VREF = 1.25 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.15            | 0.05             | 2.09            | 0.52              | 2.18            | 1.75            | –               | –               | 2.18             | 1.75             | ns    |
| -1          | 0.68              | 1.83            | 0.05             | 1.78            | 0.44              | 1.86            | 1.49            | –               | –               | 1.86             | 1.49             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-150 • SSTL2 Class II**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V,  
Worst-Case VCCI = 2.3 V, VREF = 1.25 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 2.02            | 0.04             | 1.85            | 0.40              | 2.03            | 1.64            | –               | –               | 2.03             | 1.64             | ns    |
| -1          | 0.52              | 1.72            | 0.03             | 1.58            | 0.34              | 1.73            | 1.39            | –               | –               | 1.73             | 1.39             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## SSTL3 Class I

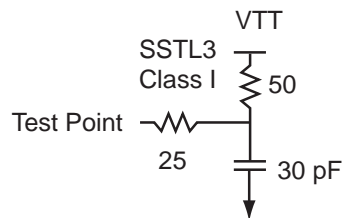
Stub-Speed Terminated Logic for 3.3 V memory bus standard (JESD8-8). Military ProASIC3E devices support Class I. This provides a differential amplifier input buffer and a push-pull output buffer.

**Table 2-151 • Minimum and Maximum DC Input and Output Levels**

| SSTL3 Class I<br>Drive Strength | VIL    |            | VIH        |        | VOL    | VOH        | IO <sub>L</sub> | IO <sub>H</sub> | IOS <sub>L</sub>     | IOS <sub>H</sub>     | I <sub>IL</sub> <sup>1</sup> | I <sub>IH</sub> <sup>2</sup> |
|---------------------------------|--------|------------|------------|--------|--------|------------|-----------------|-----------------|----------------------|----------------------|------------------------------|------------------------------|
|                                 | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V     | mA              | mA              | Max. mA <sup>3</sup> | Max. mA <sup>3</sup> | μA <sup>4</sup>              | μA <sup>4</sup>              |
| 14 mA                           | -0.3   | VREF - 0.2 | VREF + 0.2 | 3.6    | 0.7    | VCCI - 1.1 | 14              | 14              | 51                   | 54                   | 15                           | 15                           |

Notes:

1.  $I_{IL}$  is the input leakage current per I/O pin over recommended operating conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
2.  $I_{IH}$  is the input leakage current per I/O pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
3. Currents are measured at 100°C junction temperature and maximum voltage.
4. Currents are measured at 125°C junction temperature.



**Figure 2-24 • AC Loading**

**Table 2-152 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.2    | VREF + 0.2     | 1.5                  | 1.5             | 1.485          | 30                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-153 • SSTL3 Class I**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 3.0 V, VREF = 1.5 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.29            | 0.05             | 2.00            | 0.52              | 2.32            | 1.82            | –               | –               | 2.32             | 1.82             | ns    |
| -1          | 0.68              | 1.95            | 0.05             | 1.71            | 0.44              | 1.98            | 1.55            | –               | –               | 1.98             | 1.55             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-154 • SSTL3 Class I**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V,  
Worst-Case VCCI = 3.0 V, VREF = 1.5 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 2.15            | 0.04             | 1.77            | 0.40              | 2.17            | 1.70            | –               | –               | 2.17             | 1.70             | ns    |
| -1          | 0.52              | 1.83            | 0.03             | 1.51            | 0.34              | 1.84            | 1.45            | –               | –               | 1.84             | 1.45             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## SSTL3 Class II

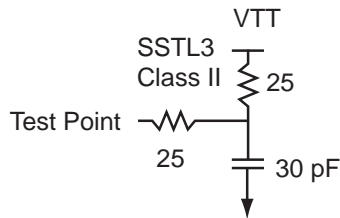
Stub-Speed Terminated Logic for 3.3 V memory bus standard (JESD8-8). Military ProASIC3E devices support Class II. This provides a differential amplifier input buffer and a push-pull output buffer.

**Table 2-155 • Minimum and Maximum DC Input and Output Levels**

| SSTL3 Class II<br>Drive Strength | VIL    |            | VIH        |        | VOL    | VOH        | I <sub>OL</sub> | I <sub>OH</sub> | I <sub>OSL</sub>     | I <sub>OSH</sub>     | I <sub>IL</sub> | I <sub>IH</sub> |
|----------------------------------|--------|------------|------------|--------|--------|------------|-----------------|-----------------|----------------------|----------------------|-----------------|-----------------|
|                                  | Min. V | Max. V     | Min. V     | Max. V | Max. V | Min. V     | mA              | mA              | Max. mA <sup>1</sup> | Max. mA <sup>1</sup> | μA <sup>2</sup> | μA <sup>2</sup> |
| 21 mA                            | -0.3   | VREF - 0.2 | VREF + 0.2 | 3.6    | 0.5    | VCCI - 0.9 | 21              | 21              | 103                  | 109                  | 15              | 15              |

Notes:

1. Currents are measured at 100°C junction temperature and maximum voltage.
2. Currents are measured at 125°C junction temperature.



**Figure 2-25 • AC Loading**

**Table 2-156 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) | VREF (typ.) (V) | VTT (typ.) (V) | C <sub>LOAD</sub> (pF) |
|---------------|----------------|----------------------|-----------------|----------------|------------------------|
| VREF - 0.2    | VREF + 0.2     | 1.5                  | 1.5             | 1.485          | 30                     |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

### Timing Characteristics

**Table 2-157 • SSTL3 Class II**

Military-Case Conditions:  $T_j = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V,  
Worst-Case VCCI = 3.0 V, VREF = 1.5 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.80              | 2.05            | 0.05             | 2.00            | 0.52              | 2.08            | 1.65            | –               | –               | 2.08             | 1.65             | ns    |
| -1          | 0.68              | 1.75            | 0.05             | 1.71            | 0.44              | 1.77            | 1.41            | –               | –               | 1.77             | 1.41             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-158 • SSTL3 Class II**

Military-Case Conditions:  $T_j = 125^\circ\text{C}$ , VCC = 1.425 V,  
Worst-Case VCCI = 3.0 V, VREF = 1.5 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | t <sub>DOUT</sub> | t <sub>DP</sub> | t <sub>DIN</sub> | t <sub>PY</sub> | t <sub>EOUT</sub> | t <sub>ZL</sub> | t <sub>ZH</sub> | t <sub>LZ</sub> | t <sub>HZ</sub> | t <sub>ZLS</sub> | t <sub>ZHS</sub> | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------|
| Std.        | 0.61              | 1.91            | 0.04             | 1.77            | 0.40              | 1.92            | 1.54            | –               | –               | 1.92             | 1.54             | ns    |
| -1          | 0.52              | 1.63            | 0.03             | 1.51            | 0.34              | 1.64            | 1.31            | –               | –               | 1.64             | 1.31             | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

## Differential I/O Characteristics

### Physical Implementation

Configuration of the I/O modules as a differential pair is handled by Designer software when the user instantiates a differential I/O macro in the design.

Differential I/Os can also be used in conjunction with the embedded Input Register (InReg), Output Register (OutReg), Enable Register (EnReg), and Double Data Rate (DDR). However, there is no support for bidirectional I/Os or tristates with the LVPECL standards.

### LVDS

Low-Voltage Differential Signaling (ANSI/TIA/EIA-644) is a high-speed, differential I/O standard. It requires that one data bit be carried through two signal lines, so two pins are needed. It also requires external resistor termination.

The full implementation of the LVDS transmitter and receiver is shown in an example in [Figure 2-26](#). The building blocks of the LVDS transmitter-receiver are one transmitter macro, one receiver macro, three board resistors at the transmitter end, and one resistor at the receiver end. The values for the three driver resistors are different from those used in the LVPECL implementation because the output standard specifications are different.

Along with LVDS I/O, military ProASIC3 also supports Bus LVDS structure and Multipoint LVDS (M-LVDS) configuration (up to 40 nodes).

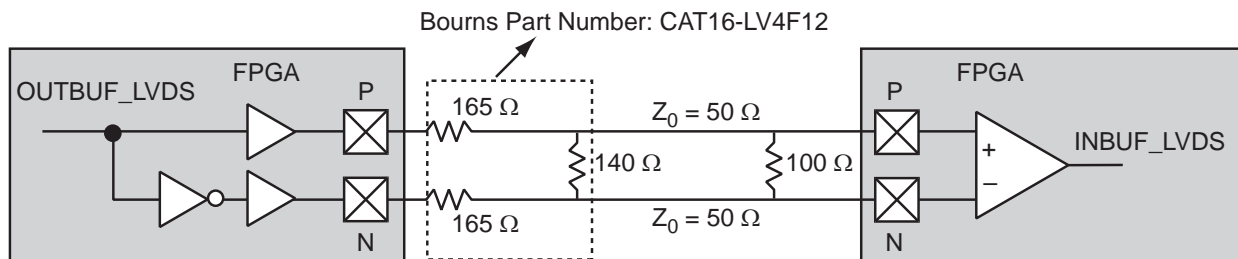


Figure 2-26 • LVDS Circuit Diagram and Board-Level Implementation

**Table 2-159 • Minimum and Maximum DC Input and Output Levels**

| DC Parameter                   | Description                 | Min.  | Typ.  | Max.  | Units |
|--------------------------------|-----------------------------|-------|-------|-------|-------|
| VCCI <sup>1</sup>              | Supply Voltage              | 2.375 | 2.5   | 2.625 | V     |
| VOL                            | Output Low Voltage          | 0.9   | 1.075 | 1.25  | V     |
| VOH                            | Output High Voltage         | 1.25  | 1.425 | 1.6   | V     |
| IOL <sup>2</sup>               | Output Lower Current        | 0.65  | 0.91  | 1.16  | mA    |
| IOH <sup>2</sup>               | Output High Current         | 0.65  | 0.91  | 1.16  | mA    |
| VI                             | Input Voltage               | 0     | –     | 2.925 | V     |
| I <sub>IH</sub> <sup>3,4</sup> | Input High Leakage Current  | –     | –     | 10    | μA    |
| I <sub>IL</sub> <sup>3,5</sup> | Input Low Leakage Current   | –     | –     | 10    | μA    |
| VODIFF                         | Differential Output Voltage | 250   | 350   | 450   | mV    |
| VOCM                           | Output Common Mode Voltage  | 1.125 | 1.25  | 1.375 | V     |
| VICM                           | Input Common Mode Voltage   | 0.05  | 1.25  | 2.35  | V     |
| VIDIFF <sup>6</sup>            | Input Differential Voltage  | 100   | 350   | –     | mV    |

**Notes:**

- ±5%
- IOL/IOH is defined by VODIFF/(Resistor Network).
- Currents are measured at 125°C junction temperature.
- I<sub>IH</sub> is the input leakage current per IO pin over recommended operating conditions  $V_{IH} < V_{IN} < V_{CCI}$ . Input current is larger when operating outside recommended ranges.
- I<sub>IL</sub> is the input leakage current per I/O pin over recommended operation conditions where  $-0.3\text{ V} < V_{IN} < V_{IL}$ .
- Differential input voltage = ±350 mV.

**Table 2-160 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) |
|---------------|----------------|----------------------|
| 1.075         | 1.325          | Cross point          |

Note: \*Measuring point =  $V_{trip}$ . See Table 2-28 on page 2-27 for a complete table of trip points.

## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-161 • LVDS**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 2.3 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | $t_{\text{DOUT}}$ | $t_{\text{DP}}$ | $t_{\text{DIN}}$ | $t_{\text{PY}}$ | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------|
| Std.        | 0.80              | 1.87            | 0.05             | 2.48            | ns    |
| -1          | 0.68              | 1.59            | 0.05             | 2.11            | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

### 1.5 V DC Core Voltage

**Table 2-162 • LVDS**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V, Worst-Case VCCI = 2.3 V  
Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | $t_{\text{DOUT}}$ | $t_{\text{DP}}$ | $t_{\text{DIN}}$ | $t_{\text{PY}}$ | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------|
| Std.        | 0.61              | 1.75            | 0.04             | 2.18            | ns    |
| -1          | 0.52              | 1.48            | 0.03             | 1.86            | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-163 • LVDS**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 2.3 V  
Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only

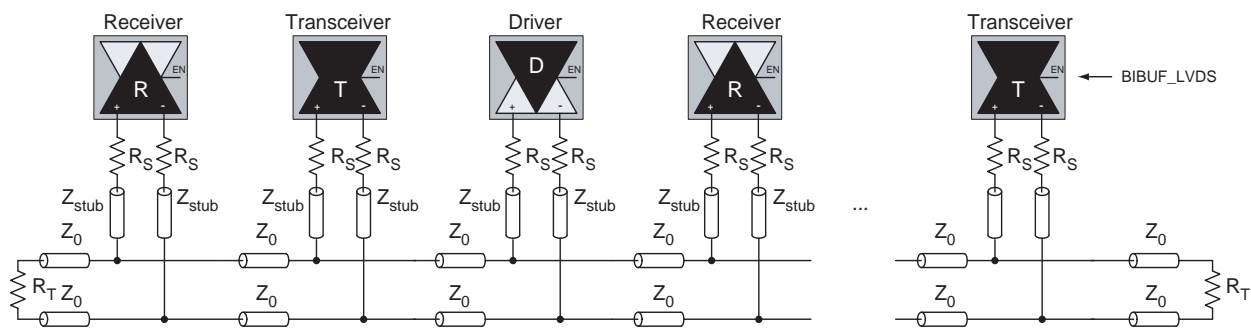
| Speed Grade | $t_{\text{DOUT}}$ | $t_{\text{DP}}$ | $t_{\text{DIN}}$ | $t_{\text{PY}}$ | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------|
| Std.        | 0.63              | 2.07            | 0.05             | 1.82            | ns    |
| -1          | 0.54              | 1.76            | 0.04             | 1.55            | ns    |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

### B-LVDS/M-LVDS

Bus LVDS (B-LVDS) and Multipoint LVDS (M-LVDS) specifications extend the existing LVDS standard to high-performance multipoint bus applications. Multidrop and multipoint bus configurations may contain any combination of drivers, receivers, and transceivers. Microsemi LVDS drivers provide the higher drive current required by B-LVDS and M-LVDS to accommodate the loading. The drivers require series terminations for better signal quality and to control voltage swing. Termination is also required at both ends of the bus since the driver can be located anywhere on the bus. These configurations can be implemented using the TRIBUF\_LVDS and BIBUF\_LVDS macros along with appropriate terminations. Multipoint designs using Microsemi LVDS macros can achieve up to 200 MHz with a maximum of 20 loads. A sample application is given in [Figure 2-27](#). The input and output buffer delays are available in the LVDS section in [Table 2-159](#) on page 2-88.

Example: For a bus consisting of 20 equidistant loads, the following terminations provide the required differential voltage, in worst-case Industrial operating conditions, at the farthest receiver:  $R_S = 60 \Omega$  and  $R_T = 70 \Omega$ , given  $Z_0 = 50 \Omega$  (2") and  $Z_{stub} = 50 \Omega$  (~1.5").



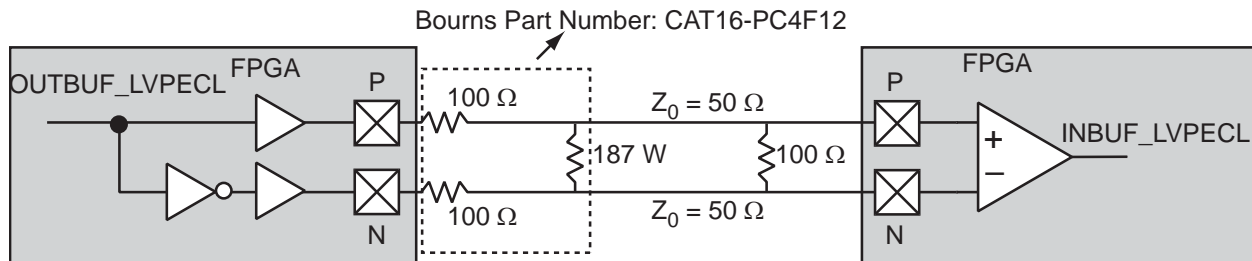
**Figure 2-27 • B-LVDS/M-LVDS Multipoint Application Using LVDS I/O Buffers**



## LVPECL

Low-Voltage Positive Emitter-Coupled Logic (LVPECL) is another differential I/O standard. It requires that one data bit be carried through two signal lines. Like LVDS, two pins are needed. It also requires external resistor termination.

The full implementation of the LVDS transmitter and receiver is shown in an example in [Figure 2-28](#). The building blocks of the LVPECL transmitter-receiver are one transmitter macro, one receiver macro, three board resistors at the transmitter end, and one resistor at the receiver end. The values for the three driver resistors are different from those used in the LVDS implementation because the output standard specifications are different.



**Figure 2-28 • LVPECL Circuit Diagram and Board-Level Implementation**

**Table 2-164 • Minimum and Maximum DC Input and Output Levels**

| DC Parameter       | Description                    | Min.  | Max. | Min.  | Max. | Min.  | Max. | Units |
|--------------------|--------------------------------|-------|------|-------|------|-------|------|-------|
| VCCI               | Supply Voltage                 | 3.0   |      | 3.3   |      | 3.6   |      | V     |
| VOL                | Output Low Voltage             | 0.96  | 1.27 | 1.06  | 1.43 | 1.30  | 1.57 | V     |
| VOH                | Output High Voltage            | 1.8   | 2.11 | 1.92  | 2.28 | 2.13  | 2.41 | V     |
| VIL, VIH           | Input Low, Input High Voltages | 0     | 3.3  | 0     | 3.6  | 0     | 3.9  | V     |
| V <sub>ODIFF</sub> | Differential Output Voltage    | 0.625 | 0.97 | 0.625 | 0.97 | 0.625 | 0.97 | V     |
| V <sub>OCM</sub>   | Output Common-Mode Voltage     | 1.762 | 1.98 | 1.762 | 1.98 | 1.762 | 1.98 | V     |
| V <sub>ICM</sub>   | Input Common-Mode Voltage      | 1.01  | 2.57 | 1.01  | 2.57 | 1.01  | 2.57 | V     |
| V <sub>IDIFF</sub> | Input Differential Voltage     | 300   |      | 300   |      | 300   |      | mV    |

**Table 2-165 • AC Waveforms, Measuring Points, and Capacitive Loads**

| Input Low (V) | Input High (V) | Measuring Point* (V) |
|---------------|----------------|----------------------|
| 1.64          | 1.94           | Cross point          |

*Note:* \*Measuring point =  $V_{trip}$ . See [Table 2-28](#) on page 2-27 for a complete table of trip points.

## Timing Characteristics

### 1.2 V DC Core Voltage

**Table 2-166 • LVPECL**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V, Worst-Case VCCI = 3.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | $t_{\text{DOUT}}$ | $t_{\text{DP}}$ | $t_{\text{DIN}}$ | $t_{\text{PY}}$ | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------|
| Std.        | 0.80              | 1.78            | 0.05             | 2.16            | ns    |
| -1          | 0.68              | 1.51            | 0.05             | 1.84            | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

### 1.5 V DC Core Voltage

**Table 2-167 • LVPECL**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only

| Speed Grade | $t_{\text{DOUT}}$ | $t_{\text{DP}}$ | $t_{\text{DIN}}$ | $t_{\text{PY}}$ | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------|
| Std.        | 0.61              | 1.65            | 0.04             | 1.89            | ns    |
| -1          | 0.52              | 1.40            | 0.03             | 1.61            | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-168 • LVPECL**

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V, Worst-Case VCCI = 3.0 V  
 Applicable to Advanced I/O Banks for A3P250 and A3P1000 Only

| Speed Grade | $t_{\text{DOUT}}$ | $t_{\text{DP}}$ | $t_{\text{DIN}}$ | $t_{\text{PY}}$ | Units |
|-------------|-------------------|-----------------|------------------|-----------------|-------|
| Std.        | 0.63              | 1.98            | 0.05             | 1.54            | ns    |
| -1          | 0.54              | 1.68            | 0.04             | 1.31            | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## I/O Register Specifications

### Fully Registered I/O Buffers with Synchronous Enable and Asynchronous Preset

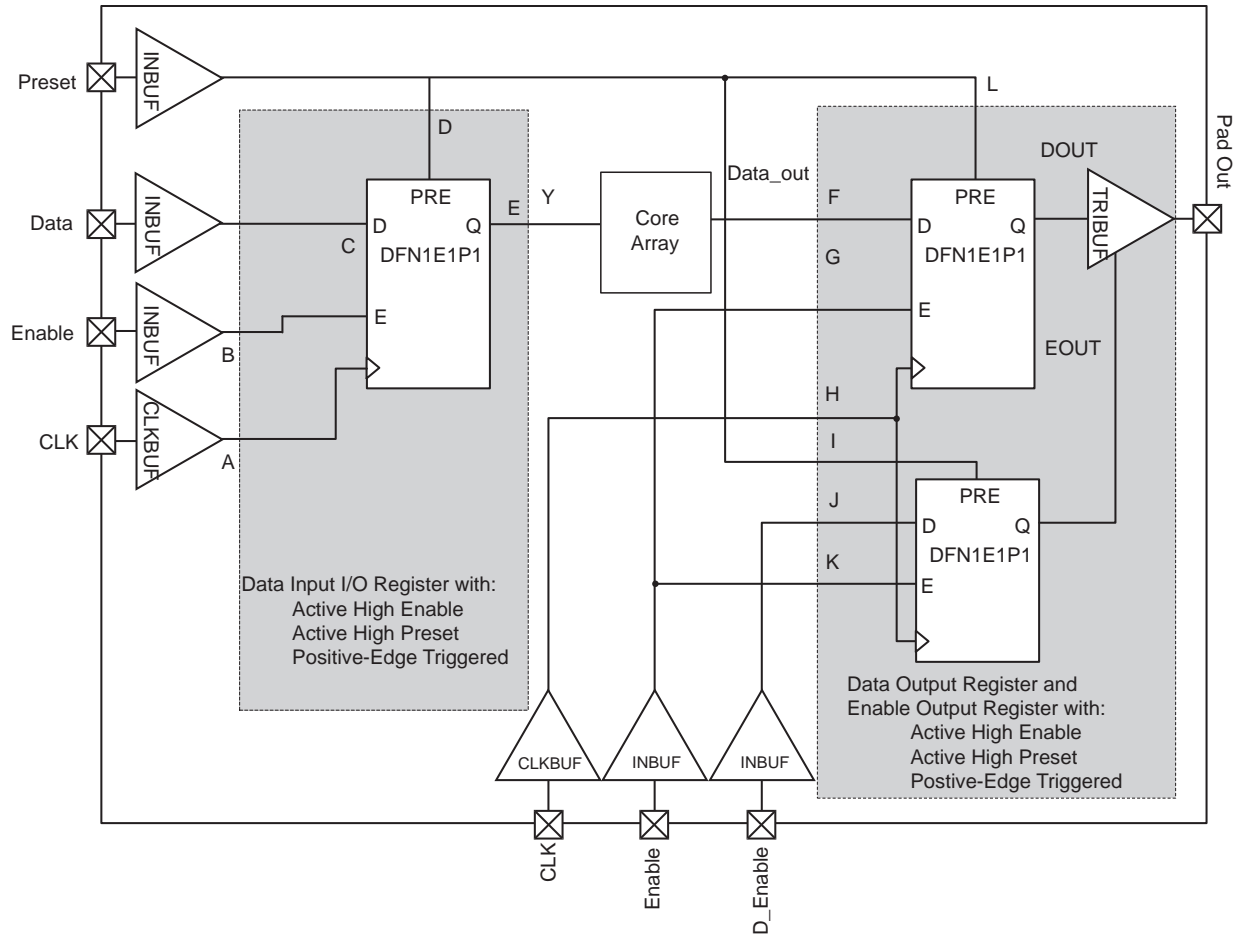


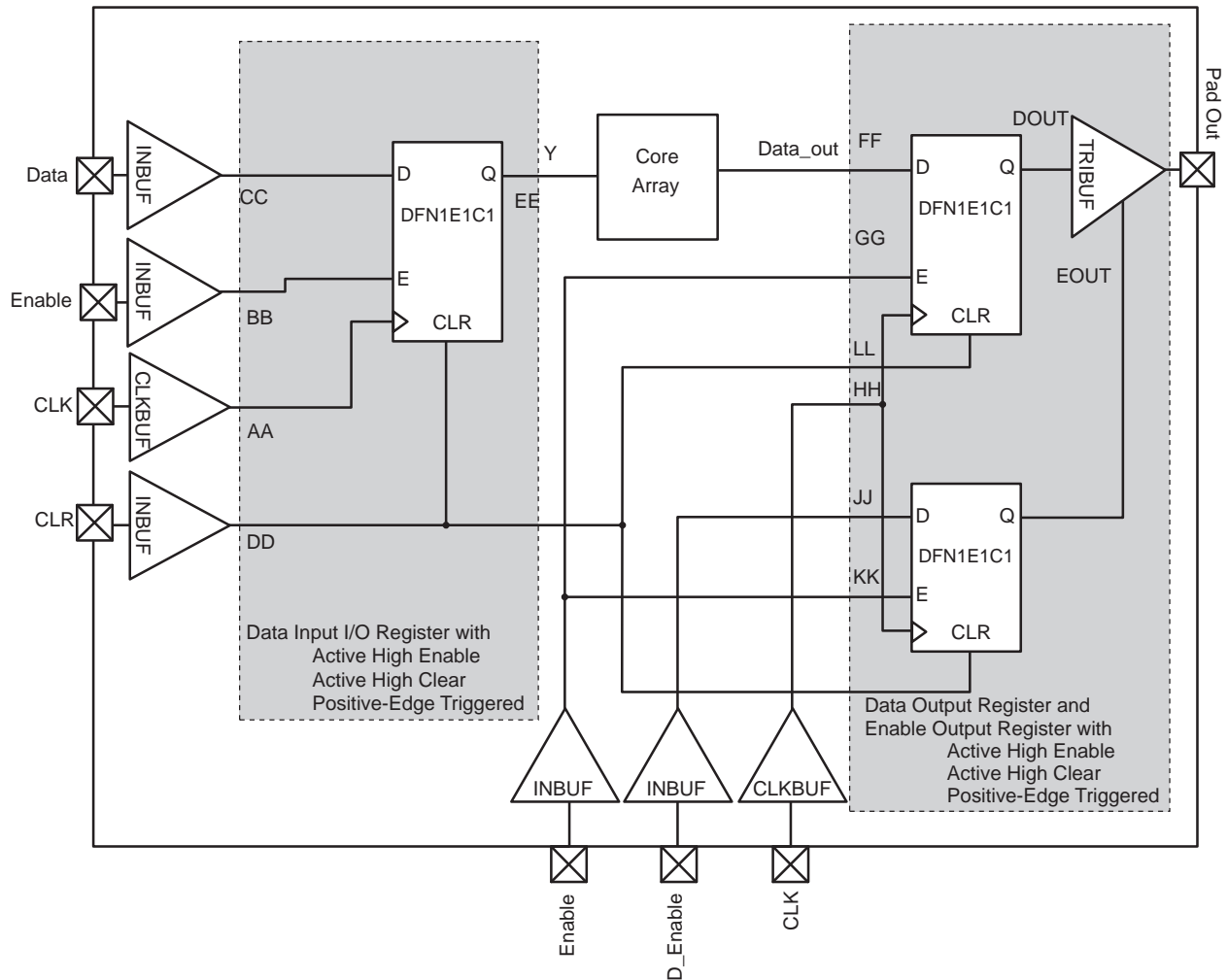
Figure 2-29 • Timing Model of Registered I/O Buffers with Synchronous Enable and Asynchronous Preset

**Table 2-169 • Parameter Definition and Measuring Nodes**

| Parameter Name | Parameter Definition   | Measuring Nodes (from, to)* |
|----------------|--|-----------------------------|
| $t_{OCLKQ}$    | Clock-to-Q of the Output Data Register                           | H, DOUT                     |
| $t_{OSUD}$     | Data Setup Time for the Output Data Register                     | F, H                        |
| $t_{OHD}$      | Data Hold Time for the Output Data Register                      | F, H                        |
| $t_{OSUE}$     | Enable Setup Time for the Output Data Register                   | G, H                        |
| $t_{OHE}$      | Enable Hold Time for the Output Data Register                    | G, H                        |
| $t_{OPRE2Q}$   | Asynchronous Preset-to-Q of the Output Data Register             | L, DOUT                     |
| $t_{OREMPRE}$  | Asynchronous Preset Removal Time for the Output Data Register    | L, H                        |
| $t_{ORECPRE}$  | Asynchronous Preset Recovery Time for the Output Data Register   | L, H                        |
| $t_{OECLKQ}$   | Clock-to-Q of the Output Enable Register                         | H, EOUT                     |
| $t_{OESUD}$    | Data Setup Time for the Output Enable Register                   | J, H                        |
| $t_{OEHD}$     | Data Hold Time for the Output Enable Register                    | J, H                        |
| $t_{OESUE}$    | Enable Setup Time for the Output Enable Register                 | K, H                        |
| $t_{OEHE}$     | Enable Hold Time for the Output Enable Register                  | K, H                        |
| $t_{OEPRE2Q}$  | Asynchronous Preset-to-Q of the Output Enable Register           | I, EOUT                     |
| $t_{OEREMPRE}$ | Asynchronous Preset Removal Time for the Output Enable Register  | I, H                        |
| $t_{OERECPRE}$ | Asynchronous Preset Recovery Time for the Output Enable Register | I, H                        |
| $t_{ICLKQ}$    | Clock-to-Q of the Input Data Register                            | A, E                        |
| $t_{ISUD}$     | Data Setup Time for the Input Data Register                      | C, A                        |
| $t_{IHD}$      | Data Hold Time for the Input Data Register                       | C, A                        |
| $t_{ISUE}$     | Enable Setup Time for the Input Data Register                    | B, A                        |
| $t_{IHE}$      | Enable Hold Time for the Input Data Register                     | B, A                        |
| $t_{IPRE2Q}$   | Asynchronous Preset-to-Q of the Input Data Register              | D, E                        |
| $t_{IREMPRE}$  | Asynchronous Preset Removal Time for the Input Data Register     | D, A                        |
| $t_{IRECPRE}$  | Asynchronous Preset Recovery Time for the Input Data Register    | D, A                        |

\* See [Figure 2-29](#) on [page 2-93](#) for more information.

**Fully Registered I/O Buffers with Synchronous Enable and Asynchronous Clear**



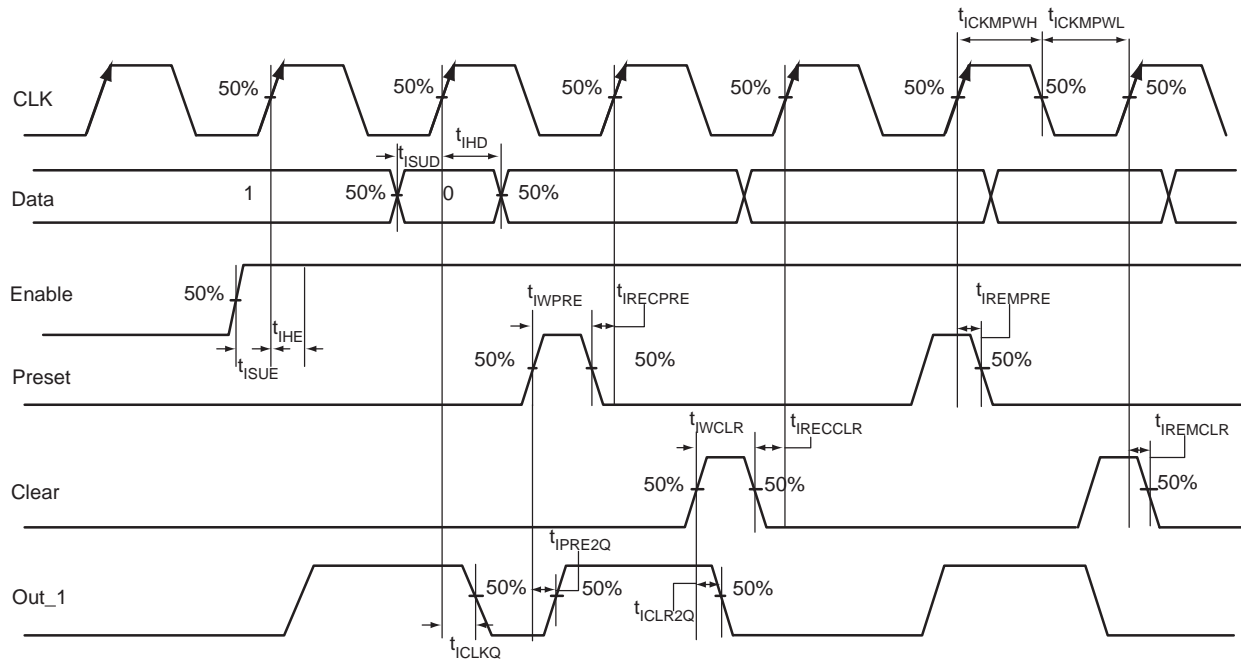
**Figure 2-30 • Timing Model of the Registered I/O Buffers with Synchronous Enable and Asynchronous Clear**

**Table 2-170 • Parameter Definition and Measuring Nodes**

| Parameter Name | Parameter Definition  | Measuring Nodes (from, to)* |
|----------------|---|-----------------------------|
| $t_{OCLKQ}$    | Clock-to-Q of the Output Data Register                          | HH, DOUT                    |
| $t_{OSUD}$     | Data Setup Time for the Output Data Register                    | FF, HH                      |
| $t_{OHD}$      | Data Hold Time for the Output Data Register                     | FF, HH                      |
| $t_{OSUE}$     | Enable Setup Time for the Output Data Register                  | GG, HH                      |
| $t_{OHE}$      | Enable Hold Time for the Output Data Register                   | GG, HH                      |
| $t_{OCLR2Q}$   | Asynchronous Clear-to-Q of the Output Data Register             | LL, DOUT                    |
| $t_{OREMCLR}$  | Asynchronous Clear Removal Time for the Output Data Register    | LL, HH                      |
| $t_{ORECCLR}$  | Asynchronous Clear Recovery Time for the Output Data Register   | LL, HH                      |
| $t_{OECLKQ}$   | Clock-to-Q of the Output Enable Register                        | HH, EOUT                    |
| $t_{OESUD}$    | Data Setup Time for the Output Enable Register                  | JJ, HH                      |
| $t_{OEHD}$     | Data Hold Time for the Output Enable Register                   | JJ, HH                      |
| $t_{OESUE}$    | Enable Setup Time for the Output Enable Register                | KK, HH                      |
| $t_{OEHE}$     | Enable Hold Time for the Output Enable Register                 | KK, HH                      |
| $t_{OECLR2Q}$  | Asynchronous Clear-to-Q of the Output Enable Register           | II, EOUT                    |
| $t_{OEREMCLR}$ | Asynchronous Clear Removal Time for the Output Enable Register  | II, HH                      |
| $t_{OERECCLR}$ | Asynchronous Clear Recovery Time for the Output Enable Register | II, HH                      |
| $t_{ICLKQ}$    | Clock-to-Q of the Input Data Register                           | AA, EE                      |
| $t_{ISUD}$     | Data Setup Time for the Input Data Register                     | CC, AA                      |
| $t_{IHD}$      | Data Hold Time for the Input Data Register                      | CC, AA                      |
| $t_{ISUE}$     | Enable Setup Time for the Input Data Register                   | BB, AA                      |
| $t_{IHE}$      | Enable Hold Time for the Input Data Register                    | BB, AA                      |
| $t_{ICLR2Q}$   | Asynchronous Clear-to-Q of the Input Data Register              | DD, EE                      |
| $t_{IREMCLR}$  | Asynchronous Clear Removal Time for the Input Data Register     | DD, AA                      |
| $t_{IRECCLR}$  | Asynchronous Clear Recovery Time for the Input Data Register    | DD, AA                      |

\* See Figure 2-30 on page 2-95 for more information.

## Input Register



**Figure 2-31 • Input Register Timing Diagram**

### Timing Characteristics

**Table 2-171 • Input Data Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter           | Description   | -1   | Std. | Units |
|---------------------|---|------|------|-------|
| $t_{\text{CLKQ}}$   | Clock-to-Q of the Input Data Register                               | 0.33 | 0.39 | ns    |
| $t_{\text{SUD}}$    | Data Setup Time for the Input Data Register                         | 0.36 | 0.43 | ns    |
| $t_{\text{IHD}}$    | Data Hold Time for the Input Data Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{SUE}}$    | Enable Setup Time for the Input Data Register                       | 0.51 | 0.60 | ns    |
| $t_{\text{IHE}}$    | Enable Hold Time for the Input Data Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{CLR2Q}}$  | Asynchronous Clear-to-Q of the Input Data Register                  | 0.63 | 0.74 | ns    |
| $t_{\text{PRE2Q}}$  | Asynchronous Preset-to-Q of the Input Data Register                 | 0.63 | 0.74 | ns    |
| $t_{\text{REMCLR}}$ | Asynchronous Clear Removal Time for the Input Data Register         | 0.00 | 0.00 | ns    |
| $t_{\text{RECCLR}}$ | Asynchronous Clear Recovery Time for the Input Data Register        | 0.31 | 0.36 | ns    |
| $t_{\text{REMPRE}}$ | Asynchronous Preset Removal Time for the Input Data Register        | 0.00 | 0.00 | ns    |
| $t_{\text{RECPRE}}$ | Asynchronous Preset Recovery Time for the Input Data Register       | 0.31 | 0.36 | ns    |
| $t_{\text{WCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Input Data Register  | 0.19 | 0.22 | ns    |
| $t_{\text{WPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Input Data Register | 0.19 | 0.22 | ns    |
| $t_{\text{CKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Input Data Register          | 0.31 | 0.36 | ns    |
| $t_{\text{CKMPWL}}$ | Clock Minimum Pulse Width LOW for the Input Data Register           | 0.28 | 0.32 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-172 • Input Data Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L

| Parameter           | Description   | -1   | Std. | Units |
|---------------------|---|------|------|-------|
| $t_{\text{CLKQ}}$   | Clock-to-Q of the Input Data Register                               | 0.25 | 0.30 | ns    |
| $t_{\text{SUD}}$    | Data Setup Time for the Input Data Register                         | 0.28 | 0.33 | ns    |
| $t_{\text{IHD}}$    | Data Hold Time for the Input Data Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{SUE}}$    | Enable Setup Time for the Input Data Register                       | 0.39 | 0.46 | ns    |
| $t_{\text{IHE}}$    | Enable Hold Time for the Input Data Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{CLR2Q}}$  | Asynchronous Clear-to-Q of the Input Data Register                  | 0.48 | 0.56 | ns    |
| $t_{\text{PRE2Q}}$  | Asynchronous Preset-to-Q of the Input Data Register                 | 0.48 | 0.56 | ns    |
| $t_{\text{REMCLR}}$ | Asynchronous Clear Removal Time for the Input Data Register         | 0.00 | 0.00 | ns    |
| $t_{\text{RECCLR}}$ | Asynchronous Clear Recovery Time for the Input Data Register        | 0.24 | 0.28 | ns    |
| $t_{\text{REMPRE}}$ | Asynchronous Preset Removal Time for the Input Data Register        | 0.00 | 0.00 | ns    |
| $t_{\text{RECPRE}}$ | Asynchronous Preset Recovery Time for the Input Data Register       | 0.24 | 0.28 | ns    |
| $t_{\text{WCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Input Data Register  | 0.19 | 0.22 | ns    |
| $t_{\text{WPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Input Data Register | 0.19 | 0.22 | ns    |
| $t_{\text{CKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Input Data Register          | 0.31 | 0.36 | ns    |
| $t_{\text{CKMPWL}}$ | Clock Minimum Pulse Width LOW for the Input Data Register           | 0.28 | 0.32 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

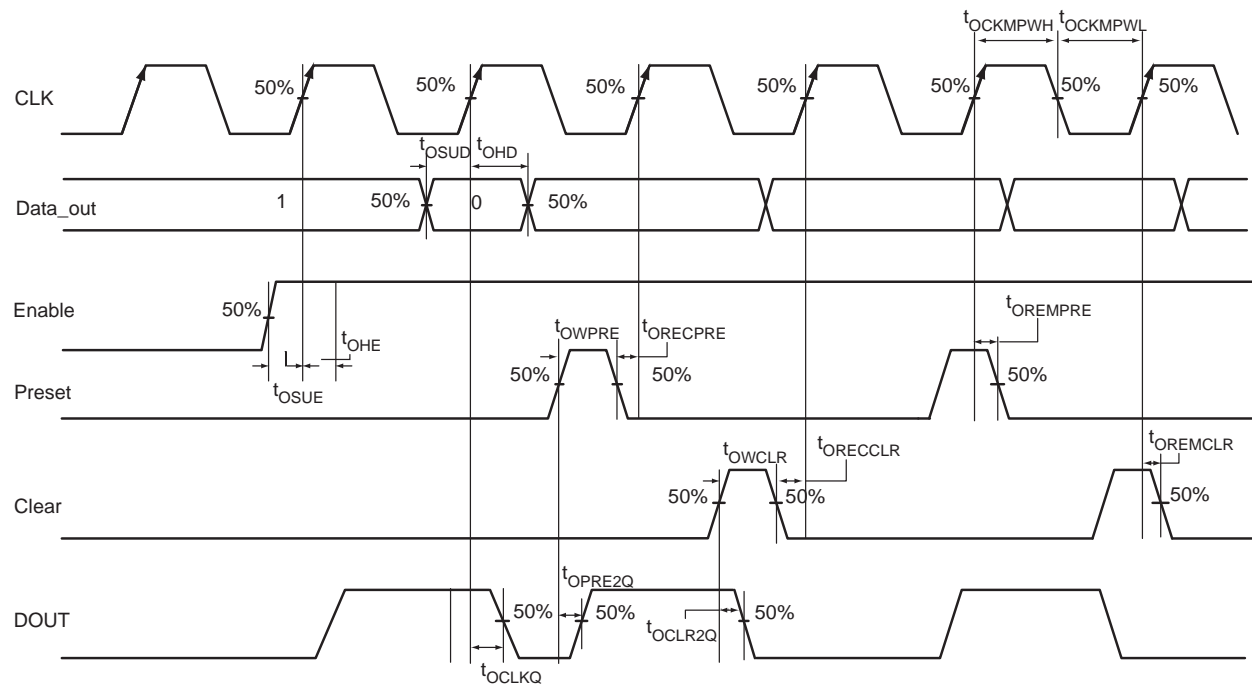


**Table 2-173 • Input Data Register Propagation Delays**  
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Parameter           | Description   | -1   | Std. | Units |
|---------------------|---|------|------|-------|
| $t_{\text{CLKQ}}$   | Clock-to-Q of the Input Data Register                               | 0.29 | 0.34 | ns    |
| $t_{\text{SUD}}$    | Data Setup Time for the Input Data Register                         | 0.32 | 0.37 | ns    |
| $t_{\text{HD}}$     | Data Hold Time for the Input Data Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{SUE}}$    | Enable Setup Time for the Input Data Register                       | 0.45 | 0.53 | ns    |
| $t_{\text{HE}}$     | Enable Hold Time for the Input Data Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{CLR2Q}}$  | Asynchronous Clear-to-Q of the Input Data Register                  | 0.55 | 0.64 | ns    |
| $t_{\text{PRE2Q}}$  | Asynchronous Preset-to-Q of the Input Data Register                 | 0.55 | 0.64 | ns    |
| $t_{\text{REMCLR}}$ | Asynchronous Clear Removal Time for the Input Data Register         | 0.00 | 0.00 | ns    |
| $t_{\text{RECCLR}}$ | Asynchronous Clear Recovery Time for the Input Data Register        | 0.27 | 0.31 | ns    |
| $t_{\text{REMPRE}}$ | Asynchronous Preset Removal Time for the Input Data Register        | 0.00 | 0.00 | ns    |
| $t_{\text{RECPRE}}$ | Asynchronous Preset Recovery Time for the Input Data Register       | 0.27 | 0.31 | ns    |
| $t_{\text{WCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Input Data Register  | 0.25 | 0.30 | ns    |
| $t_{\text{WPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Input Data Register | 0.25 | 0.30 | ns    |
| $t_{\text{CKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Input Data Register          | 0.41 | 0.48 | ns    |
| $t_{\text{CKMPWL}}$ | Clock Minimum Pulse Width LOW for the Input Data Register           | 0.37 | 0.43 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## Output Register



**Figure 2-32 • Output Register Timing Diagram**

### Timing Characteristics

**Table 2-174 • Output Data Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter            | Description  | -1   | Std. | Units |
|----------------------|--|------|------|-------|
| $t_{\text{OCLKQ}}$   | Clock-to-Q of the Output Data Register                               | 0.81 | 0.96 | ns    |
| $t_{\text{OSUD}}$    | Data Setup Time for the Output Data Register                         | 0.43 | 0.51 | ns    |
| $t_{\text{OHD}}$     | Data Hold Time for the Output Data Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{OSUE}}$    | Enable Setup Time for the Output Data Register                       | 0.61 | 0.71 | ns    |
| $t_{\text{OHE}}$     | Enable Hold Time for the Output Data Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{OCLR2Q}}$  | Asynchronous Clear-to-Q of the Output Data Register                  | 1.11 | 1.31 | ns    |
| $t_{\text{OPRE2Q}}$  | Asynchronous Preset-to-Q of the Output Data Register                 | 1.11 | 1.31 | ns    |
| $t_{\text{OEMCLR}}$  | Asynchronous Clear Removal Time for the Output Data Register         | 0.00 | 0.00 | ns    |
| $t_{\text{ORECCLR}}$ | Asynchronous Clear Recovery Time for the Output Data Register        | 0.31 | 0.36 | ns    |
| $t_{\text{OREMPRE}}$ | Asynchronous Preset Removal Time for the Output Data Register        | 0.00 | 0.00 | ns    |
| $t_{\text{ORECPRE}}$ | Asynchronous Preset Recovery Time for the Output Data Register       | 0.31 | 0.36 | ns    |
| $t_{\text{OWCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Output Data Register  | 0.19 | 0.22 | ns    |
| $t_{\text{OWPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Output Data Register | 0.19 | 0.22 | ns    |
| $t_{\text{OCKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Output Data Register          | 0.31 | 0.36 | ns    |
| $t_{\text{OCKMPWL}}$ | Clock Minimum Pulse Width LOW for the Output Data Register           | 0.28 | 0.32 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-175 • Output Data Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L

| Parameter            | Description  | -1   | Std. | Units |
|----------------------|--|------|------|-------|
| $t_{\text{OCLKQ}}$   | Clock-to-Q of the Output Data Register                               | 0.62 | 0.73 | ns    |
| $t_{\text{OSUD}}$    | Data Setup Time for the Output Data Register                         | 0.33 | 0.39 | ns    |
| $t_{\text{OHD}}$     | Data Hold Time for the Output Data Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{OSUE}}$    | Enable Setup Time for the Output Data Register                       | 0.46 | 0.55 | ns    |
| $t_{\text{OHE}}$     | Enable Hold Time for the Output Data Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{OCLR2Q}}$  | Asynchronous Clear-to-Q of the Output Data Register                  | 0.85 | 1.00 | ns    |
| $t_{\text{OPRE2Q}}$  | Asynchronous Preset-to-Q of the Output Data Register                 | 0.85 | 1.00 | ns    |
| $t_{\text{OEMCLR}}$  | Asynchronous Clear Removal Time for the Output Data Register         | 0.00 | 0.00 | ns    |
| $t_{\text{ORECCLR}}$ | Asynchronous Clear Recovery Time for the Output Data Register        | 0.24 | 0.28 | ns    |
| $t_{\text{OREMPRE}}$ | Asynchronous Preset Removal Time for the Output Data Register        | 0.00 | 0.00 | ns    |
| $t_{\text{ORECPRE}}$ | Asynchronous Preset Recovery Time for the Output Data Register       | 0.24 | 0.28 | ns    |
| $t_{\text{OWCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Output Data Register  | 0.19 | 0.22 | ns    |
| $t_{\text{OWPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Output Data Register | 0.19 | 0.22 | ns    |
| $t_{\text{OCKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Output Data Register          | 0.31 | 0.36 | ns    |
| $t_{\text{OCKMPWL}}$ | Clock Minimum Pulse Width LOW for the Output Data Register           | 0.28 | 0.32 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-176 • Output Data Register Propagation Delays**  
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Parameter            | Description  | -1   | Std. | Units |
|----------------------|--|------|------|-------|
| $t_{\text{OCLKQ}}$   | Clock-to-Q of the Output Data Register                               | 0.71 | 0.83 | ns    |
| $t_{\text{OSUD}}$    | Data Setup Time for the Output Data Register                         | 0.38 | 0.44 | ns    |
| $t_{\text{OHD}}$     | Data Hold Time for the Output Data Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{OSUE}}$    | Enable Setup Time for the Output Data Register                       | 0.53 | 0.62 | ns    |
| $t_{\text{OHE}}$     | Enable Hold Time for the Output Data Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{OCLR2Q}}$  | Asynchronous Clear-to-Q of the Output Data Register                  | 0.97 | 1.14 | ns    |
| $t_{\text{OPRE2Q}}$  | Asynchronous Preset-to-Q of the Output Data Register                 | 0.97 | 1.14 | ns    |
| $t_{\text{OREMCLR}}$ | Asynchronous Clear Removal Time for the Output Data Register         | 0.00 | 0.00 | ns    |
| $t_{\text{ORECCLR}}$ | Asynchronous Clear Recovery Time for the Output Data Register        | 0.27 | 0.31 | ns    |
| $t_{\text{OREMPRE}}$ | Asynchronous Preset Removal Time for the Output Data Register        | 0.00 | 0.00 | ns    |
| $t_{\text{ORECPRE}}$ | Asynchronous Preset Recovery Time for the Output Data Register       | 0.27 | 0.31 | ns    |
| $t_{\text{OWCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Output Data Register  | 0.25 | 0.30 | ns    |
| $t_{\text{OWPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Output Data Register | 0.25 | 0.30 | ns    |
| $t_{\text{OCKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Output Data Register          | 0.41 | 0.48 | ns    |
| $t_{\text{OCKMPWL}}$ | Clock Minimum Pulse Width LOW for the Output Data Register           | 0.37 | 0.43 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## Output Enable Register

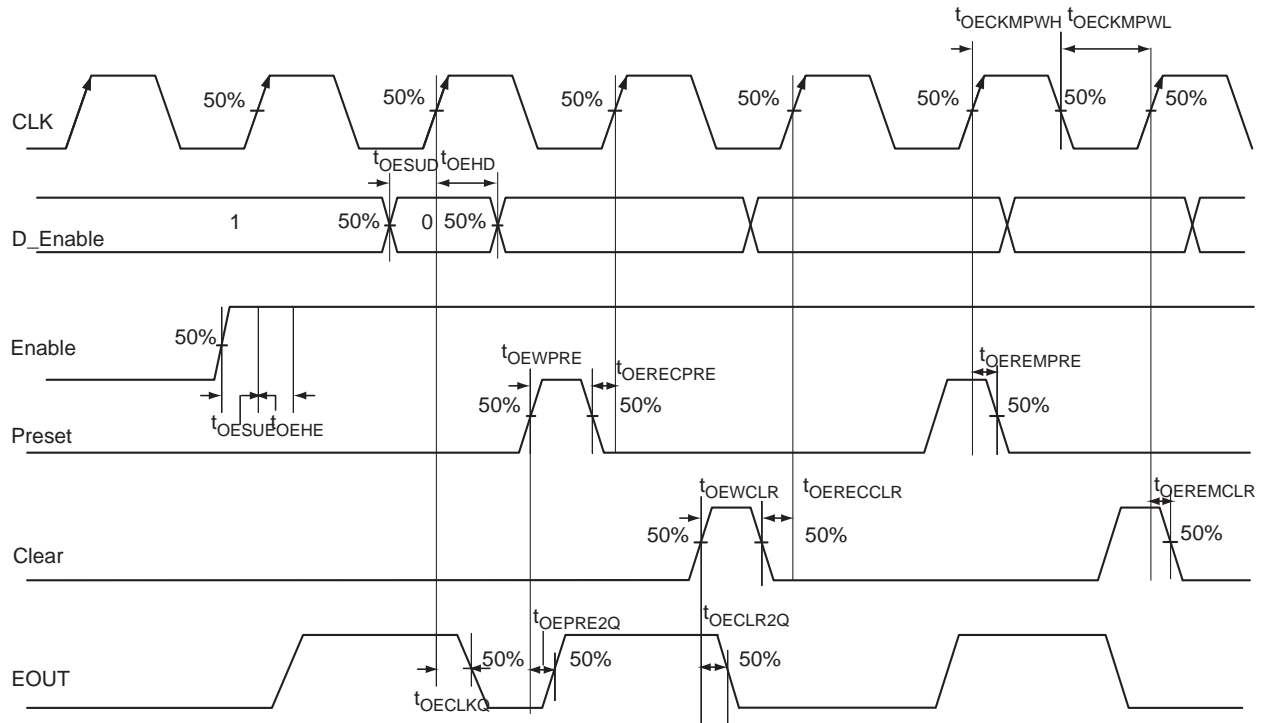


Figure 2-33 • Output Enable Register Timing Diagram

### Timing Characteristics

**Table 2-177 • Output Enable Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter      | Description  | -1   | Std. | Units |
|----------------|--|------|------|-------|
| $t_{OECLKQ}$   | Clock-to-Q of the Output Enable Register                               | 0.62 | 0.72 | ns    |
| $t_{OESUD}$    | Data Setup Time for the Output Enable Register                         | 0.43 | 0.51 | ns    |
| $t_{OEHD}$     | Data Hold Time for the Output Enable Register                          | 0.00 | 0.00 | ns    |
| $t_{OESUE}$    | Enable Setup Time for the Output Enable Register                       | 0.60 | 0.71 | ns    |
| $t_{OEHE}$     | Enable Hold Time for the Output Enable Register                        | 0.00 | 0.00 | ns    |
| $t_{OECLR2Q}$  | Asynchronous Clear-to-Q of the Output Enable Register                  | 0.92 | 1.08 | ns    |
| $t_{OEPRE2Q}$  | Asynchronous Preset-to-Q of the Output Enable Register                 | 0.92 | 1.08 | ns    |
| $t_{OEREMCLR}$ | Asynchronous Clear Removal Time for the Output Enable Register         | 0.00 | 0.00 | ns    |
| $t_{OERECCLR}$ | Asynchronous Clear Recovery Time for the Output Enable Register        | 0.31 | 0.36 | ns    |
| $t_{OEREMPRE}$ | Asynchronous Preset Removal Time for the Output Enable Register        | 0.00 | 0.00 | ns    |
| $t_{OERECPRE}$ | Asynchronous Preset Recovery Time for the Output Enable Register       | 0.31 | 0.36 | ns    |
| $t_{OEWCCLR}$  | Asynchronous Clear Minimum Pulse Width for the Output Enable Register  | 0.19 | 0.22 | ns    |
| $t_{OEWPPE}$   | Asynchronous Preset Minimum Pulse Width for the Output Enable Register | 0.19 | 0.22 | ns    |
| $t_{OECKMPWH}$ | Clock Minimum Pulse Width HIGH for the Output Enable Register          | 0.31 | 0.36 | ns    |
| $t_{OECKMPWL}$ | Clock Minimum Pulse Width LOW for the Output Enable Register           | 0.28 | 0.32 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-178 • Output Enable Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L

| Parameter      | Description  | -1   | Std. | Units |
|----------------|--|------|------|-------|
| $t_{OECLKQ}$   | Clock-to-Q of the Output Enable Register                               | 0.47 | 0.55 | ns    |
| $t_{OESUD}$    | Data Setup Time for the Output Enable Register                         | 0.33 | 0.39 | ns    |
| $t_{OEHD}$     | Data Hold Time for the Output Enable Register                          | 0.00 | 0.00 | ns    |
| $t_{OESUE}$    | Enable Setup Time for the Output Enable Register                       | 0.46 | 0.54 | ns    |
| $t_{OEHE}$     | Enable Hold Time for the Output Enable Register                        | 0.00 | 0.00 | ns    |
| $t_{OECLR2Q}$  | Asynchronous Clear-to-Q of the Output Enable Register                  | 0.70 | 0.83 | ns    |
| $t_{OEPRE2Q}$  | Asynchronous Preset-to-Q of the Output Enable Register                 | 0.70 | 0.83 | ns    |
| $t_{OEREMCLR}$ | Asynchronous Clear Removal Time for the Output Enable Register         | 0.00 | 0.00 | ns    |
| $t_{OERECCLR}$ | Asynchronous Clear Recovery Time for the Output Enable Register        | 0.24 | 0.28 | ns    |
| $t_{OEREMPRE}$ | Asynchronous Preset Removal Time for the Output Enable Register        | 0.00 | 0.00 | ns    |
| $t_{OERECPRE}$ | Asynchronous Preset Recovery Time for the Output Enable Register       | 0.24 | 0.28 | ns    |
| $t_{OEWCCLR}$  | Asynchronous Clear Minimum Pulse Width for the Output Enable Register  | 0.19 | 0.22 | ns    |
| $t_{OEWPPE}$   | Asynchronous Preset Minimum Pulse Width for the Output Enable Register | 0.19 | 0.22 | ns    |
| $t_{OECKMPWH}$ | Clock Minimum Pulse Width HIGH for the Output Enable Register          | 0.31 | 0.36 | ns    |
| $t_{OECKMPWL}$ | Clock Minimum Pulse Width LOW for the Output Enable Register           | 0.28 | 0.32 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

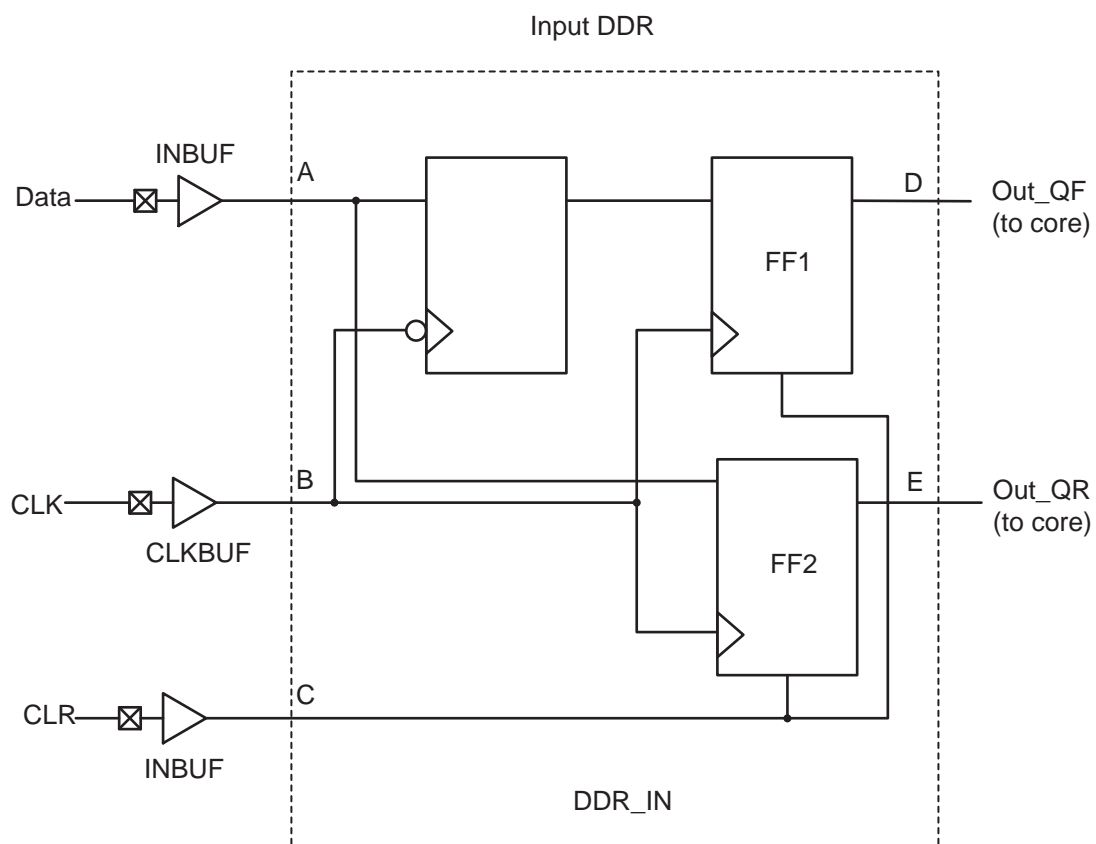
**Table 2-179 • Output Enable Register Propagation Delays**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000

| Parameter      | Description  | -1   | Std. | Units |
|----------------|--|------|------|-------|
| $t_{OECLKQ}$   | Clock-to-Q of the Output Enable Register                               | 0.54 | 0.63 | ns    |
| $t_{OESUD}$    | Data Setup Time for the Output Enable Register                         | 0.38 | 0.44 | ns    |
| $t_{OEHD}$     | Data Hold Time for the Output Enable Register                          | 0.00 | 0.00 | ns    |
| $t_{OESUE}$    | Enable Setup Time for the Output Enable Register                       | 0.52 | 0.62 | ns    |
| $t_{OEHE}$     | Enable Hold Time for the Output Enable Register                        | 0.00 | 0.00 | ns    |
| $t_{OECLR2Q}$  | Asynchronous Clear-to-Q of the Output Enable Register                  | 0.80 | 0.94 | ns    |
| $t_{OEPRE2Q}$  | Asynchronous Preset-to-Q of the Output Enable Register                 | 0.80 | 0.94 | ns    |
| $t_{OEREMCLR}$ | Asynchronous Clear Removal Time for the Output Enable Register         | 0.00 | 0.00 | ns    |
| $t_{OERECCLR}$ | Asynchronous Clear Recovery Time for the Output Enable Register        | 0.27 | 0.31 | ns    |
| $t_{OEREMPRE}$ | Asynchronous Preset Removal Time for the Output Enable Register        | 0.00 | 0.00 | ns    |
| $t_{OERECPRE}$ | Asynchronous Preset Recovery Time for the Output Enable Register       | 0.27 | 0.31 | ns    |
| $t_{OEWCCLR}$  | Asynchronous Clear Minimum Pulse Width for the Output Enable Register  | 0.25 | 0.30 | ns    |
| $t_{OEWPRES}$  | Asynchronous Preset Minimum Pulse Width for the Output Enable Register | 0.25 | 0.30 | ns    |
| $t_{OECKMPWH}$ | Clock Minimum Pulse Width HIGH for the Output Enable Register          | 0.41 | 0.48 | ns    |
| $t_{OECKMPWL}$ | Clock Minimum Pulse Width LOW for the Output Enable Register           | 0.37 | 0.43 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## DDR Module Specifications

### Input DDR Module

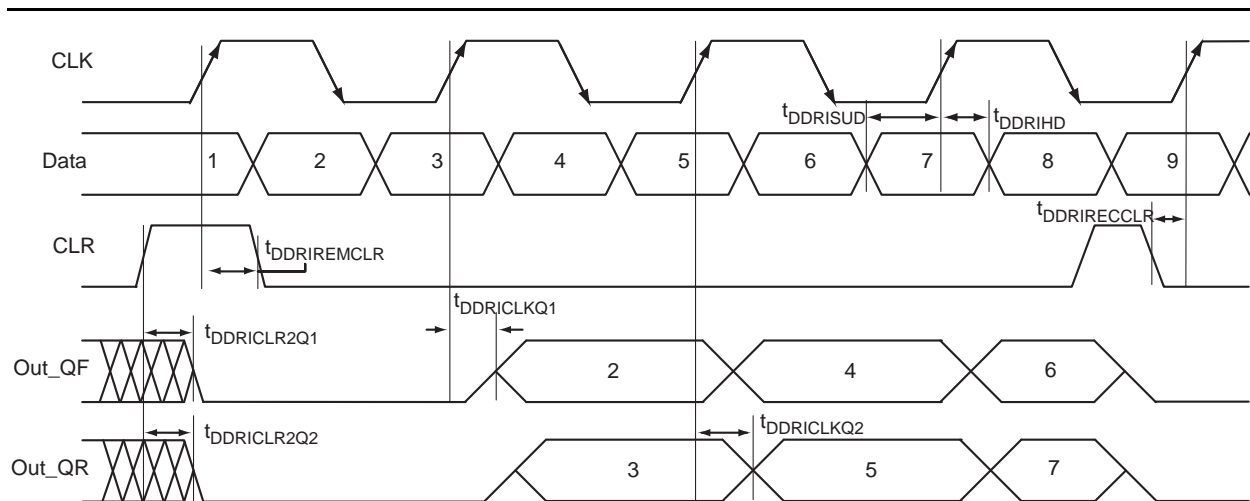


**Figure 2-34 • Input DDR Timing Model**

**Table 2-180 • Parameter Definitions**

| Parameter Name   | Parameter Definition         | Measuring Nodes (from, to) |
|------------------|------------------------------|----------------------------|
| $t_{DDRICKQ1}$   | Clock-to-Out Out_QR          | B, D                       |
| $t_{DDRICKQ2}$   | Clock-to-Out Out_QF          | B, E                       |
| $t_{DDRISUD}$    | Data Setup Time of DDR input | A, B                       |
| $t_{DDRIHD}$     | Data Hold Time of DDR input  | A, B                       |
| $t_{DDRICLR2Q1}$ | Clear-to-Out Out_QR          | C, D                       |
| $t_{DDRICLR2Q2}$ | Clear-to-Out Out_QF          | C, E                       |
| $t_{DDRIRECLR}$  | Clear Removal                | C, B                       |
| $t_{DDRIRECLR}$  | Clear Recovery               | C, B                       |




**Figure 2-35 • Input DDR Timing Diagram**

### Timing Characteristics

**Table 2-181 • Input DDR Propagation Delays**

 Military-Case Conditions:  $T_j = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter               | Description  | -1   | Std. | Units |
|-------------------------|--|------|------|-------|
| $t_{\text{DDRICKQ1}}$   | Clock-to-Out Out_QR for Input DDR                    | 0.38 | 0.45 | ns    |
| $t_{\text{DDRICKQ2}}$   | Clock-to-Out Out_QF for Input DDR                    | 0.54 | 0.63 | ns    |
| $t_{\text{DDRISUD1}}$   | Data Setup for Input DDR (fall)                      | 0.39 | 0.46 | ns    |
| $t_{\text{DDRISUD2}}$   | Data Setup for Input DDR (rise)                      | 0.34 | 0.40 | ns    |
| $t_{\text{DDRHD1}}$     | Data Hold for Input DDR (fall)                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDRHD2}}$     | Data Hold for Input DDR (rise)                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDRICLR2Q1}}$ | Asynchronous Clear-to-Out Out_QR for Input DDR       | 0.64 | 0.75 | ns    |
| $t_{\text{DDRICLR2Q2}}$ | Asynchronous Clear-to-Out Out_QF for Input DDR       | 0.79 | 0.93 | ns    |
| $t_{\text{DDRREMCLR}}$  | Asynchronous Clear Removal Time for Input DDR        | 0.00 | 0.00 | ns    |
| $t_{\text{DDRRECCLR}}$  | Asynchronous Clear Recovery Time for Input DDR       | 0.31 | 0.36 | ns    |
| $t_{\text{DDRWCLR}}$    | Asynchronous Clear Minimum Pulse Width for Input DDR | 0.19 | 0.22 | ns    |
| $t_{\text{DDRICKMPWH}}$ | Clock Minimum Pulse Width HIGH for Input DDR         | 0.31 | 0.36 | ns    |
| $t_{\text{DDRICKMPWL}}$ | Clock Minimum Pulse Width LOW for Input DDR          | 0.28 | 0.32 | ns    |
| $F_{\text{DDRIMAX}}$    | Maximum Frequency for Input DDR                      | TBD  | TBD  | MHz   |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-182 • Input DDR Propagation Delays**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for any A3PE600L/A3PE3000L**

| Parameter               | Description  | -1   | Std. | Units |
|-------------------------|--|------|------|-------|
| $t_{\text{DDRICKLQ1}}$  | Clock-to-Out Out_QR for Input DDR                    | 0.29 | 0.34 | ns    |
| $t_{\text{DDRICKLQ2}}$  | Clock-to-Out Out_QF for Input DDR                    | 0.41 | 0.48 | ns    |
| $t_{\text{DDRISUD1}}$   | Data Setup for Input DDR (fall)                      | 0.30 | 0.35 | ns    |
| $t_{\text{DDRISUD2}}$   | Data Setup for Input DDR (rise)                      | 0.26 | 0.31 | ns    |
| $t_{\text{DDRIHD1}}$    | Data Hold for Input DDR (fall)                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDRIHD2}}$    | Data Hold for Input DDR (rise)                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDRICLR2Q1}}$ | Asynchronous Clear-to-Out Out_QR for Input DDR       | 0.49 | 0.58 | ns    |
| $t_{\text{DDRICLR2Q2}}$ | Asynchronous Clear-to-Out Out_QF for Input DDR       | 0.60 | 0.71 | ns    |
| $t_{\text{DDRIREMCLR}}$ | Asynchronous Clear Removal Time for Input DDR        | 0.00 | 0.00 | ns    |
| $t_{\text{DDRIRECCLR}}$ | Asynchronous Clear Recovery Time for Input DDR       | 0.24 | 0.28 | ns    |
| $t_{\text{DDR IWCLR}}$  | Asynchronous Clear Minimum Pulse Width for Input DDR | 0.19 | 0.22 | ns    |
| $t_{\text{DDRICKMPWH}}$ | Clock Minimum Pulse Width HIGH for Input DDR         | 0.31 | 0.36 | ns    |
| $t_{\text{DDRICKMPWL}}$ | Clock Minimum Pulse Width LOW for Input DDR          | 0.28 | 0.32 | ns    |
| $F_{\text{DDRIMAX}}$    | Maximum Frequency for Input DDR                      | TBD  | TBD  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-183 • Input DDR Propagation Delays**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Parameter               | Description  | -1   | Std. | Units |
|-------------------------|--|------|------|-------|
| $t_{\text{DDRICKLQ1}}$  | Clock-to-Out Out_QR for Input DDR                    | 0.33 | 0.39 | ns    |
| $t_{\text{DDRICKLQ2}}$  | Clock-to-Out Out_QF for Input DDR                    | 0.47 | 0.55 | ns    |
| $t_{\text{DDRISUD1}}$   | Data Setup for Input DDR (fall)                      | 0.30 | 0.35 | ns    |
| $t_{\text{DDRISUD2}}$   | Data Setup for Input DDR (rise)                      | 0.30 | 0.35 | ns    |
| $t_{\text{DDRIHD1}}$    | Data Hold for Input DDR (fall)                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDRIHD2}}$    | Data Hold for Input DDR (rise)                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDRICLR2Q1}}$ | Asynchronous Clear-to-Out Out_QR for Input DDR       | 0.56 | 0.65 | ns    |
| $t_{\text{DDRICLR2Q2}}$ | Asynchronous Clear-to-Out Out_QF for Input DDR       | 0.69 | 0.81 | ns    |
| $t_{\text{DDRIREMCLR}}$ | Asynchronous Clear Removal Time for Input DDR        | 0.00 | 0.00 | ns    |
| $t_{\text{DDRIRECCLR}}$ | Asynchronous Clear Recovery Time for Input DDR       | 0.27 | 0.31 | ns    |
| $t_{\text{DDR IWCLR}}$  | Asynchronous Clear Minimum Pulse Width for Input DDR | 0.25 | 0.30 | ns    |
| $t_{\text{DDRICKMPWH}}$ | Clock Minimum Pulse Width HIGH for Input DDR         | 0.41 | 0.48 | ns    |
| $t_{\text{DDRICKMPWL}}$ | Clock Minimum Pulse Width LOW for Input DDR          | 0.37 | 0.43 | ns    |
| $F_{\text{DDRIMAX}}$    | Maximum Frequency for Input DDR                      | TBD  | TBD  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## Output DDR Module

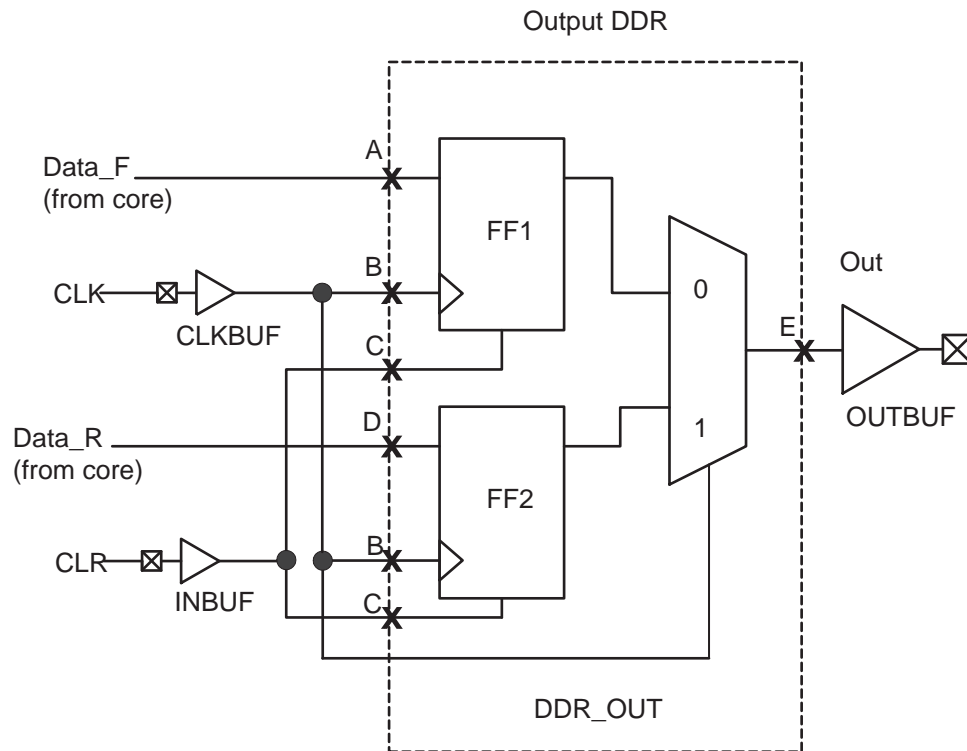
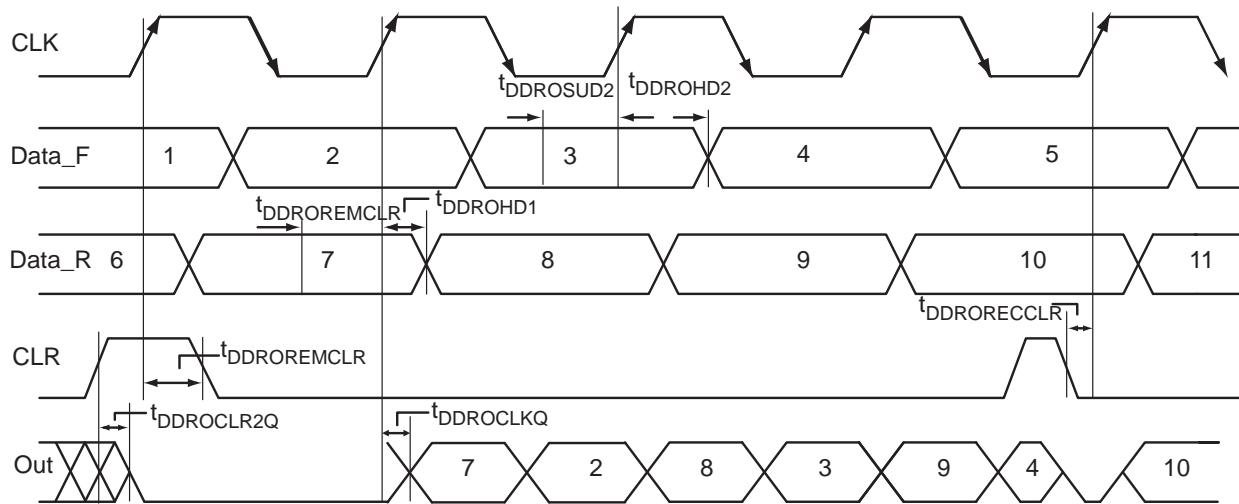


Figure 2-36 • Output DDR Timing Model

Table 2-184 • Parameter Definitions

| Parameter Name   | Parameter Definition      | Measuring Nodes (from, to) |
|------------------|---------------------------|----------------------------|
| $t_{DDROCLKQ}$   | Clock-to-Out              | B, E                       |
| $t_{DDROCLR2Q}$  | Asynchronous Clear-to-Out | C, E                       |
| $t_{DDROREMCLR}$ | Clear Removal             | C, B                       |
| $t_{DDRORECCLR}$ | Clear Recovery            | C, B                       |
| $t_{DDROSUD1}$   | Data Setup Data_F         | A, B                       |
| $t_{DDROSUD2}$   | Data Setup Data_R         | D, B                       |
| $t_{DDROHD1}$    | Data Hold Data_F          | A, B                       |
| $t_{DDROHD2}$    | Data Hold Data_R          | D, B                       |


**Figure 2-37 • Output DDR Timing Diagram**

### Timing Characteristics

**Table 2-185 • Output DDR Propagation Delays**

 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter               | Description   | -1   | Std. | Units |
|-------------------------|---|------|------|-------|
| $t_{\text{DDROCLKQ}}$   | Clock-to-Out of DDR for Output DDR                    | 0.97 | 1.14 | ns    |
| $t_{\text{DDRISUD1}}$   | Data_F Data Setup for Output DDR                      | 0.52 | 0.62 | ns    |
| $t_{\text{DDROSUD2}}$   | Data_R Data Setup for Output DDR                      | 0.52 | 0.62 | ns    |
| $t_{\text{DDROHD1}}$    | Data_F Data Hold for Output DDR                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDROHD2}}$    | Data_R Data Hold for Output DDR                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDROCLR2Q}}$  | Asynchronous Clear-to-Out for Output DDR              | 1.11 | 1.30 | ns    |
| $t_{\text{DDROEMCLR}}$  | Asynchronous Clear Removal Time for Output DDR        | 0.00 | 0.00 | ns    |
| $t_{\text{DDROECCLR}}$  | Asynchronous Clear Recovery Time for Output DDR       | 0.31 | 0.36 | ns    |
| $t_{\text{DDROWCLR1}}$  | Asynchronous Clear Minimum Pulse Width for Output DDR | 0.19 | 0.22 | ns    |
| $t_{\text{DDROCKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Output DDR     | 0.31 | 0.36 | ns    |
| $t_{\text{DDROCKMPWL}}$ | Clock Minimum Pulse Width LOW for the Output DDR      | 0.28 | 0.32 | ns    |
| $F_{\text{DDOMAX}}$     | Maximum Frequency for the Output DDR                  | TBD  | TBD  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-186 • Output DDR Propagation Delays**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter               | Description   | -1   | Std. | Units |
|-------------------------|---|------|------|-------|
| $t_{\text{DDROCLKQ}}$   | Clock-to-Out of DDR for Output DDR                    | 0.74 | 0.87 | ns    |
| $t_{\text{DDRISUD1}}$   | Data_F Data Setup for Output DDR                      | 0.40 | 0.47 | ns    |
| $t_{\text{DDROSUD2}}$   | Data_R Data Setup for Output DDR                      | 0.40 | 0.47 | ns    |
| $t_{\text{DDROHD1}}$    | Data_F Data Hold for Output DDR                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDROHD2}}$    | Data_R Data Hold for Output DDR                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDROCLR2Q}}$  | Asynchronous Clear-to-Out for Output DDR              | 0.85 | 1.00 | ns    |
| $t_{\text{DDROREMCLR}}$ | Asynchronous Clear Removal Time for Output DDR        | 0.00 | 0.00 | ns    |
| $t_{\text{DDRORECCLR}}$ | Asynchronous Clear Recovery Time for Output DDR       | 0.24 | 0.28 | ns    |
| $t_{\text{DDROWCLR1}}$  | Asynchronous Clear Minimum Pulse Width for Output DDR | 0.19 | 0.22 | ns    |
| $t_{\text{DDROCKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Output DDR     | 0.31 | 0.36 | ns    |
| $t_{\text{DDROCKMPWL}}$ | Clock Minimum Pulse Width LOW for the Output DDR      | 0.28 | 0.32 | ns    |
| $F_{\text{DDOMAX}}$     | Maximum Frequency for the Output DDR                  | TBD  | TBD  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-187 • Output DDR Propagation Delays**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Parameter               | Description   | -1   | Std. | Units |
|-------------------------|---|------|------|-------|
| $t_{\text{DDROCLKQ}}$   | Clock-to-Out of DDR for Output DDR                    | 0.84 | 0.99 | ns    |
| $t_{\text{DDRISUD1}}$   | Data_F Data Setup for Output DDR                      | 0.46 | 0.54 | ns    |
| $t_{\text{DDROSUD2}}$   | Data_R Data Setup for Output DDR                      | 0.46 | 0.54 | ns    |
| $t_{\text{DDROHD1}}$    | Data_F Data Hold for Output DDR                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDROHD2}}$    | Data_R Data Hold for Output DDR                       | 0.00 | 0.00 | ns    |
| $t_{\text{DDROCLR2Q}}$  | Asynchronous Clear-to-Out for Output DDR              | 0.96 | 1.13 | ns    |
| $t_{\text{DDROREMCLR}}$ | Asynchronous Clear Removal Time for Output DDR        | 0.00 | 0.00 | ns    |
| $t_{\text{DDRORECCLR}}$ | Asynchronous Clear Recovery Time for Output DDR       | 0.27 | 0.31 | ns    |
| $t_{\text{DDROWCLR1}}$  | Asynchronous Clear Minimum Pulse Width for Output DDR | 0.25 | 0.30 | ns    |
| $t_{\text{DDROCKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Output DDR     | 0.41 | 0.48 | ns    |
| $t_{\text{DDROCKMPWL}}$ | Clock Minimum Pulse Width LOW for the Output DDR      | 0.37 | 0.43 | ns    |
| $F_{\text{DDOMAX}}$     | Maximum Frequency for the Output DDR                  | TBD  | TBD  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## VersaTile Characteristics

### VersaTile Specifications as a Combinatorial Module

The military ProASIC3 library offers all combinations of LUT-3 combinatorial functions. In this section, timing characteristics are presented for a sample of the library. For more details, refer to the *IGLOO, Fusion, and ProASIC3 Macro Library Guide*.

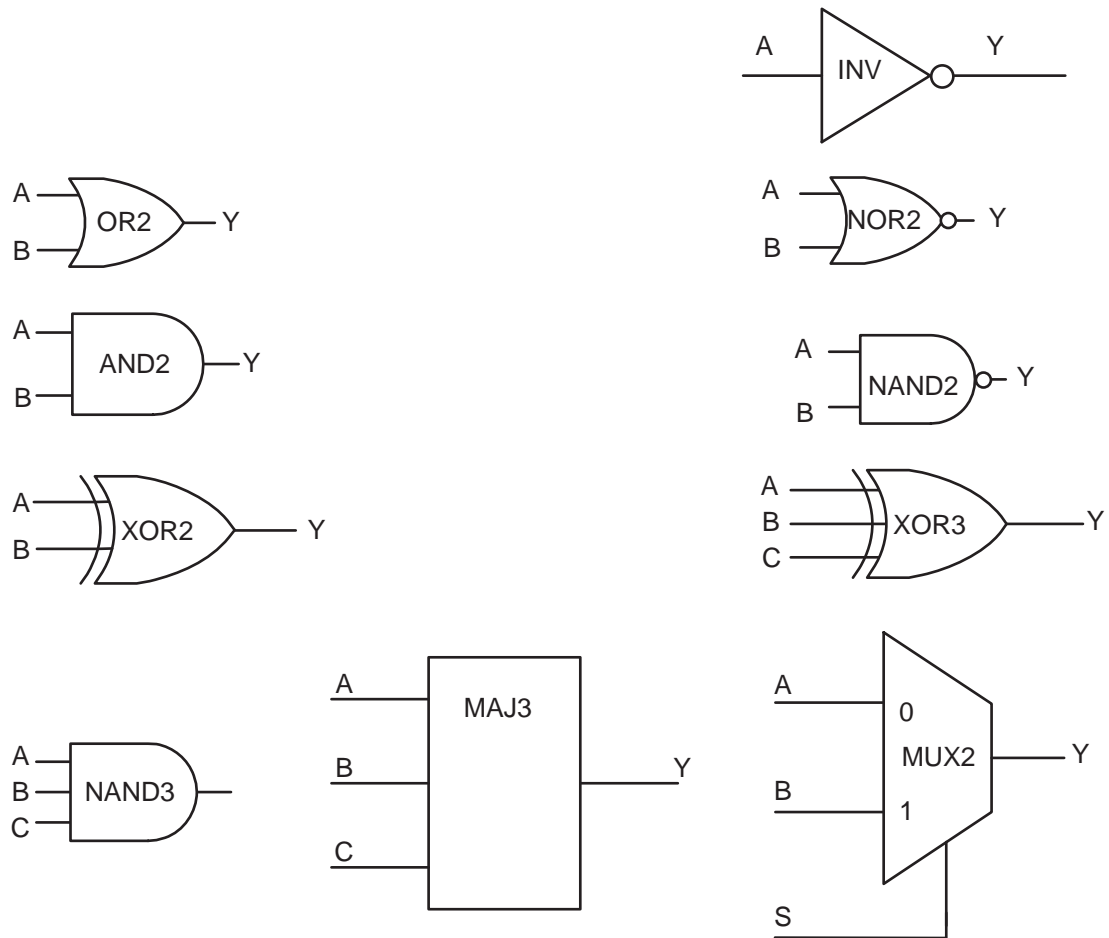
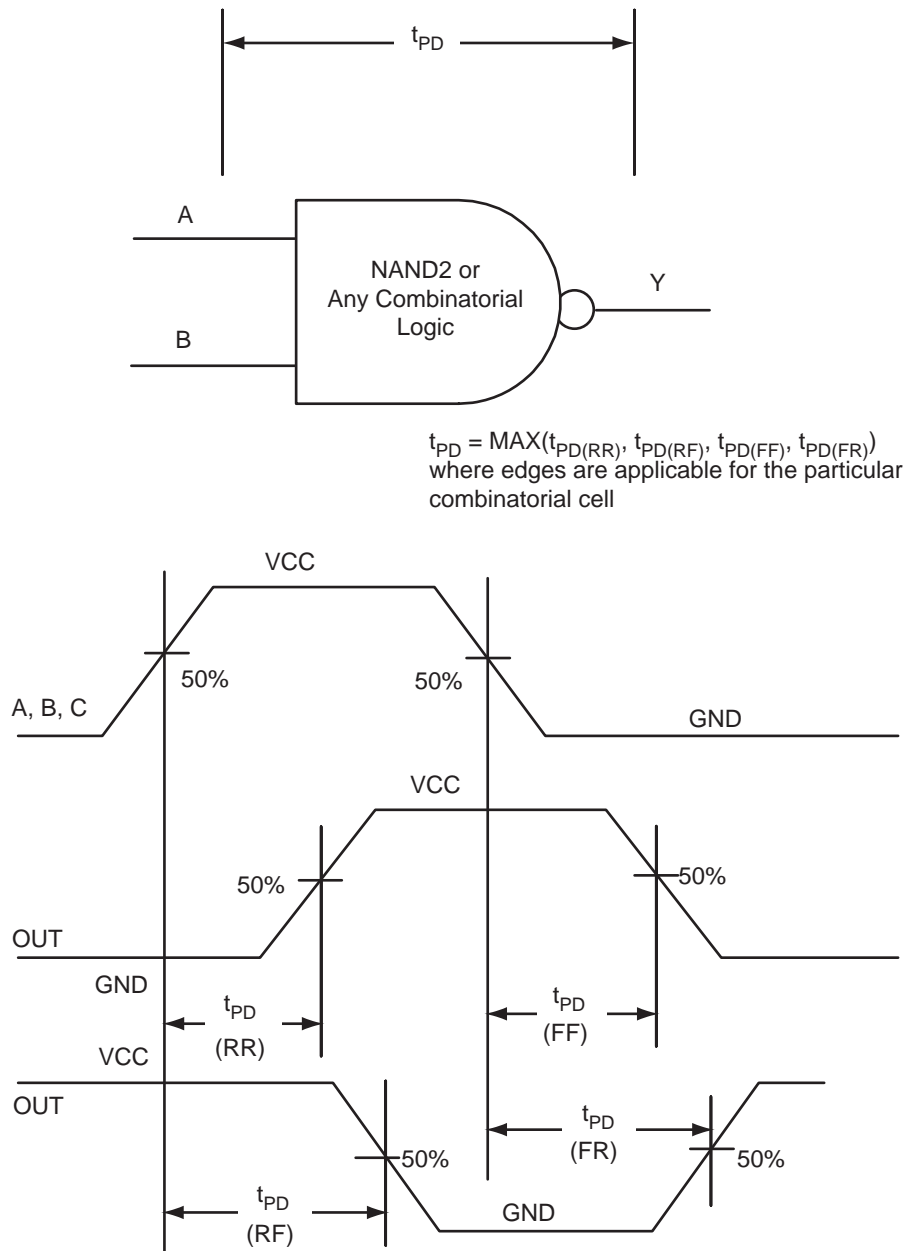


Figure 2-38 • Sample of Combinatorial Cells


**Figure 2-39 • Timing Model and Waveforms**

## Timing Characteristics

**Table 2-188 • Combinatorial Cell Propagation Delays**

 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Combinatorial Cell | Equation                  | Parameter | -1   | Std. | Units |
|--------------------|---------------------------|-----------|------|------|-------|
| INV                | $Y = !A$                  | $t_{PD}$  | 0.56 | 0.65 | ns    |
| AND2               | $Y = A \cdot B$           | $t_{PD}$  | 0.65 | 0.77 | ns    |
| NAND2              | $Y = !(A \cdot B)$        | $t_{PD}$  | 0.65 | 0.77 | ns    |
| OR2                | $Y = A + B$               | $t_{PD}$  | 0.67 | 0.79 | ns    |
| NOR2               | $Y = !(A + B)$            | $t_{PD}$  | 0.67 | 0.79 | ns    |
| XOR2               | $Y = A \oplus B$          | $t_{PD}$  | 1.02 | 1.20 | ns    |
| MAJ3               | $Y = \text{MAJ}(A, B, C)$ | $t_{PD}$  | 0.97 | 1.14 | ns    |
| XOR3               | $Y = A \oplus B \oplus C$ | $t_{PD}$  | 1.21 | 1.42 | ns    |
| MUX2               | $Y = A !S + B S$          | $t_{PD}$  | 0.70 | 0.82 | ns    |
| AND3               | $Y = A \cdot B \cdot C$   | $t_{PD}$  | 0.78 | 0.91 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-189 • Combinatorial Cell Propagation Delays**

 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for any A3PE600L/A3PE3000L

| Combinatorial Cell | Equation                  | Parameter | -1   | Std. | Units |
|--------------------|---------------------------|-----------|------|------|-------|
| INV                | $Y = !A$                  | $t_{PD}$  | 0.43 | 0.50 | ns    |
| AND2               | $Y = A \cdot B$           | $t_{PD}$  | 0.50 | 0.59 | ns    |
| NAND2              | $Y = !(A \cdot B)$        | $t_{PD}$  | 0.50 | 0.59 | ns    |
| OR2                | $Y = A + B$               | $t_{PD}$  | 0.51 | 0.61 | ns    |
| NOR2               | $Y = !(A + B)$            | $t_{PD}$  | 0.51 | 0.61 | ns    |
| XOR2               | $Y = A \oplus B$          | $t_{PD}$  | 0.78 | 0.92 | ns    |
| MAJ3               | $Y = \text{MAJ}(A, B, C)$ | $t_{PD}$  | 0.74 | 0.87 | ns    |
| XOR3               | $Y = A \oplus B \oplus C$ | $t_{PD}$  | 0.93 | 1.09 | ns    |
| MUX2               | $Y = A !S + B S$          | $t_{PD}$  | 0.54 | 0.63 | ns    |
| AND3               | $Y = A \cdot B \cdot C$   | $t_{PD}$  | 0.59 | 0.70 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.



**Table 2-190 • Combinatorial Cell Propagation Delays**  
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Combinatorial Cell | Equation                          | Parameter | -1   | Std. | Units |
|--------------------|-----------------------------------|-----------|------|------|-------|
| INV                | $Y = !A$                          | $t_{PD}$  | 0.48 | 0.57 | ns    |
| AND2               | $Y = A \cdot B$                   | $t_{PD}$  | 0.57 | 0.67 | ns    |
| NAND2              | $Y = !(A \cdot B)$                | $t_{PD}$  | 0.57 | 0.67 | ns    |
| OR2                | $Y = A + B$                       | $t_{PD}$  | 0.59 | 0.69 | ns    |
| NOR2               | $Y = !(A + B)$                    | $t_{PD}$  | 0.59 | 0.69 | ns    |
| XOR2               | $Y = A \oplus B$                  | $t_{PD}$  | 0.89 | 1.04 | ns    |
| MAJ3               | $Y = \text{MAJ}(A, B, C)$         | $t_{PD}$  | 0.84 | 0.99 | ns    |
| XOR3               | $Y = A \oplus B \oplus C$         | $t_{PD}$  | 1.05 | 1.24 | ns    |
| MUX2               | $Y = A \text{ IS } + B \text{ S}$ | $t_{PD}$  | 0.61 | 0.72 | ns    |
| AND3               | $Y = A \cdot B \cdot C$           | $t_{PD}$  | 0.68 | 0.79 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## VersaTile Specifications as a Sequential Module

The military ProASIC3 library offers a wide variety of sequential cells, including flip-flops and latches. Each has a data input and optional enable, clear, or preset. In this section, timing characteristics are presented for a representative sample from the library. For more details, refer to the *IGLOO, Fusion, and ProASIC3 Macro Library Guide*.

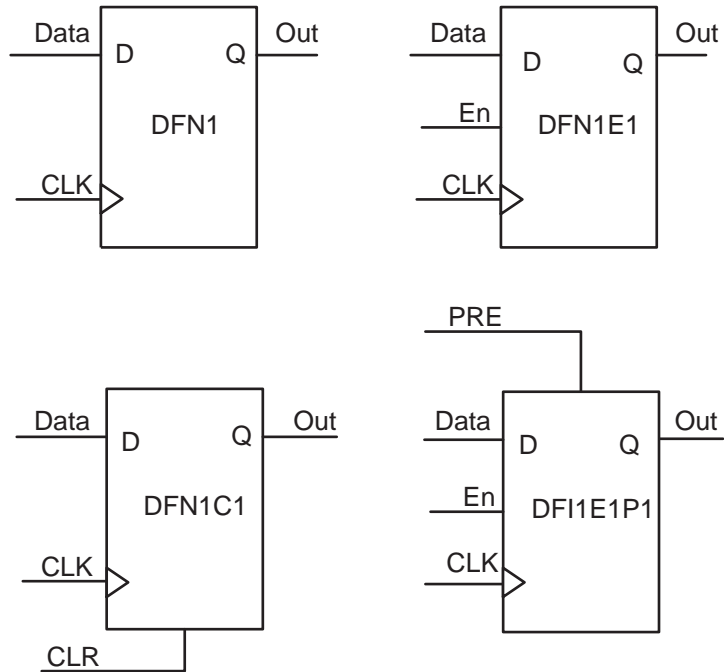
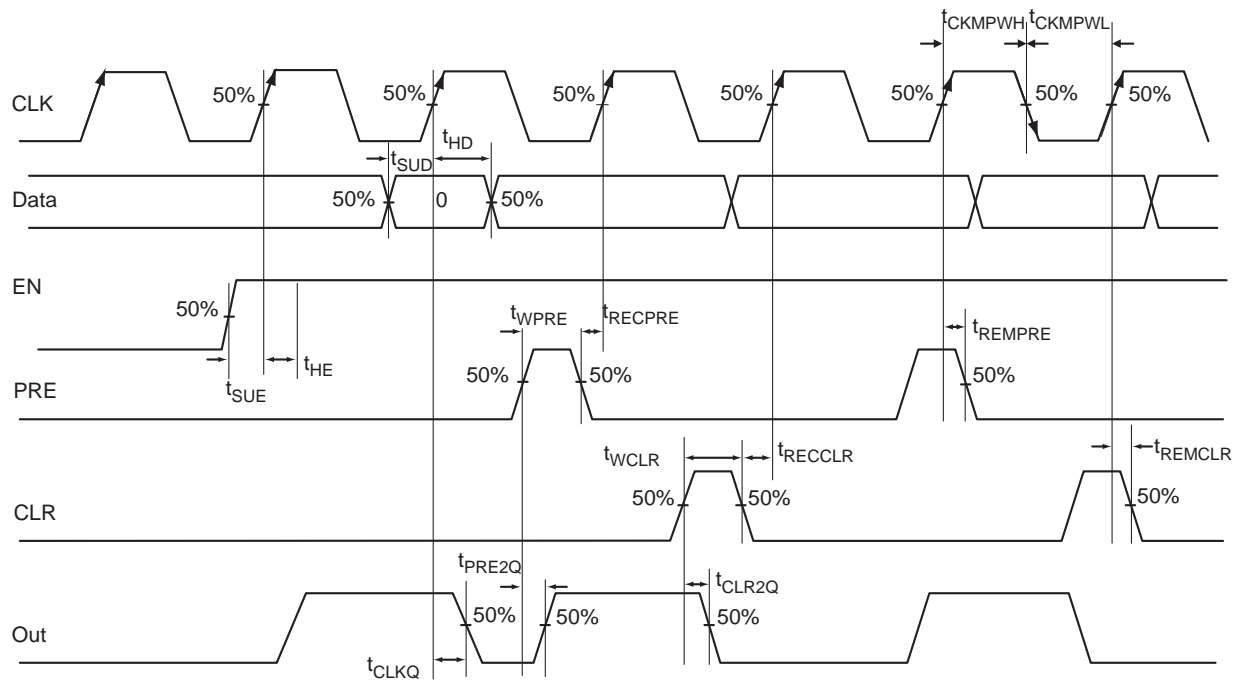


Figure 2-40 • Sample of Sequential Cells



**Figure 2-41 • Timing Model and Waveforms**

### Timing Characteristics

**Table 2-191 • Register Delays**

 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter    | Description   | -1   | Std. | Units |
|--------------|---|------|------|-------|
| $t_{CLKQ}$   | Clock-to-Q of the Core Register                               | 0.76 | 0.90 | ns    |
| $t_{SUD}$    | Data Setup Time for the Core Register                         | 0.59 | 0.70 | ns    |
| $t_{HD}$     | Data Hold Time for the Core Register                          | 0.00 | 0.00 | ns    |
| $t_{SUE}$    | Enable Setup Time for the Core Register                       | 0.63 | 0.74 | ns    |
| $t_{HE}$     | Enable Hold Time for the Core Register                        | 0.00 | 0.00 | ns    |
| $t_{CLR2Q}$  | Asynchronous Clear-to-Q of the Core Register                  | 0.55 | 0.65 | ns    |
| $t_{PRE2Q}$  | Asynchronous Preset-to-Q of the Core Register                 | 0.55 | 0.65 | ns    |
| $t_{REMCLR}$ | Asynchronous Clear Removal Time for the Core Register         | 0.00 | 0.00 | ns    |
| $t_{RECLR}$  | Asynchronous Clear Recovery Time for the Core Register        | 0.31 | 0.36 | ns    |
| $t_{REMPRE}$ | Asynchronous Preset Removal Time for the Core Register        | 0.00 | 0.00 | ns    |
| $t_{RECPRE}$ | Asynchronous Preset Recovery Time for the Core Register       | 0.31 | 0.36 | ns    |
| $t_{WCLR}$   | Asynchronous Clear Minimum Pulse Width for the Core Register  | 0.30 | 0.34 | ns    |
| $t_{WPRE}$   | Asynchronous Preset Minimum Pulse Width for the Core Register | 0.30 | 0.34 | ns    |
| $t_{CKMPWH}$ | Clock Minimum Pulse Width HIGH for the Core Register          | 0.56 | 0.64 | ns    |
| $t_{CKMPWL}$ | Clock Minimum Pulse Width LOW for the Core Register           | 0.56 | 0.64 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-192 • Register Delays**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter    | Description   | -1   | Std. | Units |
|--------------|---|------|------|-------|
| $t_{CLKQ}$   | Clock-to-Q of the Core Register                               | 0.58 | 0.69 | ns    |
| $t_{SUD}$    | Data Setup Time for the Core Register                         | 0.45 | 0.53 | ns    |
| $t_{HD}$     | Data Hold Time for the Core Register                          | 0.00 | 0.00 | ns    |
| $t_{SUE}$    | Enable Setup Time for the Core Register                       | 0.48 | 0.57 | ns    |
| $t_{HE}$     | Enable Hold Time for the Core Register                        | 0.00 | 0.00 | ns    |
| $t_{CLR2Q}$  | Asynchronous Clear-to-Q of the Core Register                  | 0.42 | 0.50 | ns    |
| $t_{PRE2Q}$  | Asynchronous Preset-to-Q of the Core Register                 | 0.42 | 0.50 | ns    |
| $t_{REMCLR}$ | Asynchronous Clear Removal Time for the Core Register         | 0.00 | 0.00 | ns    |
| $t_{RECCLR}$ | Asynchronous Clear Recovery Time for the Core Register        | 0.24 | 0.28 | ns    |
| $t_{REMPRE}$ | Asynchronous Preset Removal Time for the Core Register        | 0.00 | 0.00 | ns    |
| $t_{RECPRE}$ | Asynchronous Preset Recovery Time for the Core Register       | 0.24 | 0.28 | ns    |
| $t_{WCLR}$   | Asynchronous Clear Minimum Pulse Width for the Core Register  | 0.30 | 0.34 | ns    |
| $t_{WPRE}$   | Asynchronous Preset Minimum Pulse Width for the Core Register | 0.30 | 0.34 | ns    |
| $t_{CKMPWH}$ | Clock Minimum Pulse Width HIGH for the Core Register          | 0.56 | 0.64 | ns    |
| $t_{CKMPWL}$ | Clock Minimum Pulse Width LOW for the Core Register           | 0.56 | 0.64 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-193 • Register Delays**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V for A3P250 and A3P1000**

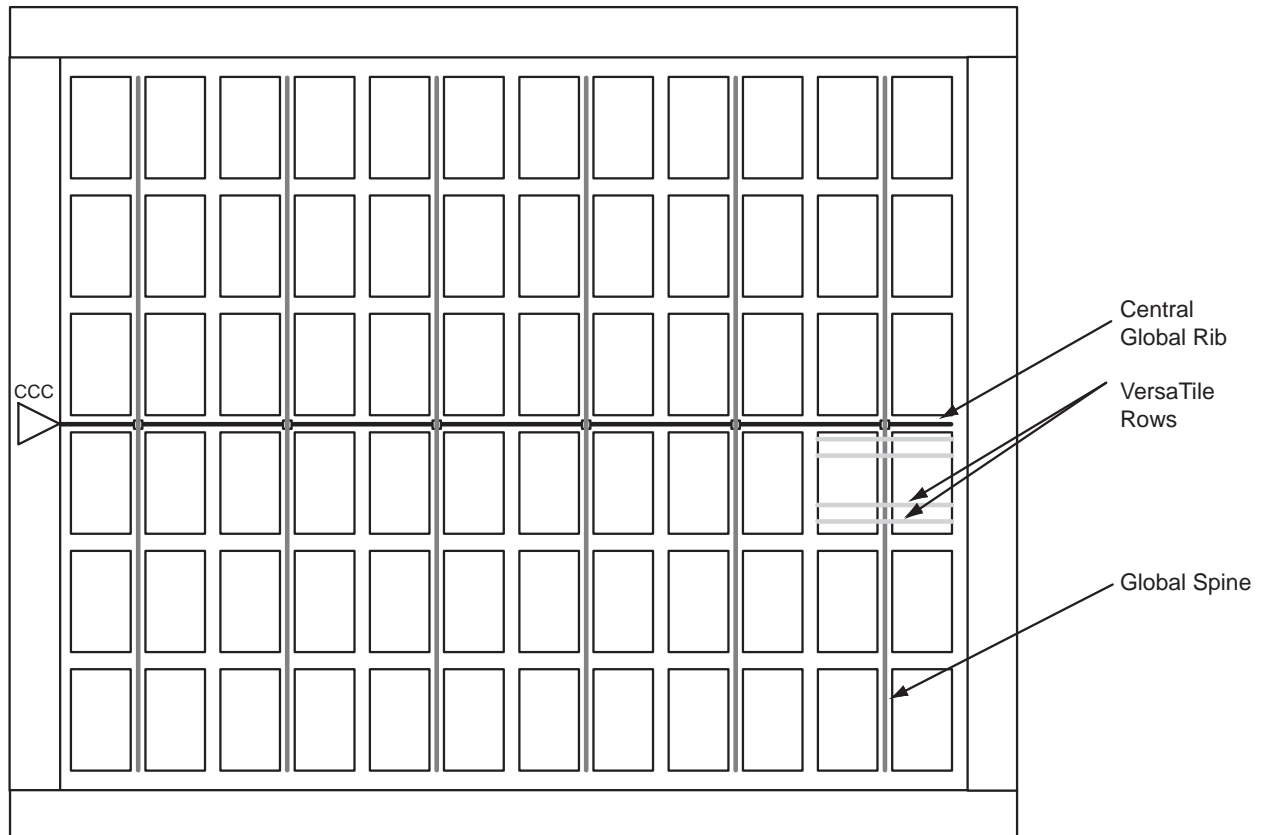
| Parameter           | Description   | -1   | Std. | Units |
|---------------------|---|------|------|-------|
| $t_{\text{CLKQ}}$   | Clock-to-Q of the Core Register                               | 0.66 | 0.78 | ns    |
| $t_{\text{SUD}}$    | Data Setup Time for the Core Register                         | 0.52 | 0.61 | ns    |
| $t_{\text{HD}}$     | Data Hold Time for the Core Register                          | 0.00 | 0.00 | ns    |
| $t_{\text{SUE}}$    | Enable Setup Time for the Core Register                       | 0.55 | 0.64 | ns    |
| $t_{\text{HE}}$     | Enable Hold Time for the Core Register                        | 0.00 | 0.00 | ns    |
| $t_{\text{CLR2Q}}$  | Asynchronous Clear-to-Q of the Core Register                  | 0.48 | 0.56 | ns    |
| $t_{\text{PRE2Q}}$  | Asynchronous Preset-to-Q of the Core Register                 | 0.48 | 0.56 | ns    |
| $t_{\text{REMCLR}}$ | Asynchronous Clear Removal Time for the Core Register         | 0.00 | 0.00 | ns    |
| $t_{\text{RECLR}}$  | Asynchronous Clear Recovery Time for the Core Register        | 0.27 | 0.31 | ns    |
| $t_{\text{REMPRE}}$ | Asynchronous Preset Removal Time for the Core Register        | 0.00 | 0.00 | ns    |
| $t_{\text{RECPRE}}$ | Asynchronous Preset Recovery Time for the Core Register       | 0.27 | 0.31 | ns    |
| $t_{\text{WCLR}}$   | Asynchronous Clear Minimum Pulse Width for the Core Register  | 0.25 | 0.30 | ns    |
| $t_{\text{WPRE}}$   | Asynchronous Preset Minimum Pulse Width for the Core Register | 0.25 | 0.30 | ns    |
| $t_{\text{CKMPWH}}$ | Clock Minimum Pulse Width HIGH for the Core Register          | 0.41 | 0.48 | ns    |
| $t_{\text{CKMPWL}}$ | Clock Minimum Pulse Width LOW for the Core Register           | 0.37 | 0.43 | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-6 on page 2-8](#) for derating values.

## Global Resource Characteristics

### A3P1000 Clock Tree Topology

Clock delays are device-specific. Figure 2-42 is an example of a global tree used for clock routing. The global tree presented in Figure 2-42 is driven by a CCC located on the west side of the A3P1000 device. It is used to drive all D-flip-flops in the device.



**Figure 2-42 • Example of Global Tree Use in an A3P1000 Device for Clock Routing**

## Global Tree Timing Characteristics

Global clock delays include the central rib delay, the spine delay, and the row delay. Delays do not include I/O input buffer clock delays, as these are I/O standard-dependent, and the clock may be driven and conditioned internally by the CCC module. For more details on clock conditioning capabilities, refer to the "Clock Conditioning Circuits" section on page 2-125. Table 2-194 to Table 2-197 on page 2-123 present minimum and maximum global clock delays within each device. Minimum and maximum delays are measured with minimum and maximum loading.

### Timing Characteristics

#### 1.2 V DC Core Voltage

**Table 2-194 • A3PE600L Global Resource**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.14\text{ V}$

| Parameter            | Description                               | -1                |                   | Std.              |                   | Units |
|----------------------|---|-------------------|-------------------|-------------------|-------------------|-------|
|                      |   | Min. <sup>1</sup> | Max. <sup>2</sup> | Min. <sup>1</sup> | Max. <sup>2</sup> |       |
| t <sub>RCKL</sub>    | Input LOW Delay for Global Clock          | 0.95              | 1.23              | 1.12              | 1.44              | ns    |
| t <sub>RCKH</sub>    | Input HIGH Delay for Global Clock         | 0.94              | 1.26              | 1.10              | 1.48              | ns    |
| t <sub>RCKMPWH</sub> | Minimum Pulse Width HIGH for Global Clock |                   |                   |                   |                   | ns    |
| t <sub>RCKMPWL</sub> | Minimum Pulse Width LOW for Global Clock  |                   |                   |                   |                   | ns    |
| t <sub>RCKSW</sub>   | Maximum Skew for Global Clock             |                   | 0.32              |                   | 0.38              | ns    |
| F <sub>RMAX</sub>    | Maximum Frequency for Global Clock        |                   |                   |                   |                   | MHz   |

#### Notes:

1. Value reflects minimum load. The delay is measured from the CCC output to the clock pin of a sequential element, located in a lightly loaded row (single element is connected to the global net).
2. Value reflects maximum load. The delay is measured on the clock pin of the farthest sequential element, located in a fully loaded row (all available flip-flops are connected to the global net in the row).
3. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-195 • A3PE3000L Global Resource**  
 Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.14\text{ V}$

| Parameter            | Description                               | -1                |                   | Std.              |                   | Units |
|----------------------|---|-------------------|-------------------|-------------------|-------------------|-------|
|                      |   | Min. <sup>1</sup> | Max. <sup>2</sup> | Min. <sup>1</sup> | Max. <sup>2</sup> |       |
| t <sub>RCKL</sub>    | Input LOW Delay for Global Clock          | 1.81              | 2.09              | 2.13              | 2.42              | ns    |
| t <sub>RCKH</sub>    | Input HIGH Delay for Global Clock         | 1.80              | 2.13              | 2.12              | 2.45              | ns    |
| t <sub>RCKMPWH</sub> | Minimum Pulse Width HIGH for Global Clock |                   |                   |                   |                   | ns    |
| t <sub>RCKMPWL</sub> | Minimum Pulse Width LOW for Global Clock  |                   |                   |                   |                   | ns    |
| t <sub>RCKSW</sub>   | Maximum Skew for Global Clock             |                   | 0.32              |                   | 0.38              | ns    |
| F <sub>RMAX</sub>    | Maximum Frequency for Global Clock        |                   |                   |                   |                   | MHz   |

#### Notes:

1. Value reflects minimum load. The delay is measured from the CCC output to the clock pin of a sequential element, located in a lightly loaded row (single element is connected to the global net).
2. Value reflects maximum load. The delay is measured on the clock pin of the farthest sequential element, located in a fully loaded row (all available flip-flops are connected to the global net in the row).
3. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.



**1.5 V DC Core Voltage**
**Table 2-196 • A3PE600L Global Resource**  
**Military-Case Conditions: T<sub>J</sub> = 125°C, VCC = 1.425 V**

| Parameter            | Description                               | -1                |                   | Std.              |                   | Units |
|----------------------|---|-------------------|-------------------|-------------------|-------------------|-------|
|                      |   | Min. <sup>1</sup> | Max. <sup>2</sup> | Min. <sup>1</sup> | Max. <sup>2</sup> |       |
| t <sub>RCKL</sub>    | Input Low Delay for Global Clock          | 0.82              | 1.07              | 0.97              | 1.26              | ns    |
| t <sub>RCKH</sub>    | Input High Delay for Global Clock         | 0.81              | 1.10              | 0.95              | 1.30              | ns    |
| t <sub>RCKMPWH</sub> | Minimum Pulse Width High for Global Clock |                   |                   |                   |                   | ns    |
| t <sub>RCKMPWL</sub> | Minimum Pulse Width Low for Global Clock  |                   |                   |                   |                   | ns    |
| t <sub>RCKSW</sub>   | Maximum Skew for Global Clock             |                   | 0.30              |                   | 0.35              | ns    |
| F <sub>RMAX</sub>    | Maximum Frequency for Global Clock        |                   |                   |                   |                   | MHz   |

**Notes:**

1. Value reflects minimum load. The delay is measured from the CCC output to the clock pin of a sequential element, located in a lightly loaded row (single element is connected to the global net).
2. Value reflects maximum load. The delay is measured on the clock pin of the farthest sequential element, located in a fully loaded row (all available flip-flops are connected to the global net in the row).
3. For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-197 • A3PE3000L Global Resource**  
**Military-Case Conditions: T<sub>J</sub> = 125°C, VCC = 1.425 V**

| Parameter            | Description                               | -1                |                   | Std.              |                   | Units |
|----------------------|---|-------------------|-------------------|-------------------|-------------------|-------|
|                      |   | Min. <sup>1</sup> | Max. <sup>2</sup> | Min. <sup>1</sup> | Max. <sup>2</sup> |       |
| t <sub>RCKL</sub>    | Input Low Delay for Global Clock          | 1.62              | 1.87              | 1.90              | 2.20              | ns    |
| t <sub>RCKH</sub>    | Input High Delay for Global Clock         | 1.61              | 1.90              | 1.89              | 2.24              | ns    |
| t <sub>RCKMPWH</sub> | Minimum Pulse Width High for Global Clock |                   |                   |                   |                   | ns    |
| t <sub>RCKMPWL</sub> | Minimum Pulse Width Low for Global Clock  |                   |                   |                   |                   | ns    |
| t <sub>RCKSW</sub>   | Maximum Skew for Global Clock             |                   | 0.30              |                   | 0.35              | ns    |
| F <sub>RMAX</sub>    | Maximum Frequency for Global Clock        |                   |                   |                   |                   | MHz   |

**Notes:**

1. Value reflects minimum load. The delay is measured from the CCC output to the clock pin of a sequential element, located in a lightly loaded row (single element is connected to the global net).
2. Value reflects maximum load. The delay is measured on the clock pin of the farthest sequential element, located in a fully loaded row (all available flip-flops are connected to the global net in the row).
3. For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-198 • A3P250 Global Resource**  
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$**

| Parameter            | Description                               | -1                |                   | Std.              |                   | Units |
|----------------------|---|-------------------|-------------------|-------------------|-------------------|-------|
|                      |   | Min. <sup>1</sup> | Max. <sup>2</sup> | Min. <sup>1</sup> | Max. <sup>2</sup> |       |
| t <sub>RCKL</sub>    | Input Low Delay for Global Clock          | 0.97              | 1.24              | 1.14              | 1.46              | ns    |
| t <sub>RCKH</sub>    | Input High Delay for Global Clock         | 0.94              | 1.27              | 1.11              | 1.49              | ns    |
| t <sub>RCKMPWH</sub> | Minimum Pulse Width High for Global Clock |                   |                   |                   |                   | ns    |
| t <sub>RCKMPWL</sub> | Minimum Pulse Width Low for Global Clock  |                   |                   |                   |                   | ns    |
| t <sub>RCKSW</sub>   | Maximum Skew for Global Clock             |                   | 0.32              |                   | 0.38              | ns    |
| F <sub>RMAX</sub>    | Maximum Frequency for Global Clock        |                   |                   |                   |                   | MHz   |

**Notes:**

1. Value reflects minimum load. The delay is measured from the CCC output to the clock pin of a sequential element, located in a lightly loaded row (single element is connected to the global net).
2. Value reflects maximum load. The delay is measured on the clock pin of the farthest sequential element, located in a fully loaded row (all available flip-flops are connected to the global net in the row).
3. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-199 • A3P1000 Global Resource**  
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$**

| Parameter            | Description                               | -1                |                   | Std.              |                   | Units |
|----------------------|---|-------------------|-------------------|-------------------|-------------------|-------|
|                      |   | Min. <sup>1</sup> | Max. <sup>2</sup> | Min. <sup>1</sup> | Max. <sup>2</sup> |       |
| t <sub>RCKL</sub>    | Input Low Delay for Global Clock          | 1.18              | 1.44              | 1.39              | 1.70              | ns    |
| t <sub>RCKH</sub>    | Input High Delay for Global Clock         | 1.17              | 1.48              | 1.37              | 1.74              | ns    |
| t <sub>RCKMPWH</sub> | Minimum Pulse Width High for Global Clock |                   |                   |                   |                   | ns    |
| t <sub>RCKMPWL</sub> | Minimum Pulse Width Low for Global Clock  |                   |                   |                   |                   | ns    |
| t <sub>RCKSW</sub>   | Maximum Skew for Global Clock             |                   | 0.32              |                   | 0.37              | ns    |
| F <sub>RMAX</sub>    | Maximum Frequency for Global Clock        |                   |                   |                   |                   | MHz   |

**Notes:**

1. Value reflects minimum load. The delay is measured from the CCC output to the clock pin of a sequential element, located in a lightly loaded row (single element is connected to the global net).
2. Value reflects maximum load. The delay is measured on the clock pin of the farthest sequential element, located in a fully loaded row (all available flip-flops are connected to the global net in the row).
3. For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

# Clock Conditioning Circuits

## CCC Electrical Specifications

### Timing Characteristics

**Table 2-200 • Military ProASIC3/EL CCC/PLL Specification**  
 For Devices Operating at 1.2 V DC Core Voltage: Applicable to A3PE600L and A3PE3000L Only

| Parameter  | Min.   | Typ.         | Max.         | Units         |
|--|--|--------------|--------------|---------------|
| Clock Conditioning Circuitry Input Frequency<br>$f_{IN\_CCC}$  | 1.5  |              | 250          | MHz           |
| Clock Conditioning Circuitry Output Frequency $f_{OUT\_CCC}$   | 0.75   |              | 250          | MHz           |
| Delay Increments in Programmable Delay Blocks <sup>1,2</sup>   |  | 360          |              | ps            |
| Number of Programmable Values in Each Programmable Delay Block |  |              | 32           |               |
| Serial Clock (SCLK) for Dynamic PLL <sup>3</sup>               |  |              | 100          | MHz           |
| Input cycle-to-cycle jitter (peak magnitude)                   |  |              | 1            | ns            |
| Acquisition Time   |  |              |              |               |
|  |  |              | 300          | $\mu$ s       |
|  |  |              | 6.0          | ms            |
| Tracking Jitter <sup>4</sup>                                   |  |              |              |               |
|  |  |              | 25           | ns            |
|  |  |              | 1.5          | ns            |
| Output Duty Cycle  | 48.5   |              | 51.5         | %             |
| Delay Range in Block: Programmable Delay 1 <sup>1,2</sup>      | 1.2  |              | 15.65        | ns            |
| Delay Range in Block: Programmable Delay 2 <sup>1,2</sup>      | 0.025  |              | 15.65        | ns            |
| Delay Range in Block: Fixed Delay <sup>1,2</sup>               |  | 3.5          |              | ns            |
| CCC Output Peak-to-Peak Period Jitter $F_{CCC\_OUT}$           | Max. Peak-to-Peak Period Jitter <sup>5,6</sup> |              |              |               |
|  | SSO $\leq$ 2                                   | SSO $\leq$ 4 | SSO $\leq$ 8 | SSO $\leq$ 16 |
| 0.75 MHz to 50 MHz   | 0.50%  | 0.60%        | 0.80%        | 1.60%         |
| 50 MHz to 160 MHz  | 2.50%  | 4.00%        | 6.00%        | 12.00%        |

#### Notes:

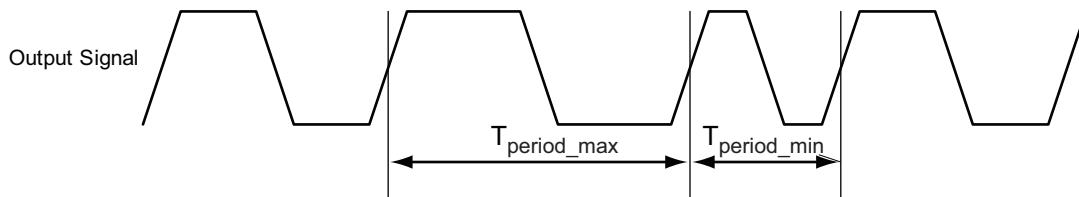
1. This delay is a function of voltage and temperature. See Table 2-5 on page 2-8 for deratings.
2.  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = 1.2\text{ V}$ .
3. Maximum value obtained for a -1 speed grade device in worst-case military conditions. For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.
4. Tracking jitter is defined as the variation in clock edge position of PLL outputs with reference to PLL input clock edge. Tracking jitter does not measure the variation in PLL output period, which is covered by period jitter parameter.
5. Measurements done with LVTTTL 3.3 V, 8 mA I/O drive strength and high slew rate.  $V_{CC}/V_{CCPLL} = 1.14\text{V}$ , VQ/PQ/TQ type of packages, 20 pF load.
6. Switching I/Os are placed outside of the PLL bank.

**Table 2-201 • Military ProASIC3/EL CCC/PLL Specification  
For Devices Operating at 1.5 V DC Core Voltage**

| Parameter  | Min.   | Typ.    | Max.    | Units    |
|--|--|---------|---------|----------|
| Clock Conditioning Circuitry Input Frequency $f_{IN\_CCC}$     | 1.5  |         | 350     | MHz      |
| Clock Conditioning Circuitry Output Frequency $f_{OUT\_CCC}$   | 0.75   |         | 350     | MHz      |
| Delay Increments in Programmable Delay Blocks <sup>1,2</sup>   |  | 160     |         | ps       |
| Number of Programmable Values in Each Programmable Delay Block |  |         | 32      |          |
| Serial Clock (SCLK) for Dynamic PLL <sup>3</sup>               |  |         | 110     | MHz      |
| Input cycle-to-cycle jitter (peak magnitude)                   |  |         | 1.5     | ns       |
| Acquisition Time   |  |         |         |          |
|  | LockControl = 0                                |         | 300     | μs       |
|  | LockControl = 1                                |         | 6.0     | ms       |
| Tracking Jitter <sup>4</sup>                                   |  |         |         |          |
|  | LockControl = 0                                |         | 1.6     | ns       |
|  | LockControl = 1                                |         | 0.8     | ns       |
| Output Duty Cycle  | 48.5   |         | 51.5    | %        |
| Delay Range in Block: Programmable Delay 1 <sup>1,2</sup>      | 0.6  |         | 5.56    | ns       |
| Delay Range in Block: Programmable Delay 2 <sup>1,2</sup>      | 0.025  |         | 5.56    | ns       |
| Delay Range in Block: Fixed Delay <sup>1,2</sup>               |  | 2.2     |         | ns       |
| CCC Output Peak-to-Peak Period Jitter $F_{CCC\_OUT}$           | Max. Peak-to-Peak Period Jitter <sup>5,6</sup> |         |         |          |
|  | SSO ≤ 2  | SSO ≤ 4 | SSO ≤ 8 | SSO ≤ 16 |
| 0.75 MHz to 50 MHz   | 0.50%  | 0.50%   | 0.70%   | 1.00%    |
| 50 MHz to 250 MHz  | 1.00%  | 3.00%   | 5.00%   | 9.00%    |
| 250 MHz to 350 MHz   | 2.50%  | 4.00%   | 6.00%   | 12.00%   |

**Notes:**

1. This delay is a function of voltage and temperature. See [Table 2-5 on page 2-8](#) for deratings.
2.  $T_J = 25^\circ\text{C}$ ,  $V_{CC} = 1.5\text{ V}$ .
3. Maximum value obtained for a -1 speed grade device in worst-case military conditions. For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.
4. Tracking jitter is defined as the variation in clock edge position of PLL outputs with reference to PLL input clock edge. Tracking jitter does not measure the variation in PLL output period, which is covered by period jitter parameter.
5. Measurements done with LVTTTL 3.3 V, 8 mA I/O drive strength and high slew rate.  $V_{CC}/V_{CCPLL} = 1.425\text{ V}$ , VQ/PQ/TQ type of packages, 20 pF load.
6. Switching I/Os are placed outside of the PLL bank.



**Note:** Peak-to-peak jitter measurements are defined by  $T_{\text{peak-to-peak}} = T_{\text{period\_max}} - T_{\text{period\_min}}$

**Figure 2-43 • Peak-to-Peak Jitter Definition**

# Embedded SRAM and FIFO Characteristics

## SRAM

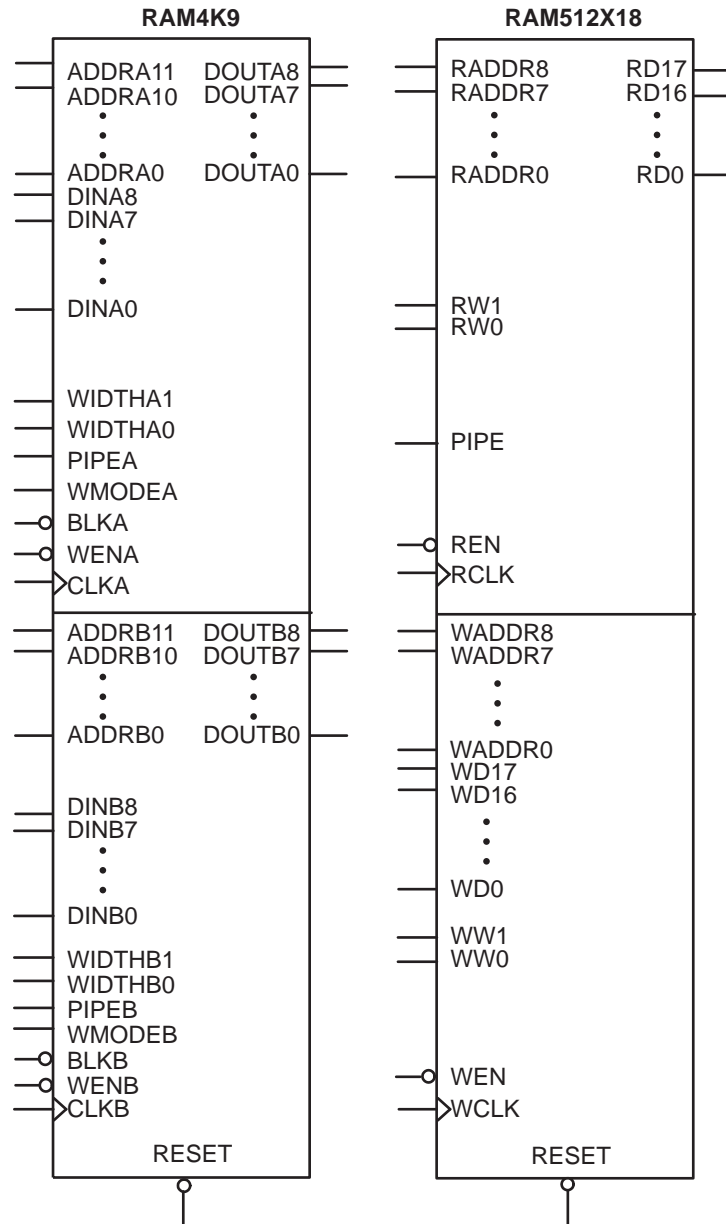
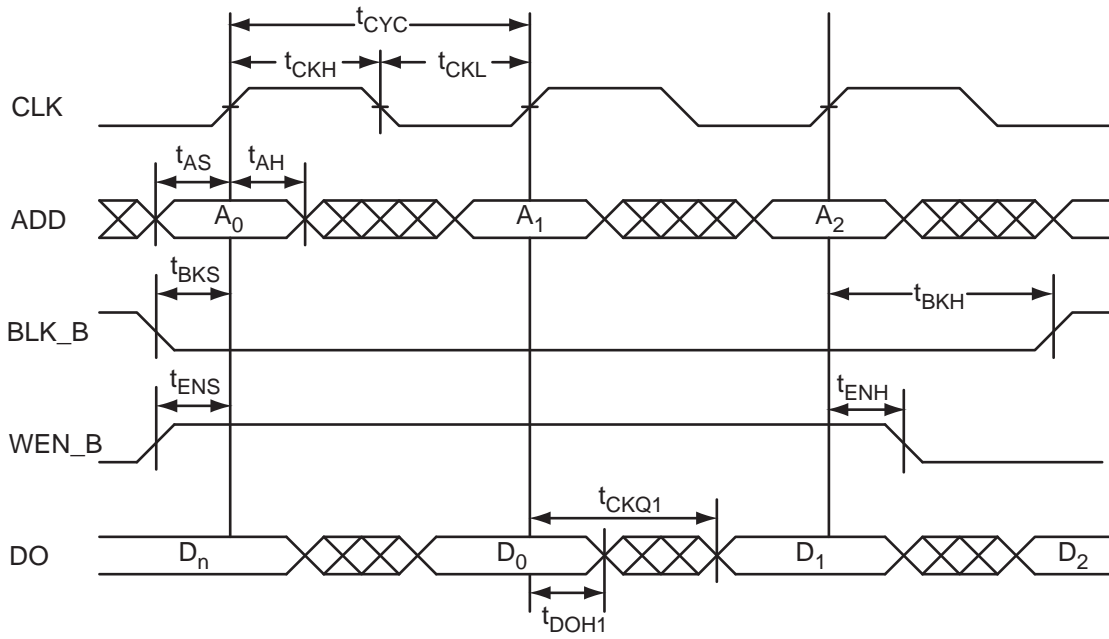
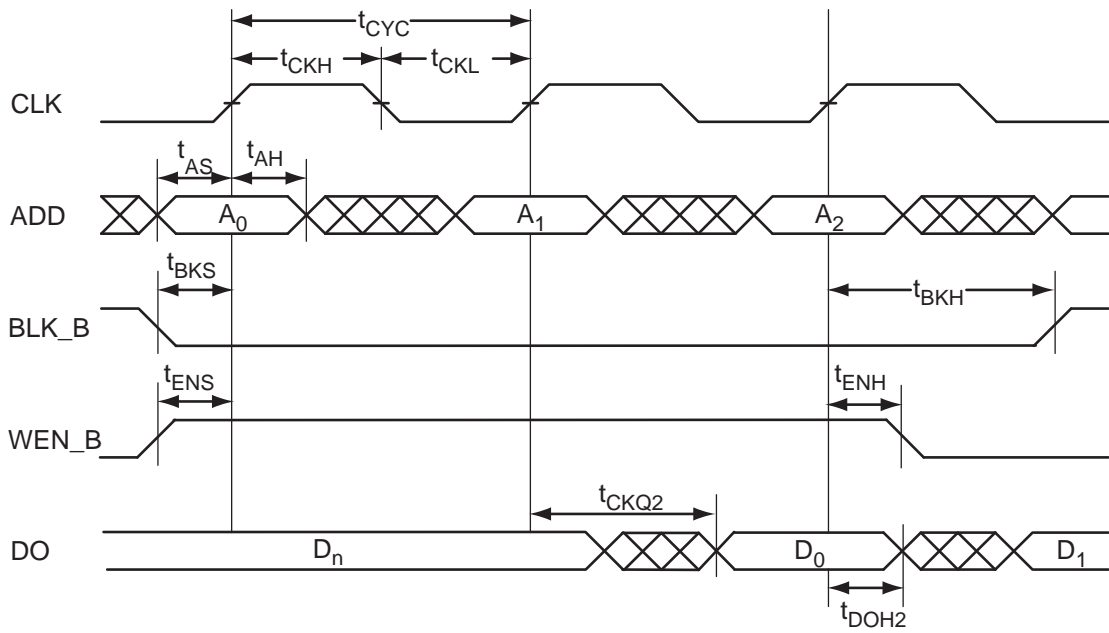


Figure 2-44 • RAM Models

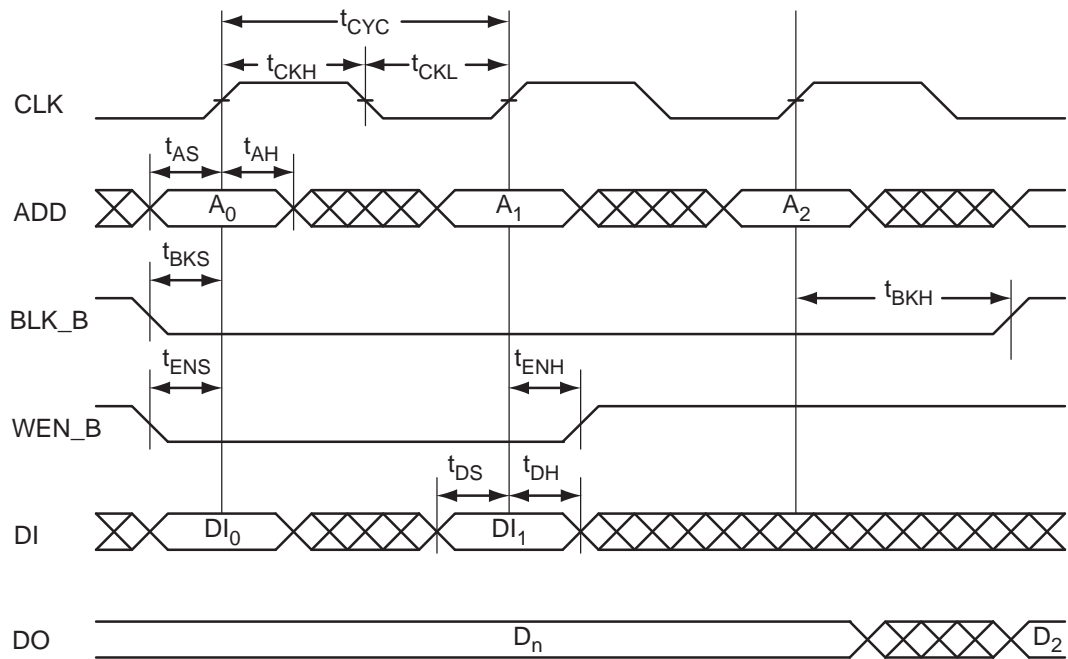
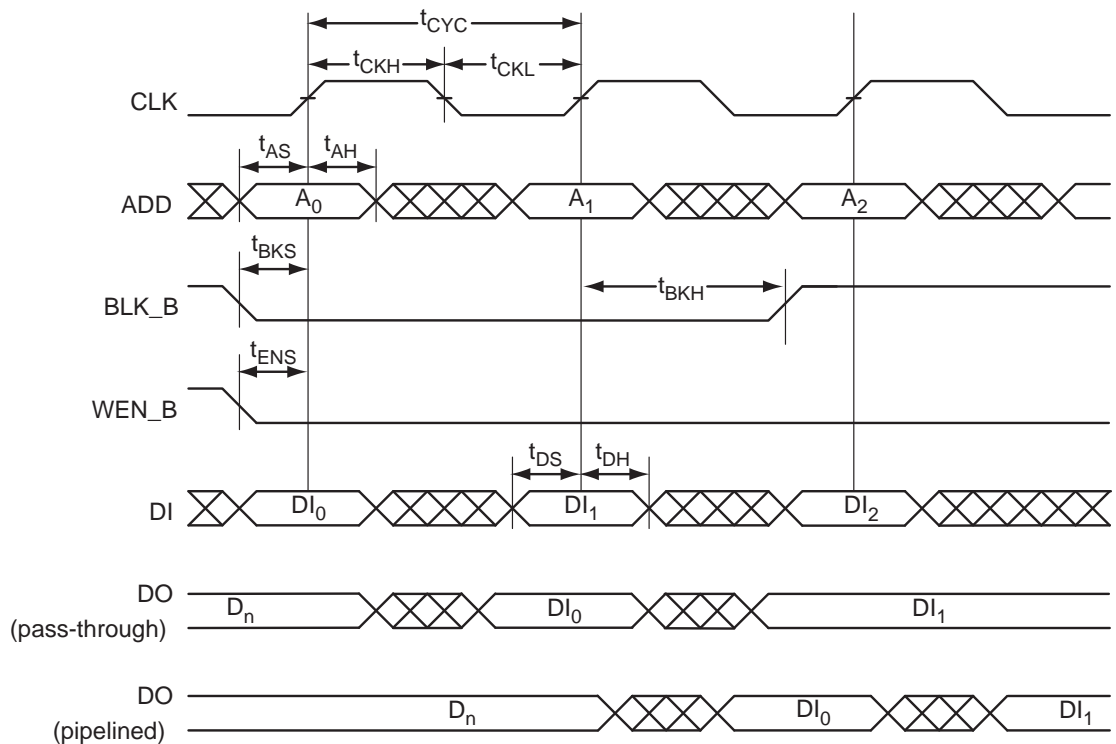
## Timing Waveforms

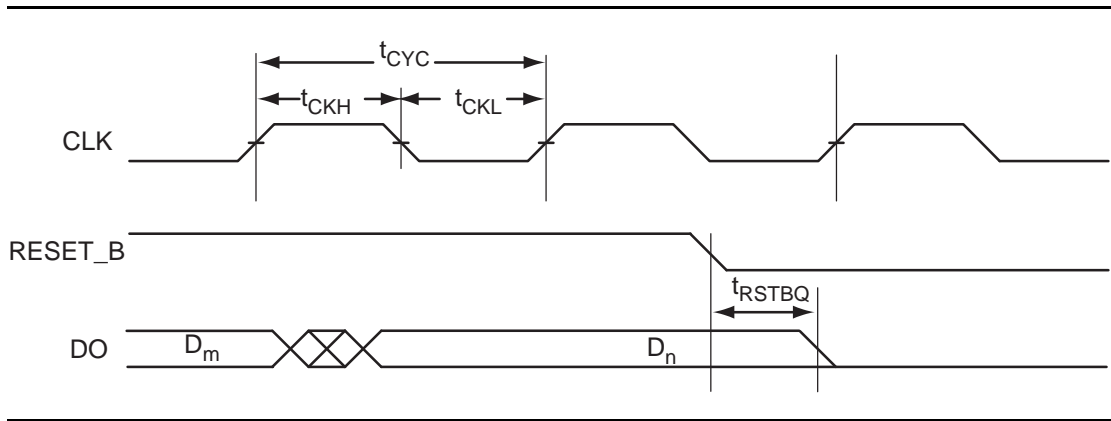


**Figure 2-45 • RAM Read for Pass-Through Output**



**Figure 2-46 • RAM Read for Pipelined Output**


**Figure 2-47 • RAM Write, Output Retained (WMODE = 0)**

**Figure 2-48 • RAM Write, Output as Write Data (WMODE = 1)**



**Figure 2-49 • RAM Reset**



## Timing Characteristics

**Table 2-202 • RAM4K9**
**Military-Case Conditions: T<sub>J</sub> = 125°C, Worst-Case VCC = 1.14 V for A3PE600L and A3PE3000L**

| Parameter            | Description  | -1   | Std. | Units |
|----------------------|--|------|------|-------|
| t <sub>AS</sub>      | Address setup time   | 0.35 | 0.41 | ns    |
| t <sub>AH</sub>      | Address hold time  | 0.00 | 0.00 | ns    |
| t <sub>ENS</sub>     | REN_B, WEN_B setup time  | 0.20 | 0.23 | ns    |
| t <sub>ENH</sub>     | REN_B, WEN_B hold time   | 0.13 | 0.16 | ns    |
| t <sub>BKS</sub>     | BLK_B setup time   | 0.32 | 0.38 | ns    |
| t <sub>BKH</sub>     | BLK_B hold time  | 0.03 | 0.03 | ns    |
| t <sub>DS</sub>      | Input data (DI) setup time   | 0.25 | 0.30 | ns    |
| t <sub>DH</sub>      | Input data (DI) hold time  | 0.00 | 0.00 | ns    |
| t <sub>CKQ1</sub>    | Clock High to new data valid on DO (output retained, WMODE = 0)  | 3.26 | 3.84 | ns    |
|                      | Clock High to new data valid on DO (flow-through, WMODE = 1)   | 2.47 | 2.91 | ns    |
| t <sub>CKQ2</sub>    | Clock High to new data valid on DO (pipelined)   | 1.24 | 1.46 | ns    |
| t <sub>C2CWWL</sub>  | Address collision clk-to-clk delay for reliable write after write on same address – applicable to closing edge       | 0.25 | 0.30 | ns    |
| t <sub>C2CRWH</sub>  | Address collision clk-to-clk delay for reliable read access after write on same address – applicable to opening edge | 0.27 | 0.32 | ns    |
| t <sub>C2CRWH</sub>  | Address collision clk-to-clk delay for reliable write access after read on same address – applicable to opening edge | 0.37 | 0.44 | ns    |
| t <sub>RSTBQ</sub>   | RESET_B Low to data out Low on DO (flow-through)   | 1.28 | 1.50 | ns    |
|                      | RESET_B Low to data out Low on DO (pipelined)  | 1.28 | 1.50 | ns    |
| t <sub>REMRSTB</sub> | RESET_B removal  | 0.40 | 0.47 | ns    |
| t <sub>RECRSTB</sub> | RESET_B recovery   | 2.08 | 2.44 | ns    |
| t <sub>MPWRSTB</sub> | RESET_B minimum pulse width  | 0.66 | 0.76 | ns    |
| t <sub>CYC</sub>     | Clock cycle time   | 6.08 | 6.99 | ns    |
| F <sub>MAX</sub>     | Maximum frequency  | 164  | 143  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-203 • RAM4K9**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter     | Description  | -1   | Std. | Units |
|---------------|--|------|------|-------|
| $t_{AS}$      | Address setup time   | 0.26 | 0.31 | ns    |
| $t_{AH}$      | Address hold time  | 0.00 | 0.00 | ns    |
| $t_{ENS}$     | REN_B, WEN_B setup time  | 0.15 | 0.18 | ns    |
| $t_{ENH}$     | REN_B, WEN_B hold time   | 0.10 | 0.12 | ns    |
| $t_{BKS}$     | BLK_B setup time   | 0.25 | 0.29 | ns    |
| $t_{BKH}$     | BLK_B hold time  | 0.02 | 0.02 | ns    |
| $t_{DS}$      | Input data (DI) setup time   | 0.19 | 0.23 | ns    |
| $t_{DH}$      | Input data (DI) hold time  | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to new data valid on DO (output retained, WMODE = 0)  | 2.50 | 2.93 | ns    |
|               | Clock HIGH to new data valid on DO (flow-through, WMODE = 1)   | 1.89 | 2.22 | ns    |
| $t_{CKQ2}$    | Clock HIGH to new data valid on DO (pipelined)   | 0.95 | 1.11 | ns    |
| $t_{C2CWWL}$  | Address collision clk-to-clk delay for reliable write after write on same address – applicable to closing edge       | 0.24 | 0.29 | ns    |
| $t_{C2CRWH}$  | Address collision clk-to-clk delay for reliable read access after write on same address – applicable to opening edge | 0.20 | 0.24 | ns    |
| $t_{C2CRWH}$  | Address collision clk-to-clk delay for reliable write access after read on same address – applicable to opening edge | 0.25 | 0.30 | ns    |
| $t_{RSTBQ}$   | RESET_B Low to data out Low on DO (flow-through)   | 0.98 | 1.15 | ns    |
|               | RESET_B Low to data out Low on DO (pipelined)  | 0.98 | 1.15 | ns    |
| $t_{REMRSTB}$ | RESET_B removal  | 0.30 | 0.36 | ns    |
| $t_{RECRSTB}$ | RESET_B recovery   | 1.59 | 1.87 | ns    |
| $t_{MPWRSTB}$ | RESET_B minimum pulse width  | 0.59 | 0.67 | ns    |
| $t_{CYC}$     | Clock cycle time   | 5.39 | 6.20 | ns    |
| $F_{MAX}$     | Maximum frequency  | 185  | 161  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-204 • RAM4K9**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Parameter     | Description  | -1   | Std. | Units |
|---------------|--|------|------|-------|
| $t_{AS}$      | Address setup time   | 0.30 | 0.35 | ns    |
| $t_{AH}$      | Address hold time  | 0.00 | 0.00 | ns    |
| $t_{ENS}$     | REN_B, WEN_B setup time  | 0.17 | 0.20 | ns    |
| $t_{ENH}$     | REN_B, WEN_B hold time   | 0.12 | 0.14 | ns    |
| $t_{BKS}$     | BLK_B setup time   | 0.28 | 0.33 | ns    |
| $t_{BKH}$     | BLK_B hold time  | 0.02 | 0.03 | ns    |
| $t_{DS}$      | Input data (DI) setup time   | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input data (DI) hold time  | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock High to new data valid on DO (output retained, WMODE = 0)  | 2.84 | 2.53 | ns    |
|               | Clock High to new data valid on DO (flow-through, WMODE = 1)   | 2.15 | 3.33 | ns    |
| $t_{CKQ2}$    | Clock High to new data valid on DO (pipelined)   | 1.08 | 1.27 | ns    |
| $t_{C2CWWL}$  | Address collision clk-to-clk delay for reliable write after write on same address – applicable to closing edge       | 0.28 | 0.33 | ns    |
| $t_{C2CWWH}$  | Address collision clk-to-clk delay for reliable write after write on same address – applicable to rising edge        | 0.26 | 0.30 | ns    |
| $t_{C2CRWH}$  | Address collision clk-to-clk delay for reliable read access after write on same address – applicable to opening edge | 0.38 | 0.45 | ns    |
| $t_{C2CWRH}$  | Address collision clk-to-clk delay for reliable write access after read on same address – applicable to opening edge | 0.42 | 0.49 | ns    |
| $t_{RSTBQ}$   | RESET_B Low to data out Low on DO (flow-through)   | 1.11 | 1.31 | ns    |
|               | RESET_B Low to data out Low on DO (pipelined)  | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B removal  | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B recovery   | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B minimum pulse width  | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock cycle time   | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum frequency  | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-205 • RAM512X18**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter     | Description  | -1   | Std. | Units |
|---------------|--|------|------|-------|
| $t_{AS}$      | Address setup time   | 0.35 | 0.41 | ns    |
| $t_{AH}$      | Address hold time  | 0.00 | 0.00 | ns    |
| $t_{ENS}$     | REN_B, WEN_B setup time  | 0.13 | 0.15 | ns    |
| $t_{ENH}$     | REN_B, WEN_B hold time   | 0.08 | 0.09 | ns    |
| $t_{DS}$      | Input data (DI) setup time   | 0.25 | 0.30 | ns    |
| $t_{DH}$      | Input data (DI) hold time  | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock High to new data valid on DO (output retained, WMODE = 0)  | 2.99 | 3.52 | ns    |
| $t_{CKQ2}$    | Clock High to new data valid on DO (pipelined)   | 1.24 | 1.46 | ns    |
| $t_{C2CRWH}$  | Address collision clk-to-clk delay for reliable read access after write on same address – applicable to opening edge | 0.25 | 0.29 | ns    |
| $t_{C2CWRH}$  | Address collision clk-to-clk delay for reliable write access after read on same address – applicable to opening edge | 0.31 | 0.36 | ns    |
| $t_{RSTBQ}$   | RESET_B Low to data out Low on DO (flow through)   | 1.28 | 1.50 | ns    |
|               | RESET_B Low to data out Low on DO (pipelined)  | 1.28 | 1.50 | ns    |
| $t_{REMRSTB}$ | RESET_B removal  | 0.40 | 0.47 | ns    |
| $t_{RECRSTB}$ | RESET_B recovery   | 2.08 | 2.44 | ns    |
| $t_{MPWRSTB}$ | RESET_B minimum pulse width  | 0.66 | 0.76 | ns    |
| $t_{CYC}$     | Clock cycle time   | 6.08 | 6.99 | ns    |
| $F_{MAX}$     | Maximum frequency  | 164  | 143  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-206 • RAM512X18**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter     | Description  | -1   | Std. | Units |
|---------------|--|------|------|-------|
| $t_{AS}$      | Address setup time   | 0.26 | 0.31 | ns    |
| $t_{AH}$      | Address hold time  | 0.00 | 0.00 | ns    |
| $t_{ENS}$     | REN_B, WEN_B setup time  | 0.10 | 0.11 | ns    |
| $t_{ENH}$     | REN_B, WEN_B hold time   | 0.06 | 0.07 | ns    |
| $t_{DS}$      | Input data (DI) setup time   | 0.19 | 0.23 | ns    |
| $t_{DH}$      | Input data (DI) hold time  | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock High to new data valid on DO (output retained, WMODE = 0)  | 2.29 | 2.69 | ns    |
| $t_{CKQ2}$    | Clock High to new data valid on DO (pipelined)   | 0.95 | 1.12 | ns    |
| $t_{C2CRWH}$  | Address collision clk-to-clk delay for reliable read access after write on same address – applicable to opening edge | 0.18 | 0.21 | ns    |
| $t_{C2CWRH}$  | Address collision clk-to-clk delay for reliable write access after read on same address – applicable to opening edge | 0.21 | 0.25 | ns    |
| $t_{RSTBQ}$   | RESET_B Low to data out Low on DO (flow through)   | 0.98 | 1.15 | ns    |
|               | RESET_B Low to data out Low on DO (pipelined)  | 0.98 | 1.15 | ns    |
| $t_{REMRSTB}$ | RESET_B removal  | 0.30 | 0.36 | ns    |
| $t_{RECRSTB}$ | RESET_B recovery   | 1.59 | 1.87 | ns    |
| $t_{MPWRSTB}$ | RESET_B minimum pulse width  | 0.59 | 0.67 | ns    |
| $t_{CYC}$     | Clock cycle time   | 5.39 | 6.20 | ns    |
| $F_{MAX}$     | Maximum frequency  | 185  | 161  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to [Table 2-5 on page 2-8](#) for derating values.

**Table 2-207 • RAM512X18**
**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000**

| Parameter     | Description  | -1   | Std. | Units |
|---------------|--|------|------|-------|
| $t_{AS}$      | Address setup time   | 0.30 | 0.35 | ns    |
| $t_{AH}$      | Address hold time  | 0.00 | 0.00 | ns    |
| $t_{ENS}$     | REN_B, WEN_B setup time  | 0.11 | 0.13 | ns    |
| $t_{ENH}$     | REN_B, WEN_B hold time   | 0.07 | 0.08 | ns    |
| $t_{DS}$      | Input data (DI) setup time   | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input data (DI) hold time  | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock High to new data valid on DO (output retained, WMODE = 0)  | 2.60 | 3.06 | ns    |
| $t_{CKQ2}$    | Clock High to new data valid on DO (pipelined)   | 1.08 | 1.27 | ns    |
| $t_{C2CRWH}$  | Address collision clk-to-clk delay for reliable read access after write on same address – applicable to opening edge | 0.43 | 0.50 | ns    |
| $t_{C2CWRH}$  | Address collision clk-to-clk delay for reliable write access after read on same address – applicable to opening edge | 0.50 | 0.59 | ns    |
| $t_{RSTBQ}$   | RESET_B Low to data out Low on DO (flow through)   | 1.11 | 1.31 | ns    |
|               | RESET_B Low to data out Low on DO (pipelined)  | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B removal  | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B recovery   | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B minimum pulse width  | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock cycle time   | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum frequency  | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## FIFO

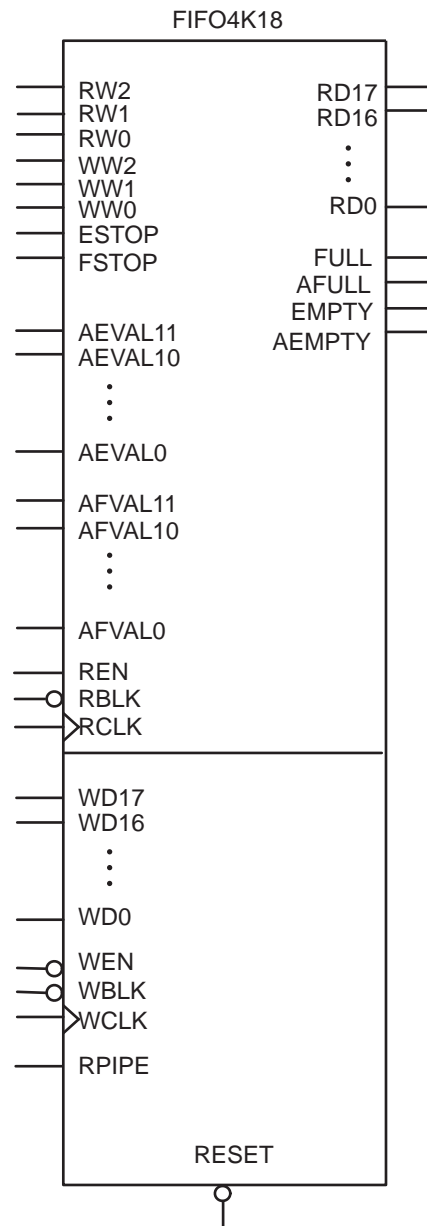
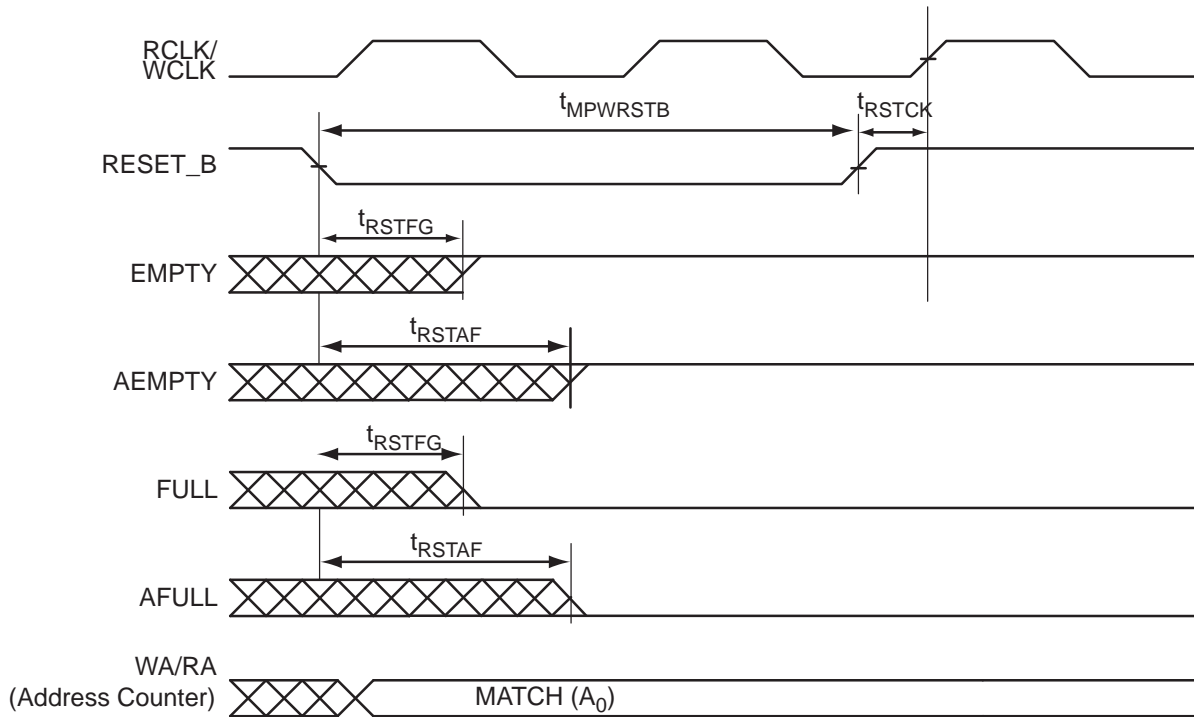
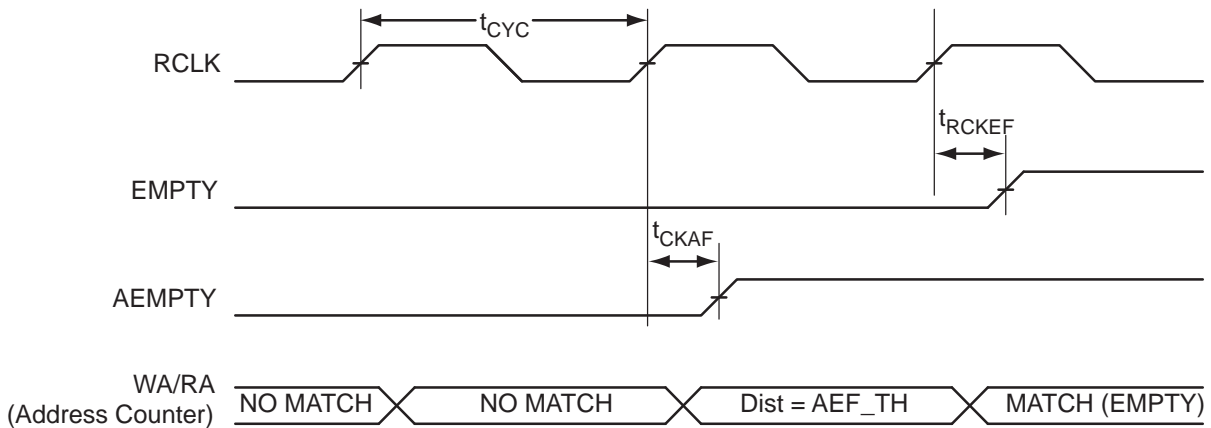


Figure 2-50 • FIFO Model

## Timing Waveforms

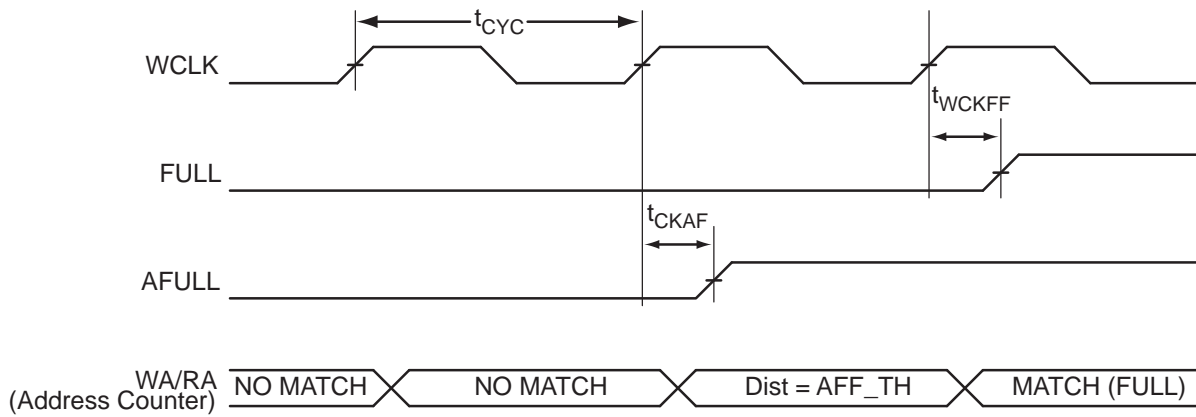
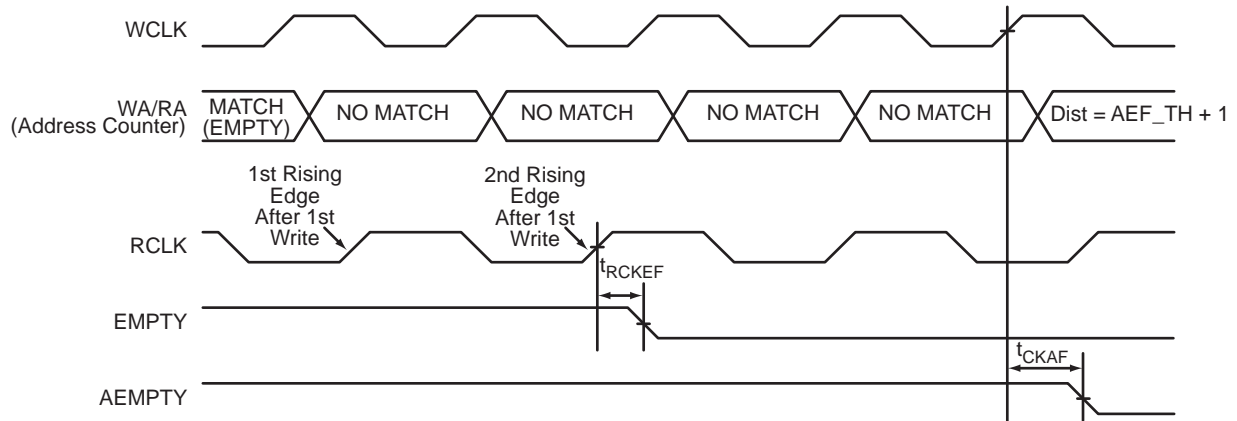
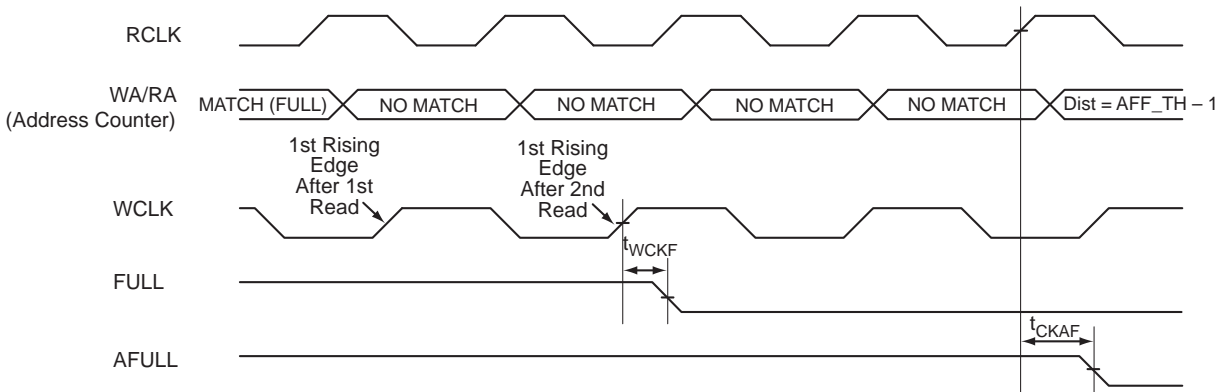


**Figure 2-51 • FIFO Reset**



**Figure 2-52 • FIFO EMPTY Flag and AEMPTY Flag Assertion**




**Figure 2-53 • FIFO FULL Flag and AFULL Flag Assertion**

**Figure 2-54 • FIFO EMPTY Flag and AEMPTY Flag Deassertion**

**Figure 2-55 • FIFO FULL Flag and AFULL Flag Deassertion**

## Timing Characteristics

**Table 2-208 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter     | Description                                       | -1   | Std.  | Units |
|---------------|---|------|-------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 1.91 | 2.24  | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.03 | 0.03  | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 0.40 | 0.47  | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00  | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.25 | 0.30  | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00  | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 3.26 | 3.84  | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.24 | 1.46  | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.38 | 2.80  | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 2.26 | 2.66  | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 8.57 | 10.08 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.34 | 2.76  | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 8.48 | 9.97  | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.28 | 1.50  | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.28 | 1.50  | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.40 | 0.47  | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 2.08 | 2.44  | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.66 | 0.76  | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 6.08 | 6.99  | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 164  | 143   | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-209 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 1.46 | 1.71 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.02 | 0.02 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 0.40 | 0.47 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.19 | 0.23 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.50 | 2.93 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 0.95 | 1.11 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 1.82 | 2.14 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.73 | 2.03 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 6.56 | 7.71 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 1.79 | 2.11 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 6.49 | 7.63 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 0.98 | 1.15 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 0.98 | 1.15 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.30 | 0.36 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.59 | 1.87 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.59 | 0.67 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 5.39 | 6.20 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 185  | 161  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-210 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3P1000**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 1.66 | 1.95 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.00 | 0.00 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 1.66 | 1.95 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.84 | 3.33 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.08 | 1.27 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.07 | 2.43 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.96 | 2.31 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 7.45 | 8.76 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.04 | 2.40 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 7.38 | 8.67 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.11 | 1.31 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-211 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3P250 (256x16)**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 3.92 | 4.61 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.00 | 0.00 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 1.66 | 1.95 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.61 | 3.06 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.14 | 1.34 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.07 | 2.43 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.96 | 2.31 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 7.45 | 8.76 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.04 | 2.40 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 7.38 | 8.67 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.11 | 1.31 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-212 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3P250 (512x8)**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 4.52 | 5.31 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.00 | 0.00 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 1.66 | 1.95 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.61 | 3.06 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.14 | 1.34 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.07 | 2.43 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.96 | 2.31 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 7.45 | 8.76 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.04 | 2.40 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 7.38 | 8.67 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.11 | 1.31 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-213 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3P250 (1kx4)**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 4.88 | 5.73 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.00 | 0.00 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 1.66 | 1.95 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.84 | 3.33 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.08 | 1.27 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.07 | 2.43 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.96 | 2.31 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 7.45 | 8.76 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.04 | 2.40 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 7.38 | 8.67 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.11 | 1.31 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

**Table 2-214 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3P250 (2kx2)**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 5.28 | 6.21 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.00 | 0.00 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 1.66 | 1.95 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.84 | 3.33 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.08 | 1.27 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.07 | 2.43 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.96 | 2.31 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 7.45 | 8.76 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.04 | 2.40 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 7.38 | 8.67 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.11 | 1.31 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.



**Table 2-215 • FIFO**
**Worst Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3P250 (4kx1)**

| Parameter     | Description                                       | -1   | Std. | Units |
|---------------|---|------|------|-------|
| $t_{ENS}$     | REN_B, WEN_B Setup Time                           | 5.85 | 6.87 | ns    |
| $t_{ENH}$     | REN_B, WEN_B Hold Time                            | 0.00 | 0.00 | ns    |
| $t_{BKS}$     | BLK_B Setup Time                                  | 1.66 | 1.95 | ns    |
| $t_{BKH}$     | BLK_B Hold Time                                   | 0.00 | 0.00 | ns    |
| $t_{DS}$      | Input Data (DI) Setup Time                        | 0.22 | 0.26 | ns    |
| $t_{DH}$      | Input Data (DI) Hold Time                         | 0.00 | 0.00 | ns    |
| $t_{CKQ1}$    | Clock HIGH to New Data Valid on DO (flow-through) | 2.84 | 3.33 | ns    |
| $t_{CKQ2}$    | Clock HIGH to New Data Valid on DO (pipelined)    | 1.08 | 1.27 | ns    |
| $t_{RCKEF}$   | RCLK HIGH to Empty Flag Valid                     | 2.07 | 2.43 | ns    |
| $t_{WCKFF}$   | WCLK HIGH to Full Flag Valid                      | 1.96 | 2.31 | ns    |
| $t_{CKAF}$    | Clock HIGH to Almost Empty/Full Flag Valid        | 7.45 | 8.76 | ns    |
| $t_{RSTFG}$   | RESET_B LOW to Empty/Full Flag Valid              | 2.04 | 2.40 | ns    |
| $t_{RSTAF}$   | RESET_B LOW to Almost Empty/Full Flag Valid       | 7.38 | 8.67 | ns    |
| $t_{RSTBQ}$   | RESET_B LOW to Data Out LOW on DO (flow-through)  | 1.11 | 1.31 | ns    |
|               | RESET_B LOW to Data Out LOW on DO (pipelined)     | 1.11 | 1.31 | ns    |
| $t_{REMRSTB}$ | RESET_B Removal                                   | 0.34 | 0.40 | ns    |
| $t_{RECRSTB}$ | RESET_B Recovery                                  | 1.81 | 2.12 | ns    |
| $t_{MPWRSTB}$ | RESET_B Minimum Pulse Width                       | 0.26 | 0.30 | ns    |
| $t_{CYC}$     | Clock Cycle Time                                  | 3.89 | 4.57 | ns    |
| $F_{MAX}$     | Maximum Frequency for FIFO                        | 257  | 219  | MHz   |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## Embedded FlashROM Characteristics

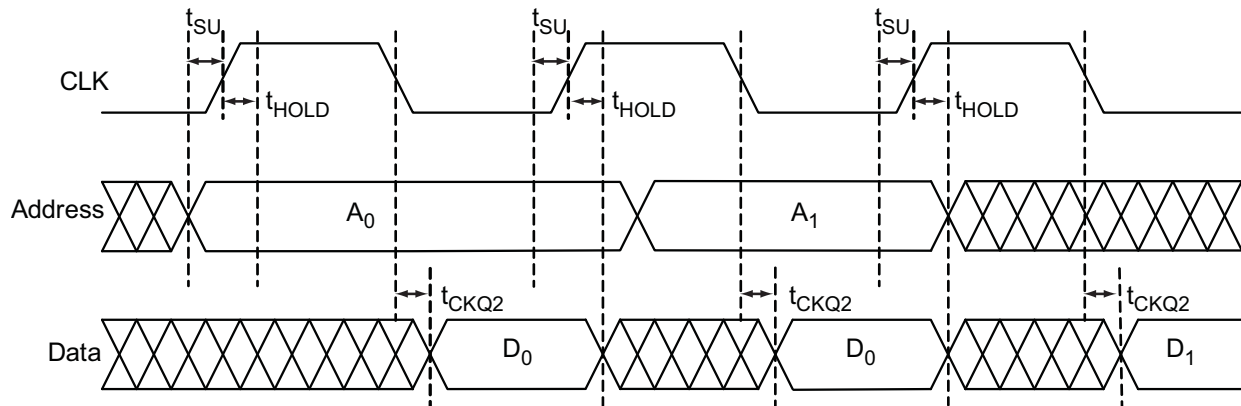


Figure 2-56 • Timing Diagram

### Timing Characteristics

Table 2-216 • Embedded FlashROM Access Time

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.14\text{ V}$  for A3PE600L and A3PE3000L

| Parameter  | Description             | -1    | Std.  | Units |
|------------|-------------------------|-------|-------|-------|
| $t_{SU}$   | Address Setup Time      | 0.74  | 0.87  | ns    |
| $t_{HOLD}$ | Address Hold Time       | 0.00  | 0.00  | ns    |
| $t_{CKQ2}$ | Clock to Out            | 16.18 | 19.02 | ns    |
| $F_{MAX}$  | Maximum Clock Frequency | 15    | 15    | MHz   |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

Table 2-217 • Embedded FlashROM Access Time

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 1.425\text{ V}$  for A3PE600L and A3PE3000L

| Parameter  | Description             | -1    | Std.  | Units |
|------------|-------------------------|-------|-------|-------|
| $t_{SU}$   | Address Setup Time      | 0.58  | 0.68  | ns    |
| $t_{HOLD}$ | Address Hold Time       | 0.00  | 0.00  | ns    |
| $t_{CKQ2}$ | Clock to Out            | 12.77 | 15.01 | ns    |
| $F_{MAX}$  | Maximum Clock Frequency | 15    | 15    | MHz   |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

Table 2-218 • Embedded FlashROM Access Time

Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case  $V_{CC} = 1.425\text{ V}$  for A3P250 and A3P1000

| Parameter  | Description             | -1    | Std.  | Units |
|------------|-------------------------|-------|-------|-------|
| $t_{SU}$   | Address Setup Time      | 0.64  | 0.75  | ns    |
| $t_{HOLD}$ | Address Hold Time       | 0.00  | 0.00  | ns    |
| $t_{CKQ2}$ | Clock to Out            | 19.54 | 22.97 | ns    |
| $F_{MAX}$  | Maximum Clock Frequency | 15    | 15    | MHz   |

Note: For specific junction temperature and voltage supply levels, refer to Table 2-6 on page 2-8 for derating values.

## JTAG 1532 Characteristics

JTAG timing delays do not include JTAG I/Os. To obtain complete JTAG timing, add I/O buffer delays to the corresponding standard selected; refer to the I/O timing characteristics in the "User I/O Characteristics" section on page 2-20 for more details.

### Timing Characteristics

**Table 2-219 • JTAG 1532**

**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.14 V for A3PE600L and A3PE3000L**

| Parameter            | Description                 | -1    | Std.  | Units |
|----------------------|-----------------------------|-------|-------|-------|
| $t_{\text{DISU}}$    | Test Data Input Setup Time  | 0.80  | 0.94  | ns    |
| $t_{\text{DIHD}}$    | Test Data Input Hold Time   | 1.60  | 1.88  | ns    |
| $t_{\text{TMSSU}}$   | Test Mode Select Setup Time | 0.80  | 0.94  | ns    |
| $t_{\text{TMDHD}}$   | Test Mode Select Hold Time  | 1.60  | 1.88  | ns    |
| $t_{\text{TCK2Q}}$   | Clock to Q (data out)       | 6.39  | 7.52  | ns    |
| $t_{\text{RSTB2Q}}$  | Reset to Q (data out)       | 26.63 | 31.33 | ns    |
| $F_{\text{TCKMAX}}$  | TCK Maximum Frequency       | 18.70 | 15.90 | MHz   |
| $t_{\text{TRSTREM}}$ | ResetB Removal Time         | 0.48  | 0.56  | ns    |
| $t_{\text{TRSTREC}}$ | ResetB Recovery Time        | 0.00  | 0.00  | ns    |
| $t_{\text{TRSTMPW}}$ | ResetB Minimum Pulse        | TBD   | TBD   | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.

**Table 2-220 • JTAG 1532**

**Military-Case Conditions:  $T_J = 125^\circ\text{C}$ , Worst-Case VCC = 1.425 V for All Dies**

| Parameter            | Description                 | -1    | Std.  | Units |
|----------------------|-----------------------------|-------|-------|-------|
| $t_{\text{DISU}}$    | Test Data Input Setup Time  | 0.60  | 0.71  | ns    |
| $t_{\text{DIHD}}$    | Test Data Input Hold Time   | 1.21  | 1.42  | ns    |
| $t_{\text{TMSSU}}$   | Test Mode Select Setup Time | 0.60  | 0.71  | ns    |
| $t_{\text{TMDHD}}$   | Test Mode Select Hold Time  | 1.21  | 1.42  | ns    |
| $t_{\text{TCK2Q}}$   | Clock to Q (data out)       | 6.04  | 7.10  | ns    |
| $t_{\text{RSTB2Q}}$  | Reset to Q (data out)       | 24.15 | 28.41 | ns    |
| $F_{\text{TCKMAX}}$  | TCK Maximum Frequency       | 22.00 | 19.00 | MHz   |
| $t_{\text{TRSTREM}}$ | ResetB Removal Time         | 0.00  | 0.00  | ns    |
| $t_{\text{TRSTREC}}$ | ResetB Recovery Time        | 0.24  | 0.28  | ns    |
| $t_{\text{TRSTMPW}}$ | ResetB Minimum Pulse        | TBD   | TBD   | ns    |

*Note:* For specific junction temperature and voltage supply levels, refer to Table 2-5 on page 2-8 for derating values.



## 3 – Pin Descriptions and Packaging

### Supply Pins

**GND**                                  **Ground**

Ground supply voltage to the core, I/O outputs, and I/O logic.

**GNDQ**                                  **Ground (quiet)**

Quiet ground supply voltage to input buffers of I/O banks. Within the package, the GNDQ plane is decoupled from the simultaneous switching noise originated from the output buffer ground domain. This minimizes the noise transfer within the package and improves input signal integrity. GNDQ must always be connected to GND on the board.

**VCC**                                      **Core Supply Voltage**

Supply voltage to the FPGA core, nominally 1.5 V for A3P250 and A3P100 devices and 1.2 V or 1.5 V for A3PE600L and A3PE3000L devices. VCC is required for powering the JTAG state machine in addition to VJTAG. Even when a device is in bypass mode in a JTAG chain of interconnected devices, both VCC and VJTAG must remain powered to allow JTAG signals to pass through the device.

For A3PE600L and A3PE3000L devices, VCC can be switched dynamically from 1.2 V to 1.5 V or vice versa. This allows in-system programming (ISP) when VCC is at 1.5 V and the benefit of low power operation when VCC is at 1.2 V.

**VCCIBx**                                  **I/O Supply Voltage**

Supply voltage to the bank's I/O output buffers and I/O logic. Bx is the I/O bank number. There are up to eight I/O banks on low power flash devices plus a dedicated VJTAG bank. Each bank can have a separate VCCI connection. All I/Os in a bank will run off the same VCCIBx supply. VCCI can be 1.5 V, 1.8 V, 2.5 V, or 3.3 V, nominal voltage. Unused I/O banks should have their corresponding VCCI pins tied to GND.

**VMVx**                                      **I/O Supply Voltage (quiet)**

Quiet supply voltage to the input buffers of each I/O bank. x is the bank number. Within the package, the VMV plane is decoupled from the simultaneous switching noise originating from the output buffer  $V_{CCI}$  domain. This minimizes the noise transfer within the package and improves input signal integrity. Each bank must have at least one VMV connection, and no VMV should be left unconnected. All I/Os in a bank run off the same VMVx supply. VMV is used to provide a quiet supply voltage to the input buffers of each I/O bank. VMVx can be 1.2 V (A3PE600L and A3PE3000L only), 1.5 V, 1.8 V, 2.5 V, or 3.3 V, nominal voltage. Unused I/O banks should have their corresponding VMV pins tied to GND. VMV and VCCI should be at the same voltage within a given I/O bank. Used VMV pins must be connected to the corresponding VCCI pins of the same bank (i.e., VMV0 to VCCIB0, VMV1 to VCCIB1, etc.).

**VCCPLA/B/C/D/E/F**                  **PLL Supply Voltage**

Supply voltage to analog PLL, nominally 1.5 V or 1.2 V, depending on the device.

- 1.5 V for A3P250 and A3P1000 devices
- 1.2 V or 1.5 V for A3PE600L or A3PE3000L devices

When the PLLs are not used, the Microsemi Designer place-and-route tool automatically disables the unused PLLs to lower power consumption. The user should tie unused VCCPLx and VCOMPLx pins to ground. Microsemi recommends tying VCCPLx to VCC and using proper filtering circuits to decouple VCC noise from the PLLs. Refer to the PLL Power Supply Decoupling section of the "Clock Conditioning Circuits in Low Power Flash Devices and Mixed Signal FPGAs" chapter of the [Military ProASIC3/EL Device Family User's Guide](#) for a complete board solution for the PLL analog power supply and ground.

- There is one VCCPLF pin on A3P250 and A3P1000 devices.
- There are six VCCPLX pins on A3PE600L and A3PE3000L devices.

**VCOMPLA/B/C/D/E/F PLL Ground**

Ground to analog PLL power supplies. When the PLLs are not used, the Microsemi Designer place-and-route tool automatically disables the unused PLLs to lower power consumption. The user should tie unused VCCPLx and VCOMPLx pins to ground.

- There is one VCOMPLF pin on A3P250 and A3P1000 devices.
- There are six VCOMPL pins (PLL ground) on A3PE600L and A3PE3000L devices.

**VJTAG JTAG Supply Voltage**

Military ProASIC3/EL devices have a separate bank for the dedicated JTAG pins. The JTAG pins can be run at any voltage from 1.5 V to 3.3 V (nominal). Isolating the JTAG power supply in a separate I/O bank gives greater flexibility in supply selection and simplifies power supply and PCB design. If the JTAG interface is neither used nor planned for use, the VJTAG pin together with the TRST pin could be tied to GND. It should be noted that VCC is required to be powered for JTAG operation; VJTAG alone is insufficient. If a device is in a JTAG chain of interconnected boards, the board containing the device can be powered down, provided both VJTAG and VCC to the part remain powered; otherwise, JTAG signals will not be able to transition the device, even in bypass mode.

Microsemi recommends that VPUMP and VJTAG power supplies be kept separate with independent filtering capacitors rather than supplying them from a common rail.

**VPUMP Programming Supply Voltage**

A3P250 and A3P1000 devices support single-voltage ISP of the configuration flash and FlashROM. For programming, VPUMP should be 3.3 V nominal. During normal device operation, VPUMP can be left floating or can be tied (pulled up) to any voltage between 0 V and the VPUMP maximum. Programming power supply voltage (VPUMP) range is listed in [Table 2-2 on page 2-2](#).

When the VPUMP pin is tied to ground, it will shut off the charge pump circuitry, resulting in no sources of oscillation from the charge pump circuitry.

For proper programming, 0.01  $\mu$ F and 0.33  $\mu$ F capacitors (both rated at 16 V) are to be connected in parallel across VPUMP and GND, and positioned as close to the FPGA pins as possible.

Microsemi recommends that VPUMP and VJTAG power supplies be kept separate with independent filtering capacitors rather than supplying them from a common rail.

## User-Defined Supply Pins

**VREF I/O Voltage Reference**

Reference voltage for I/O minibanks in A3PE600L and A3PE3000L devices. VREF pins are configured by the user from regular I/Os, and any I/O in a bank, except JTAG I/Os, can be designated the voltage reference I/O. Only certain I/O standards require a voltage reference—HSTL (I) and (II), SSTL2 (I) and (II), SSTL3 (I) and (II), and GTL/GTL+. One VREF pin can support the number of I/Os available in its minibank.

## User Pins

**I/O User Input/Output**

The I/O pin functions as an input, output, tristate, or bidirectional buffer. Input and output signal levels are compatible with the I/O standard selected.

During programming, I/Os become tristated and weakly pulled up to VCCI. With VCCI, VMV, and VCC supplies continuously powered up, when the device transitions from programming to operating mode, the I/Os are instantly configured to the desired user configuration.

Unused I/Os are configured as follows:

- Output buffer is disabled (with tristate value of high impedance)
- Input buffer is disabled (with tristate value of high impedance)
- Weak pull-up is programmed

## GL Globals

GL I/Os have access to certain clock conditioning circuitry (and the PLL) and/or have direct access to the global network (spines). Additionally, the global I/Os can be used as regular I/Os, since they have identical capabilities. Unused GL pins are configured as inputs with pull-up resistors.

See more detailed descriptions of global I/O connectivity in the "Clock Conditioning Circuits in Low Power Flash Devices and Mixed Signal FPGAs " chapter of the *Military ProASIC3/EL FPGA Fabric User's Guide*. All inputs labeled GC/GF are direct inputs into the quadrant clocks. For example, if GAA0 is used for an input, GAA1 and GAA2 are no longer available for input to the quadrant globals. All inputs labeled GC/GF are direct inputs into the chip-level globals, and the rest are connected to the quadrant globals. The inputs to the global network are multiplexed, and only one input can be used as a global input.

Refer to the "I/O Structures in IGLOO and ProASIC3 Devices" chapter (for A3P250 and A3P1000) or "I/O Structures in IGLOOe and ProASIC3E Devices" (for A3PE600L and A3PE3000L) of the *Military ProASIC3/EL FPGA Fabric User's Guide* for an explanation of the naming of global pins.

## FF Flash\*Freeze Mode Activation Pin

Flash\*Freeze is available on A3PE600L and A3PE3000L devices. The FF pin is a dedicated input pin used to enter and exit Flash\*Freeze mode. The FF pin is active low, has the same characteristics as a single-ended I/O, and must meet the maximum rise and fall times. When Flash\*Freeze mode is not used in the design, the FF pin is available as a regular I/O. The FF pin can be configured as a Schmitt trigger input.

When Flash\*Freeze mode is used, the FF pin must not be left floating to avoid accidentally entering Flash\*Freeze mode. While in Flash\*Freeze mode, the Flash\*Freeze pin should be constantly asserted.

The Flash\*Freeze pin can be used with any single-ended I/O standard supported by the I/O bank in which the pin is located, and input signal levels compatible with the I/O standard selected. The FF pin should be treated as a sensitive asynchronous signal. When defining pin placement and board layout, simultaneously switching outputs (SSOs) and their effects on sensitive asynchronous pins must be considered.

Unused FF or I/O pins are tristated with weak pull-up. This default configuration applies to both Flash\*Freeze mode and normal operation mode. No user intervention is required.

Table 3-1 shows the Flash\*Freeze pin location on the available packages for Military ProASIC3/EL devices. The Flash\*Freeze pin location is independent of device, allowing migration to larger or smaller devices while maintaining the same pin location on the board. Refer to the "Flash\*Freeze Technology and Low Power Modes" chapter of the *Military ProASIC3/EL FPGA Fabric User's Guide* for more information on I/O states during Flash\*Freeze mode.

**Table 3-1 • Flash\*Freeze Pin Location in Military ProASIC3/EL Packages (device-independent)**

| Military ProASIC3/EL Packages | Flash*Freeze Pin |
|-------------------------------|------------------|
| FG484                         | W6               |
| FG896                         | AH4              |

## JTAG Pins

Low power flash devices have a separate bank for the dedicated JTAG pins. The JTAG pins can be run at any voltage from 1.5 V to 3.3 V (nominal). VCC must also be powered for the JTAG state machine to operate, even if the device is in bypass mode; VJTAG alone is insufficient. Both VJTAG and VCC to the part must be supplied to allow JTAG signals to transition the device. Isolating the JTAG power supply in a separate I/O bank gives greater flexibility in supply selection and simplifies power supply and PCB design. If the JTAG interface is neither used nor planned for use, the VJTAG pin together with the TRST pin could be tied to GND.

### **TCK** **Test Clock**

Test clock input for JTAG boundary scan, ISP, and UJTAG. The TCK pin does not have an internal pull-up/down resistor. If JTAG is not used, Microsemi recommends tying off TCK to GND through a resistor placed close to the FPGA pin. This prevents JTAG operation in case TMS enters an undesired state.

Note that to operate at all VJTAG voltages, 500  $\Omega$  to 1 k $\Omega$  will satisfy the requirements. Refer to [Table 3-2](#) for more information.

**Table 3-2 • Recommended Tie-Off Values for the TCK and TRST Pins**

| VJTAG          | Tie-Off Resistance           |
|----------------|------------------------------|
| VJTAG at 3.3 V | 200 $\Omega$ to 1 k $\Omega$ |
| VJTAG at 2.5 V | 200 $\Omega$ to 1 k $\Omega$ |
| VJTAG at 1.8 V | 500 $\Omega$ to 1 k $\Omega$ |
| VJTAG at 1.5 V | 500 $\Omega$ to 1 k $\Omega$ |

*Notes:*

1. Equivalent parallel resistance if more than one device is on the JTAG chain
2. The TCK pin can be pulled up/down.
3. The TRST pin is pulled down.

### **TDI** **Test Data Input**

Serial input for JTAG boundary scan, ISP, and UJTAG usage. There is an internal weak pull-up resistor on the TDI pin.

### **TDO** **Test Data Output**

Serial output for JTAG boundary scan, ISP, and UJTAG usage.

### **TMS** **Test Mode Select**

The TMS pin controls the use of the IEEE 1532 boundary scan pins (TCK, TDI, TDO, TRST). There is an internal weak pull-up resistor on the TMS pin.

### **TRST** **Boundary Scan Reset Pin**

The TRST pin functions as an active low input to asynchronously initialize (or reset) the boundary scan circuitry. There is an internal weak pull-up resistor on the TRST pin. If JTAG is not used, an external pull-down resistor could be included to ensure the test access port (TAP) is held in reset mode. The resistor values must be chosen from [Table 3-2](#) and must satisfy the parallel resistance value requirement. The values in [Table 3-2](#) correspond to the resistor recommended when a single device is used, and the equivalent parallel resistor when multiple devices are connected via a JTAG chain.

In critical applications, an upset in the JTAG circuit could allow entrance to an undesired JTAG state. In such cases, Microsemi recommends tying off TRST to GND through a resistor placed close to the FPGA pin.

Note that to operate at all VJTAG voltages, 500  $\Omega$  to 1 k $\Omega$  will satisfy the requirements.



## Special Function Pins

### **NC**                                **No Connect**

This pin is not connected to circuitry within the device. These pins can be driven to any voltage or can be left floating with no effect on the operation of the device.

### **DC**                                **Do Not Connect**

This pin should not be connected to any signals on the PCB. These pins should be left unconnected.

## Packaging

Semiconductor technology is constantly shrinking in size while growing in capability and functional integration. To enable next-generation silicon technologies, semiconductor packages have also evolved to provide improved performance and flexibility.

Microsemi consistently delivers packages that provide the necessary mechanical and environmental protection to ensure consistent reliability and performance. Microsemi IC packaging technology efficiently supports high-density FPGAs with large-pin-count Ball Grid Arrays (BGAs), but is also flexible enough to accommodate stringent form factor requirements for Chip Scale Packaging (CSP). In addition, Microsemi offers a variety of packages designed to meet your most demanding application and economic requirements for today's embedded and mobile systems.

## Related Documents

### **User's Guides**

*Military ProASIC3/EL Device Family User's Guide*

[http://www.actel.com/documents/Mil\\_PA3\\_EL\\_UG.pdf](http://www.actel.com/documents/Mil_PA3_EL_UG.pdf)

### **Packaging**

The following documents provide packaging information and device selection for low power flash devices.

#### **Product Catalog**

[http://www.actel.com/documents/ProdCat\\_PIB.pdf](http://www.actel.com/documents/ProdCat_PIB.pdf)

Lists devices currently recommended for new designs and the packages available for each member of the family. Use this document or the datasheet tables to determine the best package for your design, and which package drawing to use.

#### **Package Mechanical Drawings**

<http://www.actel.com/documents/PckgMechDrwns.pdf>

This document contains the package mechanical drawings for all packages currently or previously supplied by Microsemi. Use the bookmarks to navigate to the package mechanical drawings.

Additional packaging materials are at <http://www.actel.com/products/solutions/package/docs.aspx>.



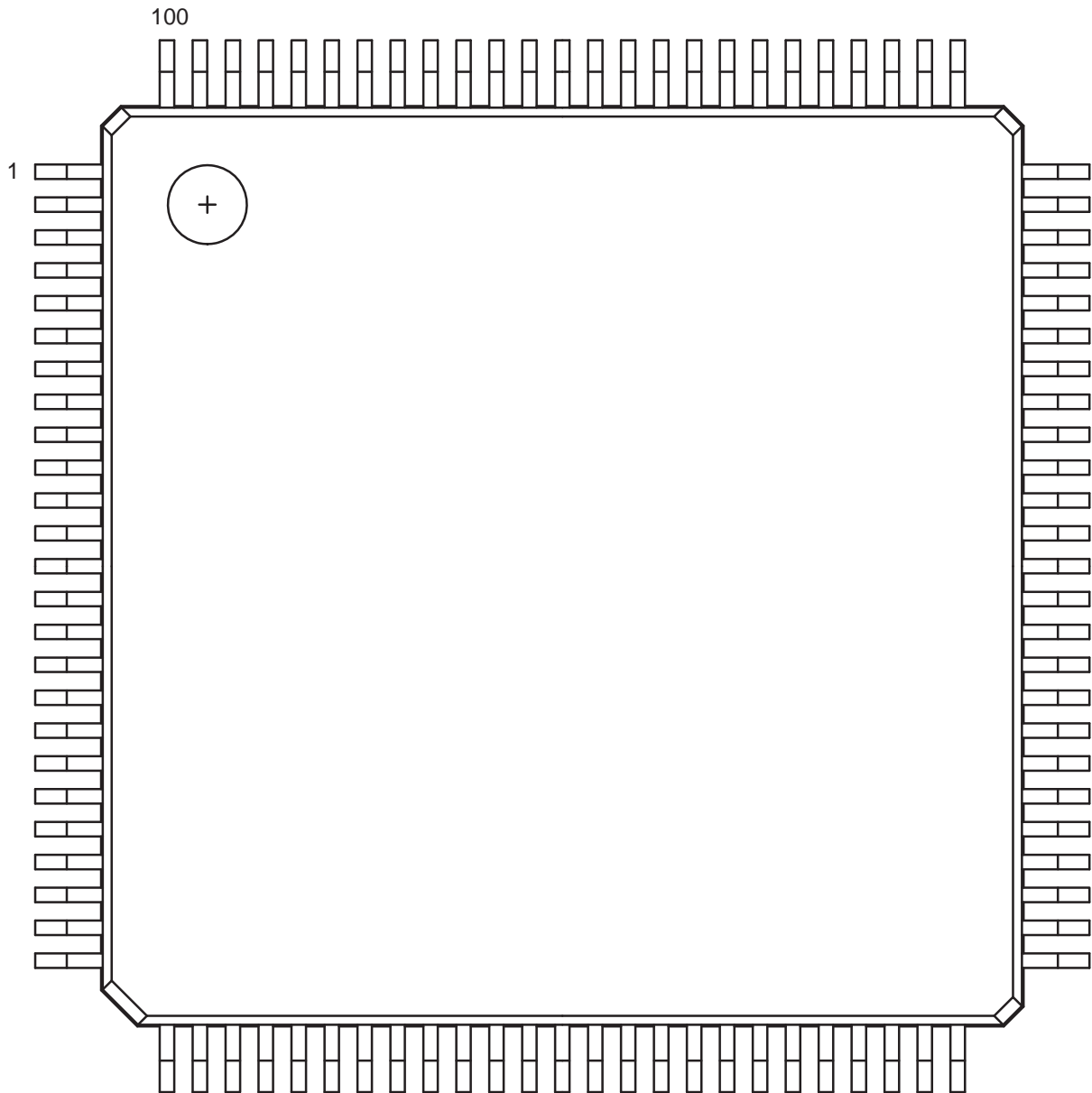
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## 4 – Package Pin Assignments

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### VQ100

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*Note:* This is the top view of the package.

#### **Note**

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.actel.com/products/solutions/package/docs.aspx>.

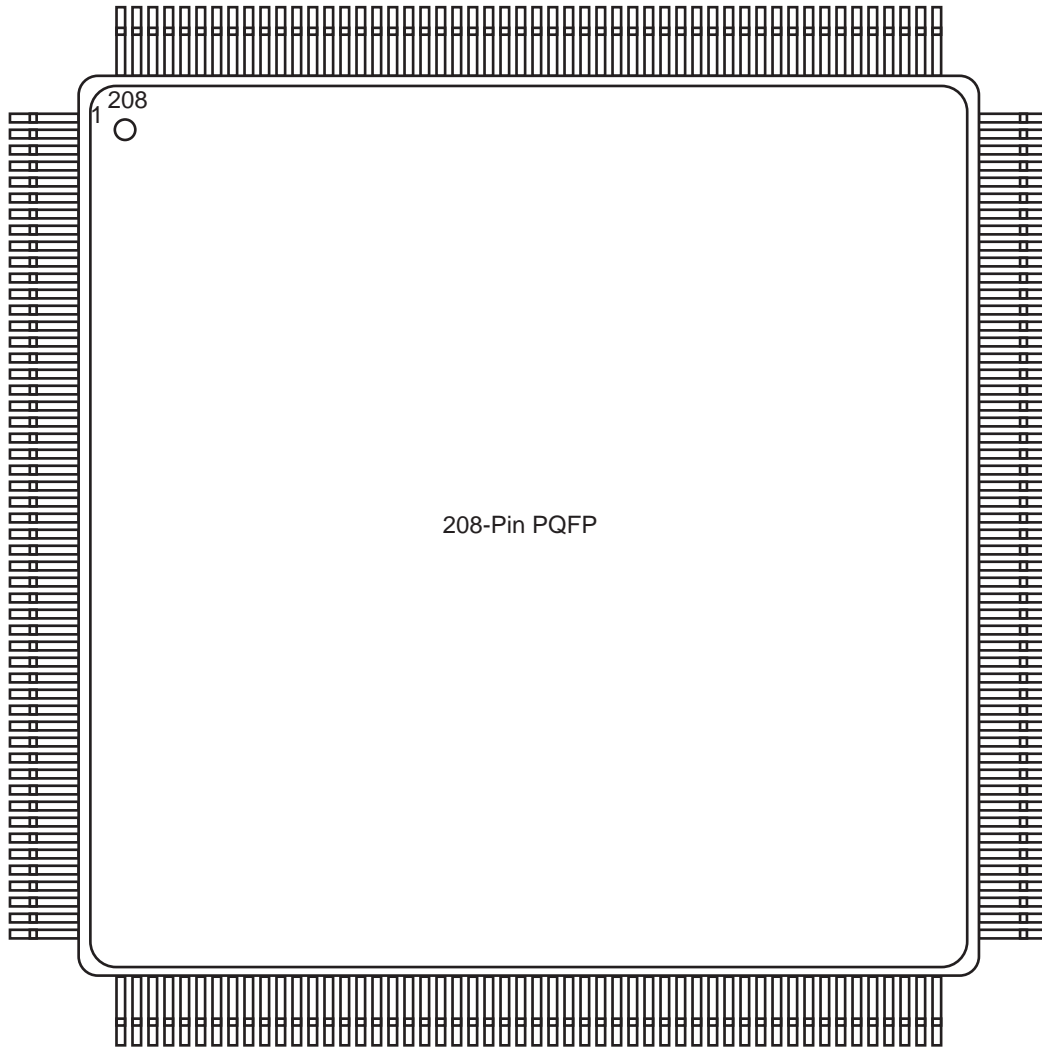
| VQ100*     |                 |
|------------|-----------------|
| Pin Number | A3P250 Function |
| 1          | GND             |
| 2          | GAA2/IO118UDB3  |
| 3          | IO118VDB3       |
| 4          | GAB2/IO117UDB3  |
| 5          | IO117VDB3       |
| 6          | GAC2/IO116UDB3  |
| 7          | IO116VDB3       |
| 8          | IO112PSB3       |
| 9          | GND             |
| 10         | GFB1/IO109PDB3  |
| 11         | GFB0/IO109NDB3  |
| 12         | VCOMPLF         |
| 13         | GFA0/IO108NPB3  |
| 14         | VCCPLF          |
| 15         | GFA1/IO108PPB3  |
| 16         | GFA2/IO107PSB3  |
| 17         | VCC             |
| 18         | VCCIB3          |
| 19         | GFC2/IO105PSB3  |
| 20         | GEC1/IO100PDB3  |
| 21         | GEC0/IO100NDB3  |
| 22         | GEA1/IO98PDB3   |
| 23         | GEA0/IO98NDB3   |
| 24         | VMV3            |
| 25         | GNDQ            |
| 26         | GEA2/IO97RSB2   |
| 27         | GEB2/IO96RSB2   |
| 28         | GEC2/IO95RSB2   |
| 29         | IO93RSB2        |
| 30         | IO92RSB2        |
| 31         | IO91RSB2        |
| 32         | IO90RSB2        |
| 33         | IO88RSB2        |
| 34         | IO86RSB2        |
| 35         | IO85RSB2        |
| 36         | IO84RSB2        |

| VQ100*     |                 |
|------------|-----------------|
| Pin Number | A3P250 Function |
| 37         | VCC             |
| 38         | GND             |
| 39         | VCCIB2          |
| 40         | IO77RSB2        |
| 41         | IO74RSB2        |
| 42         | IO71RSB2        |
| 43         | GDC2/IO63RSB2   |
| 44         | GDB2/IO62RSB2   |
| 45         | GDA2/IO61RSB2   |
| 46         | GNDQ            |
| 47         | TCK             |
| 48         | TDI             |
| 49         | TMS             |
| 50         | VMV2            |
| 51         | GND             |
| 52         | VPUMP           |
| 53         | NC              |
| 54         | TDO             |
| 55         | TRST            |
| 56         | VJTAG           |
| 57         | GDA1/IO60USB1   |
| 58         | GDC0/IO58VDB1   |
| 59         | GDC1/IO58UDB1   |
| 60         | IO52NDB1        |
| 61         | GCB2/IO52PDB1   |
| 62         | GCA1/IO50PDB1   |
| 63         | GCA0/IO50NDB1   |
| 64         | GCC0/IO48NDB1   |
| 65         | GCC1/IO48PDB1   |
| 66         | VCCIB1          |
| 67         | GND             |
| 68         | VCC             |
| 69         | IO43NDB1        |
| 70         | GBC2/IO43PDB1   |
| 71         | GBB2/IO42PSB1   |
| 72         | IO41NDB1        |

| VQ100*     |                 |
|------------|-----------------|
| Pin Number | A3P250 Function |
| 73         | GBA2/IO41PDB1   |
| 74         | VMV1            |
| 75         | GNDQ            |
| 76         | GBA1/IO40RSB0   |
| 77         | GBA0/IO39RSB0   |
| 78         | GBB1/IO38RSB0   |
| 79         | GBB0/IO37RSB0   |
| 80         | GBC1/IO36RSB0   |
| 81         | GBC0/IO35RSB0   |
| 82         | IO29RSB0        |
| 83         | IO27RSB0        |
| 84         | IO25RSB0        |
| 85         | IO23RSB0        |
| 86         | IO21RSB0        |
| 87         | VCCIB0          |
| 88         | GND             |
| 89         | VCC             |
| 90         | IO15RSB0        |
| 91         | IO13RSB0        |
| 92         | IO11RSB0        |
| 93         | GAC1/IO05RSB0   |
| 94         | GAC0/IO04RSB0   |
| 95         | GAB1/IO03RSB0   |
| 96         | GAB0/IO02RSB0   |
| 97         | GAA1/IO01RSB0   |
| 98         | GAA0/IO00RSB0   |
| 99         | GNDQ            |
| 100        | VMV0            |

## PQ208

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*Note:* This is the top view of the package.

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### **Note**

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.actel.com/products/solutions/package/docs.aspx>.

| PQ208      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| 1          | GND              |
| 2          | GAA2/IO225PDB3   |
| 3          | IO225NDB3        |
| 4          | GAB2/IO224PDB3   |
| 5          | IO224NDB3        |
| 6          | GAC2/IO223PDB3   |
| 7          | IO223NDB3        |
| 8          | IO222PDB3        |
| 9          | IO222NDB3        |
| 10         | IO220PDB3        |
| 11         | IO220NDB3        |
| 12         | IO218PDB3        |
| 13         | IO218NDB3        |
| 14         | IO216PDB3        |
| 15         | IO216NDB3        |
| 16         | VCC              |
| 17         | GND              |
| 18         | VCCIB3           |
| 19         | IO212PDB3        |
| 20         | IO212NDB3        |
| 21         | GFC1/IO209PDB3   |
| 22         | GFC0/IO209NDB3   |
| 23         | GFB1/IO208PDB3   |
| 24         | GFB0/IO208NDB3   |
| 25         | VCOMPLF          |
| 26         | GFA0/IO207NPB3   |
| 27         | VCCPLF           |
| 28         | GFA1/IO207PPB3   |
| 29         | GND              |
| 30         | GFA2/IO206PDB3   |
| 31         | IO206NDB3        |
| 32         | GFB2/IO205PDB3   |
| 33         | IO205NDB3        |
| 34         | GFC2/IO204PDB3   |
| 35         | IO204NDB3        |
| 36         | VCC              |

| PQ208      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| 37         | IO199PDB3        |
| 38         | IO199NDB3        |
| 39         | IO197PSB3        |
| 40         | VCCIB3           |
| 41         | GND              |
| 42         | IO191PDB3        |
| 43         | IO191NDB3        |
| 44         | GEC1/IO190PDB3   |
| 45         | GEC0/IO190NDB3   |
| 46         | GEB1/IO189PDB3   |
| 47         | GEB0/IO189NDB3   |
| 48         | GEA1/IO188PDB3   |
| 49         | GEA0/IO188NDB3   |
| 50         | VMV3             |
| 51         | GNDQ             |
| 52         | GND              |
| 53         | VMV2             |
| 54         | GEA2/IO187RSB2   |
| 55         | GEB2/IO186RSB2   |
| 56         | GEC2/IO185RSB2   |
| 57         | IO184RSB2        |
| 58         | IO183RSB2        |
| 59         | IO182RSB2        |
| 60         | IO181RSB2        |
| 61         | IO180RSB2        |
| 62         | VCCIB2           |
| 63         | IO178RSB2        |
| 64         | IO176RSB2        |
| 65         | GND              |
| 66         | IO174RSB2        |
| 67         | IO172RSB2        |
| 68         | IO170RSB2        |
| 69         | IO168RSB2        |
| 70         | IO166RSB2        |
| 71         | VCC              |
| 72         | VCCIB2           |

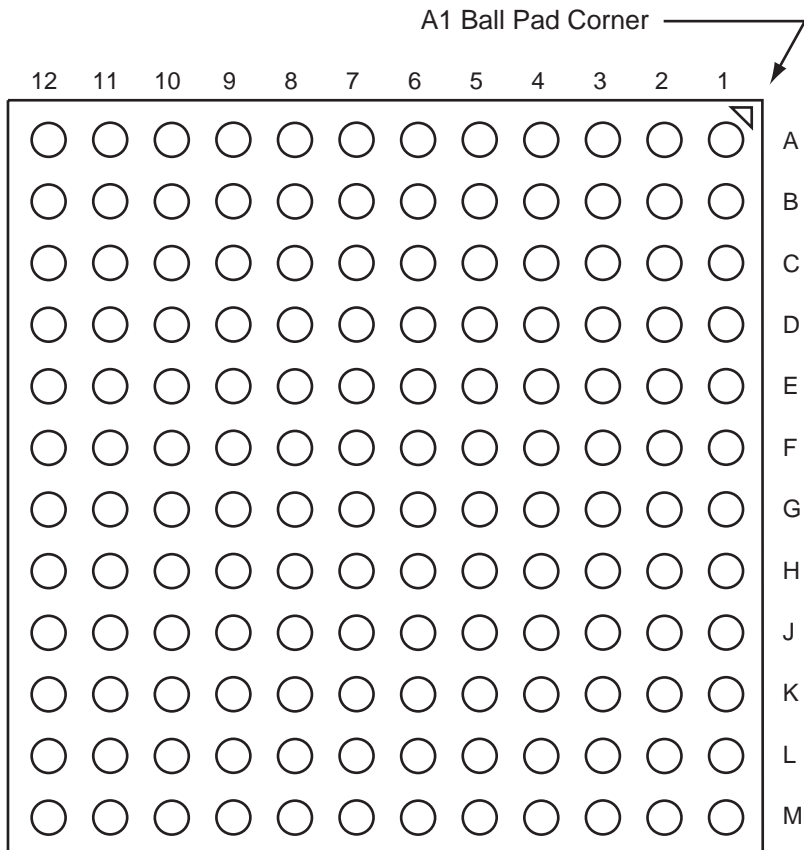
| PQ208      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| 73         | IO162RSB2        |
| 74         | IO160RSB2        |
| 75         | IO158RSB2        |
| 76         | IO156RSB2        |
| 77         | IO154RSB2        |
| 78         | IO152RSB2        |
| 79         | IO150RSB2        |
| 80         | IO148RSB2        |
| 81         | GND              |
| 82         | IO143RSB2        |
| 83         | IO141RSB2        |
| 84         | IO139RSB2        |
| 85         | IO137RSB2        |
| 86         | IO135RSB2        |
| 87         | IO133RSB2        |
| 88         | VCC              |
| 89         | VCCIB2           |
| 90         | IO128RSB2        |
| 91         | IO126RSB2        |
| 92         | IO124RSB2        |
| 93         | IO122RSB2        |
| 94         | IO120RSB2        |
| 95         | IO118RSB2        |
| 96         | GDC2/IO116RSB2   |
| 97         | GND              |
| 98         | GDB2/IO115RSB2   |
| 99         | GDA2/IO114RSB2   |
| 100        | GNDQ             |
| 101        | TCK              |
| 102        | TDI              |
| 103        | TMS              |
| 104        | VMV2             |
| 105        | GND              |
| 106        | VPUMP            |
| 107        | GNDQ             |
| 108        | TDO              |

| PQ208      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| 109        | TRST             |
| 110        | VJTAG            |
| 111        | GDA0/IO113NDB1   |
| 112        | GDA1/IO113PDB1   |
| 113        | GDB0/IO112NDB1   |
| 114        | GDB1/IO112PDB1   |
| 115        | GDC0/IO111NDB1   |
| 116        | GDC1/IO111PDB1   |
| 117        | IO109NDB1        |
| 118        | IO109PDB1        |
| 119        | IO106NDB1        |
| 120        | IO106PDB1        |
| 121        | IO104PSB1        |
| 122        | GND              |
| 123        | VCCIB1           |
| 124        | IO99NDB1         |
| 125        | IO99PDB1         |
| 126        | NC               |
| 127        | IO96NDB1         |
| 128        | GCC2/IO96PDB1    |
| 129        | GCB2/IO95PSB1    |
| 130        | GND              |
| 131        | GCA2/IO94PSB1    |
| 132        | GCA1/IO93PDB1    |
| 133        | GCA0/IO93NDB1    |
| 134        | GCB0/IO92NDB1    |
| 135        | GCB1/IO92PDB1    |
| 136        | GCC0/IO91NDB1    |
| 137        | GCC1/IO91PDB1    |
| 138        | IO88NDB1         |
| 139        | IO88PDB1         |
| 140        | VCCIB1           |
| 141        | GND              |
| 142        | VCC              |
| 143        | IO86PSB1         |
| 144        | IO84NDB1         |

| PQ208      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| 145        | IO84PDB1         |
| 146        | IO82NDB1         |
| 147        | IO82PDB1         |
| 148        | IO80NDB1         |
| 149        | GBC2/IO80PDB1    |
| 150        | IO79NDB1         |
| 151        | GBB2/IO79PDB1    |
| 152        | IO78NDB1         |
| 153        | GBA2/IO78PDB1    |
| 154        | VMV1             |
| 155        | GNDQ             |
| 156        | GND              |
| 157        | VMV0             |
| 158        | GBA1/IO77RSB0    |
| 159        | GBA0/IO76RSB0    |
| 160        | GBB1/IO75RSB0    |
| 161        | GBB0/IO74RSB0    |
| 162        | GND              |
| 163        | GBC1/IO73RSB0    |
| 164        | GBC0/IO72RSB0    |
| 165        | IO70RSB0         |
| 166        | IO67RSB0         |
| 167        | IO63RSB0         |
| 168        | IO60RSB0         |
| 169        | IO57RSB0         |
| 170        | VCCIB0           |
| 171        | VCC              |
| 172        | IO54RSB0         |
| 173        | IO51RSB0         |
| 174        | IO48RSB0         |
| 175        | IO45RSB0         |
| 176        | IO42RSB0         |
| 177        | IO40RSB0         |
| 178        | GND              |
| 179        | IO38RSB0         |
| 180        | IO35RSB0         |

| PQ208      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| 181        | IO33RSB0         |
| 182        | IO31RSB0         |
| 183        | IO29RSB0         |
| 184        | IO27RSB0         |
| 185        | IO25RSB0         |
| 186        | VCCIB0           |
| 187        | VCC              |
| 188        | IO22RSB0         |
| 189        | IO20RSB0         |
| 190        | IO18RSB0         |
| 191        | IO16RSB0         |
| 192        | IO15RSB0         |
| 193        | IO14RSB0         |
| 194        | IO13RSB0         |
| 195        | GND              |
| 196        | IO12RSB0         |
| 197        | IO11RSB0         |
| 198        | IO10RSB0         |
| 199        | IO09RSB0         |
| 200        | VCCIB0           |
| 201        | GAC1/IO05RSB0    |
| 202        | GAC0/IO04RSB0    |
| 203        | GAB1/IO03RSB0    |
| 204        | GAB0/IO02RSB0    |
| 205        | GAA1/IO01RSB0    |
| 206        | GAA0/IO00RSB0    |
| 207        | GNDQ             |
| 208        | VMV0             |

## FG144



*Note:* This is the bottom view of the package.

### **Note**

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.actel.com/products/solutions/package/docs.aspx>.



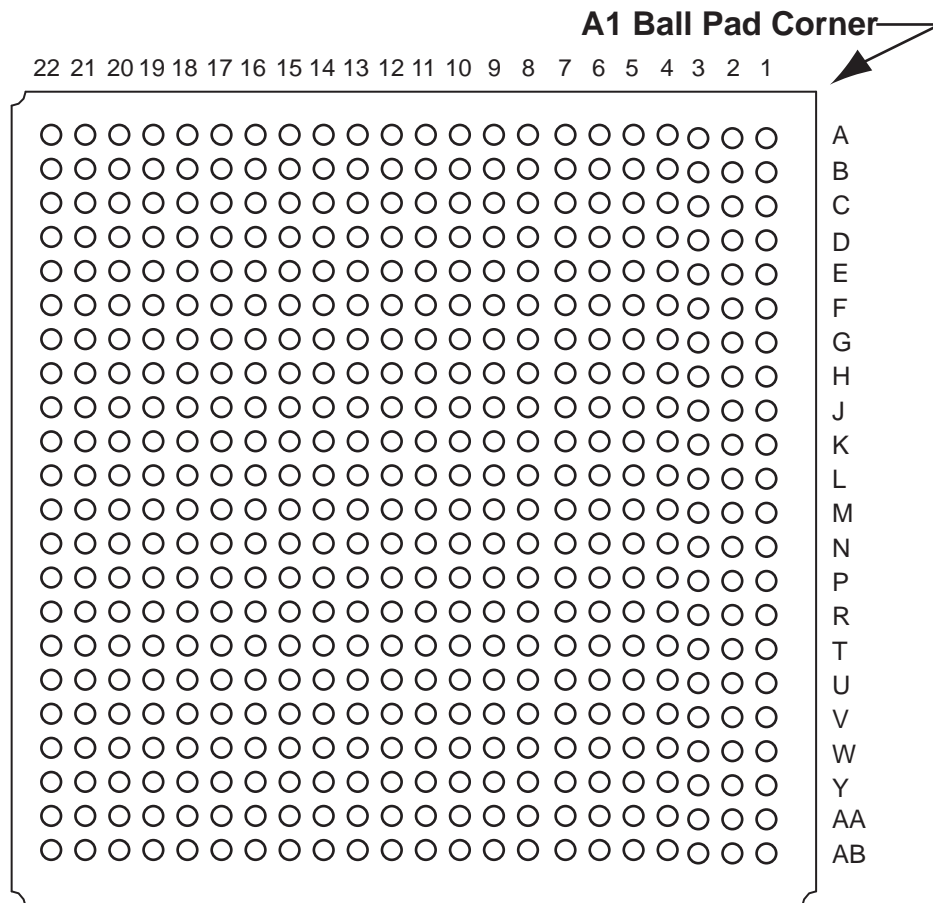
| FG144      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| A1         | GNDQ             |
| A2         | VMV0             |
| A3         | GAB0/IO02RSB0    |
| A4         | GAB1/IO03RSB0    |
| A5         | IO10RSB0         |
| A6         | GND              |
| A7         | IO44RSB0         |
| A8         | VCC              |
| A9         | IO69RSB0         |
| A10        | GBA0/IO76RSB0    |
| A11        | GBA1/IO77RSB0    |
| A12        | GNDQ             |
| B1         | GAB2/IO224PDB3   |
| B2         | GND              |
| B3         | GAA0/IO00RSB0    |
| B4         | GAA1/IO01RSB0    |
| B5         | IO13RSB0         |
| B6         | IO26RSB0         |
| B7         | IO35RSB0         |
| B8         | IO60RSB0         |
| B9         | GBB0/IO74RSB0    |
| B10        | GBB1/IO75RSB0    |
| B11        | GND              |
| B12        | VMV1             |
| C1         | IO224NDB3        |
| C2         | GFA2/IO206PPB3   |
| C3         | GAC2/IO223PDB3   |
| C4         | VCC              |
| C5         | IO16RSB0         |
| C6         | IO29RSB0         |
| C7         | IO32RSB0         |
| C8         | IO63RSB0         |
| C9         | IO66RSB0         |
| C10        | GBA2/IO78PDB1    |
| C11        | IO78NDB1         |
| C12        | GBC2/IO80PPB1    |

| FG144      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| D1         | IO213PDB3        |
| D2         | IO213NDB3        |
| D3         | IO223NDB3        |
| D4         | GAA2/IO225PPB3   |
| D5         | GAC0/IO04RSB0    |
| D6         | GAC1/IO05RSB0    |
| D7         | GBC0/IO72RSB0    |
| D8         | GBC1/IO73RSB0    |
| D9         | GBB2/IO79PDB1    |
| D10        | IO79NDB1         |
| D11        | IO80NPB1         |
| D12        | GCB1/IO92PPB1    |
| E1         | VCC              |
| E2         | GFC0/IO209NDB3   |
| E3         | GFC1/IO209PDB3   |
| E4         | VCCIB3           |
| E5         | IO225NPB3        |
| E6         | VCCIB0           |
| E7         | VCCIB0           |
| E8         | GCC1/IO91PDB1    |
| E9         | VCCIB1           |
| E10        | VCC              |
| E11        | GCA0/IO93NDB1    |
| E12        | IO94NDB1         |
| F1         | GFB0/IO208NPB3   |
| F2         | VCOMPLF          |
| F3         | GFB1/IO208PPB3   |
| F4         | IO206NPB3        |
| F5         | GND              |
| F6         | GND              |
| F7         | GND              |
| F8         | GCC0/IO91NDB1    |
| F9         | GCB0/IO92NPB1    |
| F10        | GND              |
| F11        | GCA1/IO93PDB1    |
| F12        | GCA2/IO94PDB1    |

| FG144      |                  |
|------------|------------------|
| Pin Number | A3P1000 Function |
| G1         | GFA1/IO207PPB3   |
| G2         | GND              |
| G3         | VCCPLF           |
| G4         | GFA0/IO207NPB3   |
| G5         | GND              |
| G6         | GND              |
| G7         | GND              |
| G8         | GDC1/IO111PPB1   |
| G9         | IO96NDB1         |
| G10        | GCC2/IO96PDB1    |
| G11        | IO95NDB1         |
| G12        | GCB2/IO95PDB1    |
| H1         | VCC              |
| H2         | GFB2/IO205PDB3   |
| H3         | GFC2/IO204PSB3   |
| H4         | GEC1/IO190PDB3   |
| H5         | VCC              |
| H6         | IO105PDB1        |
| H7         | IO105NDB1        |
| H8         | GDB2/IO115RSB2   |
| H9         | GDC0/IO111NPB1   |
| H10        | VCCIB1           |
| H11        | IO101PSB1        |
| H12        | VCC              |
| J1         | GEB1/IO189PDB3   |
| J2         | IO205NDB3        |
| J3         | VCCIB3           |
| J4         | GEC0/IO190NDB3   |
| J5         | IO160RSB2        |
| J6         | IO157RSB2        |
| J7         | VCC              |
| J8         | TCK              |
| J9         | GDA2/IO114RSB2   |
| J10        | TDO              |
| J11        | GDA1/IO113PDB1   |
| J12        | GDB1/IO112PDB1   |

| <b>FG144</b>      |                         |
|-------------------|-------------------------|
| <b>Pin Number</b> | <b>A3P1000 Function</b> |
| K1                | GEB0/IO189NDB3          |
| K2                | GEA1/IO188PDB3          |
| K3                | GEA0/IO188NDB3          |
| K4                | GEA2/IO187RSB2          |
| K5                | IO169RSB2               |
| K6                | IO152RSB2               |
| K7                | GND                     |
| K8                | IO117RSB2               |
| K9                | GDC2/IO116RSB2          |
| K10               | GND                     |
| K11               | GDA0/IO113NDB1          |
| K12               | GDB0/IO112NDB1          |
| L1                | GND                     |
| L2                | VMV3                    |
| L3                | GEB2/IO186RSB2          |
| L4                | IO172RSB2               |
| L5                | VCCIB2                  |
| L6                | IO153RSB2               |
| L7                | IO144RSB2               |
| L8                | IO140RSB2               |
| L9                | TMS                     |
| L10               | VJTAG                   |
| L11               | VMV2                    |
| L12               | TRST                    |
| M1                | GNDQ                    |
| M2                | GEC2/IO185RSB2          |
| M3                | IO173RSB2               |
| M4                | IO168RSB2               |
| M5                | IO161RSB2               |
| M6                | IO156RSB2               |
| M7                | IO145RSB2               |
| M8                | IO141RSB2               |
| M9                | TDI                     |
| M10               | VCCIB2                  |
| M11               | VPUMP                   |
| M12               | GNDQ                    |

# FG484



*Note:* This is the bottom view of the package.

### Note

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.actel.com/products/solutions/package/docs.aspx>.

| FG484      |                   | FG484      |                   | FG484      |                   |
|------------|-------------------|------------|-------------------|------------|-------------------|
| Pin Number | A3PE600L Function | Pin Number | A3PE600L Function | Pin Number | A3PE600L Function |
| A1         | GND               | B14        | NC                | D5         | GAA0/IO00NDB0V0   |
| A2         | GND               | B15        | NC                | D6         | GAA1/IO00PDB0V0   |
| A3         | VCCIB0            | B16        | IO30NDB1V1        | D7         | GAB0/IO01NDB0V0   |
| A4         | IO06NDB0V1        | B17        | IO30PDB1V1        | D8         | IO05PDB0V0        |
| A5         | IO06PDB0V1        | B18        | IO32PDB1V1        | D9         | IO10PDB0V1        |
| A6         | IO08NDB0V1        | B19        | NC                | D10        | IO12PDB0V2        |
| A7         | IO08PDB0V1        | B20        | NC                | D11        | IO16NDB0V2        |
| A8         | IO11PDB0V1        | B21        | VCCIB2            | D12        | IO23NDB1V0        |
| A9         | IO17PDB0V2        | B22        | GND               | D13        | IO23PDB1V0        |
| A10        | IO18NDB0V2        | C1         | VCCIB7            | D14        | IO28NDB1V1        |
| A11        | IO18PDB0V2        | C2         | NC                | D15        | IO28PDB1V1        |
| A12        | IO22PDB1V0        | C3         | NC                | D16        | GBB1/IO34PDB1V1   |
| A13        | IO26PDB1V0        | C4         | NC                | D17        | GBA0/IO35NDB1V1   |
| A14        | IO29NDB1V1        | C5         | GND               | D18        | GBA1/IO35PDB1V1   |
| A15        | IO29PDB1V1        | C6         | IO04NDB0V0        | D19        | GND               |
| A16        | IO31NDB1V1        | C7         | IO04PDB0V0        | D20        | NC                |
| A17        | IO31PDB1V1        | C8         | VCC               | D21        | NC                |
| A18        | IO32NDB1V1        | C9         | VCC               | D22        | NC                |
| A19        | NC                | C10        | IO14NDB0V2        | E1         | NC                |
| A20        | VCCIB1            | C11        | IO19NDB0V2        | E2         | NC                |
| A21        | GND               | C12        | NC                | E3         | GND               |
| A22        | GND               | C13        | NC                | E4         | GAB2/IO133PDB7V1  |
| B1         | GND               | C14        | VCC               | E5         | GAA2/IO134PDB7V1  |
| B2         | VCCIB7            | C15        | VCC               | E6         | GNDQ              |
| B3         | NC                | C16        | NC                | E7         | GAB1/IO01PDB0V0   |
| B4         | IO03NDB0V0        | C17        | NC                | E8         | IO05NDB0V0        |
| B5         | IO03PDB0V0        | C18        | GND               | E9         | IO10NDB0V1        |
| B6         | IO07NDB0V1        | C19        | NC                | E10        | IO12NDB0V2        |
| B7         | IO07PDB0V1        | C20        | NC                | E11        | IO16PDB0V2        |
| B8         | IO11NDB0V1        | C21        | NC                | E12        | IO20NDB1V0        |
| B9         | IO17NDB0V2        | C22        | VCCIB2            | E13        | IO24NDB1V0        |
| B10        | IO14PDB0V2        | D1         | NC                | E14        | IO24PDB1V0        |
| B11        | IO19PDB0V2        | D2         | NC                | E15        | GBC1/IO33PDB1V1   |
| B12        | IO22NDB1V0        | D3         | NC                | E16        | GBB0/IO34NDB1V1   |
| B13        | IO26NDB1V0        | D4         | GND               | E17        | GNDQ              |

| FG484      |                   | FG484      |                   | FG484      |                   |
|------------|-------------------|------------|-------------------|------------|-------------------|
| Pin Number | A3PE600L Function | Pin Number | A3PE600L Function | Pin Number | A3PE600L Function |
| E18        | GBA2/IO36PDB2V0   | G9         | IO09NDB0V1        | H22        | NC                |
| E19        | IO42NDB2V0        | G10        | IO09PDB0V1        | J1         | IO123NDB7V0       |
| E20        | GND               | G11        | IO13PDB0V2        | J2         | IO123PDB7V0       |
| E21        | NC                | G12        | IO21PDB1V0        | J3         | NC                |
| E22        | NC                | G13        | IO25PDB1V0        | J4         | IO124PDB7V0       |
| F1         | NC                | G14        | IO27NDB1V0        | J5         | IO125PDB7V0       |
| F2         | IO131NDB7V1       | G15        | GNDQ              | J6         | IO126PDB7V0       |
| F3         | IO131PDB7V1       | G16        | VCOMPLB           | J7         | IO130NDB7V1       |
| F4         | IO133NDB7V1       | G17        | GBB2/IO37PDB2V0   | J8         | VCCIB7            |
| F5         | IO134NDB7V1       | G18        | IO39PDB2V0        | J9         | GND               |
| F6         | VMV7              | G19        | IO39NDB2V0        | J10        | VCC               |
| F7         | VCCPLA            | G20        | IO43PDB2V0        | J11        | VCC               |
| F8         | GAC0/IO02NDB0V0   | G21        | IO43NDB2V0        | J12        | VCC               |
| F9         | GAC1/IO02PDB0V0   | G22        | NC                | J13        | VCC               |
| F10        | IO15NDB0V2        | H1         | NC                | J14        | GND               |
| F11        | IO15PDB0V2        | H2         | NC                | J15        | VCCIB2            |
| F12        | IO20PDB1V0        | H3         | VCC               | J16        | IO38NDB2V0        |
| F13        | IO25NDB1V0        | H4         | IO128NDB7V1       | J17        | IO40NDB2V0        |
| F14        | IO27PDB1V0        | H5         | IO129NDB7V1       | J18        | IO40PDB2V0        |
| F15        | GBC0/IO33NDB1V1   | H6         | IO132NDB7V1       | J19        | IO45PDB2V1        |
| F16        | VCCPLB            | H7         | IO130PDB7V1       | J20        | NC                |
| F17        | VMV2              | H8         | VMV0              | J21        | IO48PDB2V1        |
| F18        | IO36NDB2V0        | H9         | VCCIB0            | J22        | IO46PDB2V1        |
| F19        | IO42PDB2V0        | H10        | VCCIB0            | K1         | IO121NDB7V0       |
| F20        | NC                | H11        | IO13NDB0V2        | K2         | IO121PDB7V0       |
| F21        | NC                | H12        | IO21NDB1V0        | K3         | NC                |
| F22        | NC                | H13        | VCCIB1            | K4         | IO124NDB7V0       |
| G1         | IO127NDB7V1       | H14        | VCCIB1            | K5         | IO125NDB7V0       |
| G2         | IO127PDB7V1       | H15        | VMV1              | K6         | IO126NDB7V0       |
| G3         | NC                | H16        | GBC2/IO38PDB2V0   | K7         | GFC1/IO120PPB7V0  |
| G4         | IO128PDB7V1       | H17        | IO37NDB2V0        | K8         | VCCIB7            |
| G5         | IO129PDB7V1       | H18        | IO41NDB2V0        | K9         | VCC               |
| G6         | GAC2/IO132PDB7V1  | H19        | IO41PDB2V0        | K10        | GND               |
| G7         | VCOMPLA           | H20        | VCC               | K11        | GND               |
| G8         | GNDQ              | H21        | NC                | K12        | GND               |

| FG484      |                   | FG484      |                   | FG484      |                   |
|------------|-------------------|------------|-------------------|------------|-------------------|
| Pin Number | A3PE600L Function | Pin Number | A3PE600L Function | Pin Number | A3PE600L Function |
| K13        | GND               | M4         | GFA2/IO117PDB6V1  | N17        | IO57NPB3V0        |
| K14        | VCC               | M5         | GFA1/IO118PDB6V1  | N18        | IO55NPB3V0        |
| K15        | VCCIB2            | M6         | VCCPLF            | N19        | IO57PPB3V0        |
| K16        | GCC1/IO50PPB2V1   | M7         | IO116NDB6V1       | N20        | NC                |
| K17        | IO44NDB2V1        | M8         | GFB2/IO116PDB6V1  | N21        | IO56NDB3V0        |
| K18        | IO44PDB2V1        | M9         | VCC               | N22        | IO58PDB3V0        |
| K19        | IO49NPB2V1        | M10        | GND               | P1         | NC                |
| K20        | IO45NDB2V1        | M11        | GND               | P2         | IO111PDB6V1       |
| K21        | IO48NDB2V1        | M12        | GND               | P3         | IO115NDB6V1       |
| K22        | IO46NDB2V1        | M13        | GND               | P4         | IO113NPB6V1       |
| L1         | NC                | M14        | VCC               | P5         | IO109PPB6V0       |
| L2         | IO122PDB7V0       | M15        | GCB2/IO54PPB3V0   | P6         | IO108PDB6V0       |
| L3         | IO122NDB7V0       | M16        | GCA1/IO52PPB3V0   | P7         | IO108NDB6V0       |
| L4         | GFB0/IO119NPB7V0  | M17        | GCC2/IO55PPB3V0   | P8         | VCCIB6            |
| L5         | GFA0/IO118NDB6V1  | M18        | VCCPLC            | P9         | GND               |
| L6         | GFB1/IO119PPB7V0  | M19        | GCA2/IO53PDB3V0   | P10        | VCC               |
| L7         | VCOMPLF           | M20        | IO53NDB3V0        | P11        | VCC               |
| L8         | GFC0/IO120NPB7V0  | M21        | IO56PDB3V0        | P12        | VCC               |
| L9         | VCC               | M22        | NC                | P13        | VCC               |
| L10        | GND               | N1         | IO114PDB6V1       | P14        | GND               |
| L11        | GND               | N2         | IO111NDB6V1       | P15        | VCCIB3            |
| L12        | GND               | N3         | NC                | P16        | GDB0/IO66NPB3V1   |
| L13        | GND               | N4         | GFC2/IO115PDB6V1  | P17        | IO60NDB3V1        |
| L14        | VCC               | N5         | IO113PPB6V1       | P18        | IO60PDB3V1        |
| L15        | GCC0/IO50NPB2V1   | N6         | IO112PDB6V1       | P19        | IO61PDB3V1        |
| L16        | GCB1/IO51PPB2V1   | N7         | IO112NDB6V1       | P20        | NC                |
| L17        | GCA0/IO52NPB3V0   | N8         | VCCIB6            | P21        | IO59PDB3V0        |
| L18        | VCOMPLC           | N9         | VCC               | P22        | IO58NDB3V0        |
| L19        | GCB0/IO51NPB2V1   | N10        | GND               | R1         | NC                |
| L20        | IO49PPB2V1        | N11        | GND               | R2         | IO110PDB6V0       |
| L21        | IO47NDB2V1        | N12        | GND               | R3         | VCC               |
| L22        | IO47PDB2V1        | N13        | GND               | R4         | IO109NPB6V0       |
| M1         | NC                | N14        | VCC               | R5         | IO106NDB6V0       |
| M2         | IO114NDB6V1       | N15        | VCCIB3            | R6         | IO106PDB6V0       |
| M3         | IO117NDB6V1       | N16        | IO54NPB3V0        | R7         | GEC0/IO104NPB6V0  |

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|------------|-------------------|------------|-------------------|------------|---------------------|
| Pin Number | A3PE600L Function | Pin Number | A3PE600L Function | Pin Number | A3PE600L Function   |
| R8         | VMV5              | T21        | IO64PDB3V1        | V12        | IO83PDB5V0          |
| R9         | VCCIB5            | T22        | IO62NDB3V1        | V13        | IO77NDB4V1          |
| R10        | VCCIB5            | U1         | NC                | V14        | IO77PDB4V1          |
| R11        | IO84NDB5V0        | U2         | IO107PDB6V0       | V15        | IO69NDB4V0          |
| R12        | IO84PDB5V0        | U3         | IO107NDB6V0       | V16        | GDB2/IO69PDB4V0     |
| R13        | VCCIB4            | U4         | GEB1/IO103PDB6V0  | V17        | TDI                 |
| R14        | VCCIB4            | U5         | GEB0/IO103NDB6V0  | V18        | GNDQ                |
| R15        | VMV3              | U6         | VMV6              | V19        | TDO                 |
| R16        | VCCPLD            | U7         | VCCPLE            | V20        | GND                 |
| R17        | GDB1/IO66PPB3V1   | U8         | IO101NPB5V2       | V21        | NC                  |
| R18        | GDC1/IO65PDB3V1   | U9         | IO95PPB5V1        | V22        | IO63NDB3V1          |
| R19        | IO61NDB3V1        | U10        | IO92PDB5V1        | W1         | NC                  |
| R20        | VCC               | U11        | IO90PDB5V1        | W2         | NC                  |
| R21        | IO59NDB3V0        | U12        | IO82PDB5V0        | W3         | NC                  |
| R22        | IO62PDB3V1        | U13        | IO76NDB4V1        | W4         | GND                 |
| T1         | NC                | U14        | IO76PDB4V1        | W5         | IO100NDB5V2         |
| T2         | IO110NDB6V0       | U15        | VMV4              | W6         | FF/GEB2/IO100PDB5V2 |
| T3         | NC                | U16        | TCK               | W7         | IO99NDB5V2          |
| T4         | IO105PDB6V0       | U17        | VPUMP             | W8         | IO88NDB5V0          |
| T5         | IO105NDB6V0       | U18        | TRST              | W9         | IO88PDB5V0          |
| T6         | GEC1/IO104PPB6V0  | U19        | GDA0/IO67NDB3V1   | W10        | IO89NDB5V0          |
| T7         | VCOMPLE           | U20        | NC                | W11        | IO80NDB4V1          |
| T8         | GNDQ              | U21        | IO64NDB3V1        | W12        | IO81NDB4V1          |
| T9         | GEA2/IO101PPB5V2  | U22        | IO63PDB3V1        | W13        | IO81PDB4V1          |
| T10        | IO92NDB5V1        | V1         | NC                | W14        | IO70NDB4V0          |
| T11        | IO90NDB5V1        | V2         | NC                | W15        | GDC2/IO70PDB4V0     |
| T12        | IO82NDB5V0        | V3         | GND               | W16        | IO68NDB4V0          |
| T13        | IO74NDB4V1        | V4         | GEA1/IO102PDB6V0  | W17        | GDA2/IO68PDB4V0     |
| T14        | IO74PDB4V1        | V5         | GEA0/IO102NDB6V0  | W18        | TMS                 |
| T15        | GNDQ              | V6         | GNDQ              | W19        | GND                 |
| T16        | VCOMPLD           | V7         | GEC2/IO99PDB5V2   | W20        | NC                  |
| T17        | VJTAG             | V8         | IO95NPB5V1        | W21        | NC                  |
| T18        | GDC0/IO65NDB3V1   | V9         | IO91NDB5V1        | W22        | NC                  |
| T19        | GDA1/IO67PDB3V1   | V10        | IO91PDB5V1        | Y1         | VCCIB6              |
| T20        | NC                | V11        | IO83NDB5V0        | Y2         | NC                  |

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| Pin Number | A3PE600L Function |
| Y3         | NC                |
| Y4         | IO98NDB5V2        |
| Y5         | GND               |
| Y6         | IO94NDB5V1        |
| Y7         | IO94PDB5V1        |
| Y8         | VCC               |
| Y9         | VCC               |
| Y10        | IO89PDB5V0        |
| Y11        | IO80PDB4V1        |
| Y12        | IO78NPB4V1        |
| Y13        | NC                |
| Y14        | VCC               |
| Y15        | VCC               |
| Y16        | NC                |
| Y17        | NC                |
| Y18        | GND               |
| Y19        | NC                |
| Y20        | NC                |
| Y21        | NC                |
| Y22        | VCCIB3            |
| AA1        | GND               |
| AA2        | VCCIB6            |
| AA3        | NC                |
| AA4        | IO98PDB5V2        |
| AA5        | IO96NDB5V2        |
| AA6        | IO96PDB5V2        |
| AA7        | IO86NDB5V0        |
| AA8        | IO86PDB5V0        |
| AA9        | IO85PDB5V0        |
| AA10       | IO85NDB5V0        |
| AA11       | IO78PPB4V1        |
| AA12       | IO79NDB4V1        |
| AA13       | IO79PDB4V1        |
| AA14       | NC                |
| AA15       | NC                |

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| Pin Number | A3PE600L Function |
| AA16       | IO71NDB4V0        |
| AA17       | IO71PDB4V0        |
| AA18       | NC                |
| AA19       | NC                |
| AA20       | NC                |
| AA21       | VCCIB3            |
| AA22       | GND               |
| AB1        | GND               |
| AB2        | GND               |
| AB3        | VCCIB5            |
| AB4        | IO97NDB5V2        |
| AB5        | IO97PDB5V2        |
| AB6        | IO93NDB5V1        |
| AB7        | IO93PDB5V1        |
| AB8        | IO87NDB5V0        |
| AB9        | IO87PDB5V0        |
| AB10       | NC                |
| AB11       | NC                |
| AB12       | IO75NDB4V1        |
| AB13       | IO75PDB4V1        |
| AB14       | IO72NDB4V0        |
| AB15       | IO72PDB4V0        |
| AB16       | IO73NDB4V0        |
| AB17       | IO73PDB4V0        |
| AB18       | NC                |
| AB19       | NC                |
| AB20       | VCCIB4            |
| AB21       | GND               |
| AB22       | GND               |



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| Pin Number | A3P1000 Function | Pin Number | A3P1000 Function | Pin Number | A3P1000 Function |
| A1         | GND              | B14        | IO58RSB0         | D5         | GAA0/IO00RSB0    |
| A2         | GND              | B15        | IO63RSB0         | D6         | GAA1/IO01RSB0    |
| A3         | VCCIB0           | B16        | IO66RSB0         | D7         | GAB0/IO02RSB0    |
| A4         | IO07RSB0         | B17        | IO68RSB0         | D8         | IO16RSB0         |
| A5         | IO09RSB0         | B18        | IO70RSB0         | D9         | IO22RSB0         |
| A6         | IO13RSB0         | B19        | NC               | D10        | IO28RSB0         |
| A7         | IO18RSB0         | B20        | NC               | D11        | IO35RSB0         |
| A8         | IO20RSB0         | B21        | VCCIB1           | D12        | IO45RSB0         |
| A9         | IO26RSB0         | B22        | GND              | D13        | IO50RSB0         |
| A10        | IO32RSB0         | C1         | VCCIB3           | D14        | IO55RSB0         |
| A11        | IO40RSB0         | C2         | IO220PDB3        | D15        | IO61RSB0         |
| A12        | IO41RSB0         | C3         | NC               | D16        | GBB1/IO75RSB0    |
| A13        | IO53RSB0         | C4         | NC               | D17        | GBA0/IO76RSB0    |
| A14        | IO59RSB0         | C5         | GND              | D18        | GBA1/IO77RSB0    |
| A15        | IO64RSB0         | C6         | IO10RSB0         | D19        | GND              |
| A16        | IO65RSB0         | C7         | IO14RSB0         | D20        | NC               |
| A17        | IO67RSB0         | C8         | VCC              | D21        | NC               |
| A18        | IO69RSB0         | C9         | VCC              | D22        | NC               |
| A19        | NC               | C10        | IO30RSB0         | E1         | IO219NDB3        |
| A20        | VCCIB0           | C11        | IO37RSB0         | E2         | NC               |
| A21        | GND              | C12        | IO43RSB0         | E3         | GND              |
| A22        | GND              | C13        | NC               | E4         | GAB2/IO224PDB3   |
| B1         | GND              | C14        | VCC              | E5         | GAA2/IO225PDB3   |
| B2         | VCCIB3           | C15        | VCC              | E6         | GNDQ             |
| B3         | NC               | C16        | NC               | E7         | GAB1/IO03RSB0    |
| B4         | IO06RSB0         | C17        | NC               | E8         | IO17RSB0         |
| B5         | IO08RSB0         | C18        | GND              | E9         | IO21RSB0         |
| B6         | IO12RSB0         | C19        | NC               | E10        | IO27RSB0         |
| B7         | IO15RSB0         | C20        | NC               | E11        | IO34RSB0         |
| B8         | IO19RSB0         | C21        | NC               | E12        | IO44RSB0         |
| B9         | IO24RSB0         | C22        | VCCIB1           | E13        | IO51RSB0         |
| B10        | IO31RSB0         | D1         | IO219PDB3        | E14        | IO57RSB0         |
| B11        | IO39RSB0         | D2         | IO220NDB3        | E15        | GBC1/IO73RSB0    |
| B12        | IO48RSB0         | D3         | NC               | E16        | GBB0/IO74RSB0    |
| B13        | IO54RSB0         | D4         | GND              | E17        | IO71RSB0         |

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|------------|------------------|------------|------------------|------------|------------------|
| Pin Number | A3P1000 Function | Pin Number | A3P1000 Function | Pin Number | A3P1000 Function |
| E18        | GBA2/IO78PDB1    | G9         | IO23RSB0         | H22        | NC               |
| E19        | IO81PDB1         | G10        | IO29RSB0         | J1         | IO212NDB3        |
| E20        | GND              | G11        | IO33RSB0         | J2         | IO212PDB3        |
| E21        | NC               | G12        | IO46RSB0         | J3         | NC               |
| E22        | IO84PDB1         | G13        | IO52RSB0         | J4         | IO217NDB3        |
| F1         | NC               | G14        | IO60RSB0         | J5         | IO218NDB3        |
| F2         | IO215PDB3        | G15        | GNDQ             | J6         | IO216PDB3        |
| F3         | IO215NDB3        | G16        | IO80NDB1         | J7         | IO216NDB3        |
| F4         | IO224NDB3        | G17        | GBB2/IO79PDB1    | J8         | VCCIB3           |
| F5         | IO225NDB3        | G18        | IO79NDB1         | J9         | GND              |
| F6         | VMV3             | G19        | IO82NPB1         | J10        | VCC              |
| F7         | IO11RSB0         | G20        | IO85PDB1         | J11        | VCC              |
| F8         | GAC0/IO04RSB0    | G21        | IO85NDB1         | J12        | VCC              |
| F9         | GAC1/IO05RSB0    | G22        | NC               | J13        | VCC              |
| F10        | IO25RSB0         | H1         | NC               | J14        | GND              |
| F11        | IO36RSB0         | H2         | NC               | J15        | VCCIB1           |
| F12        | IO42RSB0         | H3         | VCC              | J16        | IO83NPB1         |
| F13        | IO49RSB0         | H4         | IO217PDB3        | J17        | IO86NPB1         |
| F14        | IO56RSB0         | H5         | IO218PDB3        | J18        | IO90PPB1         |
| F15        | GBC0/IO72RSB0    | H6         | IO221NDB3        | J19        | IO87NDB1         |
| F16        | IO62RSB0         | H7         | IO221PDB3        | J20        | NC               |
| F17        | VMV0             | H8         | VMV0             | J21        | IO89PDB1         |
| F18        | IO78NDB1         | H9         | VCCIB0           | J22        | IO89NDB1         |
| F19        | IO81NDB1         | H10        | VCCIB0           | K1         | IO211PDB3        |
| F20        | IO82PPB1         | H11        | IO38RSB0         | K2         | IO211NDB3        |
| F21        | NC               | H12        | IO47RSB0         | K3         | NC               |
| F22        | IO84NDB1         | H13        | VCCIB0           | K4         | IO210PPB3        |
| G1         | IO214NDB3        | H14        | VCCIB0           | K5         | IO213NDB3        |
| G2         | IO214PDB3        | H15        | VMV1             | K6         | IO213PDB3        |
| G3         | NC               | H16        | GBC2/IO80PDB1    | K7         | GFC1/IO209PPB3   |
| G4         | IO222NDB3        | H17        | IO83PPB1         | K8         | VCCIB3           |
| G5         | IO222PDB3        | H18        | IO86PPB1         | K9         | VCC              |
| G6         | GAC2/IO223PDB3   | H19        | IO87PDB1         | K10        | GND              |
| G7         | IO223NDB3        | H20        | VCC              | K11        | GND              |
| G8         | GNDQ             | H21        | NC               | K12        | GND              |

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| Pin Number | A3P1000 Function | Pin Number | A3P1000 Function | Pin Number | A3P1000 Function |
| K13        | GND              | M4         | GFA2/IO206PDB3   | N17        | IO100NPB1        |
| K14        | VCC              | M5         | GFA1/IO207PDB3   | N18        | IO102NDB1        |
| K15        | VCCIB1           | M6         | VCCPLF           | N19        | IO102PDB1        |
| K16        | GCC1/IO91PPB1    | M7         | IO205NDB3        | N20        | NC               |
| K17        | IO90NPB1         | M8         | GFB2/IO205PDB3   | N21        | IO101NPB1        |
| K18        | IO88PDB1         | M9         | VCC              | N22        | IO103PDB1        |
| K19        | IO88NDB1         | M10        | GND              | P1         | NC               |
| K20        | IO94NPB1         | M11        | GND              | P2         | IO199PDB3        |
| K21        | IO98NDB1         | M12        | GND              | P3         | IO199NDB3        |
| K22        | IO98PDB1         | M13        | GND              | P4         | IO202NDB3        |
| L1         | NC               | M14        | VCC              | P5         | IO202PDB3        |
| L2         | IO200PDB3        | M15        | GCB2/IO95PPB1    | P6         | IO196PPB3        |
| L3         | IO210NPB3        | M16        | GCA1/IO93PPB1    | P7         | IO193PPB3        |
| L4         | GFB0/IO208NPB3   | M17        | GCC2/IO96PPB1    | P8         | VCCIB3           |
| L5         | GFA0/IO207NDB3   | M18        | IO100PPB1        | P9         | GND              |
| L6         | GFB1/IO208PPB3   | M19        | GCA2/IO94PPB1    | P10        | VCC              |
| L7         | VCOMPLF          | M20        | IO101PPB1        | P11        | VCC              |
| L8         | GFC0/IO209NPB3   | M21        | IO99PPB1         | P12        | VCC              |
| L9         | VCC              | M22        | NC               | P13        | VCC              |
| L10        | GND              | N1         | IO201NDB3        | P14        | GND              |
| L11        | GND              | N2         | IO201PDB3        | P15        | VCCIB1           |
| L12        | GND              | N3         | NC               | P16        | GDB0/IO112NPB1   |
| L13        | GND              | N4         | GFC2/IO204PDB3   | P17        | IO106NDB1        |
| L14        | VCC              | N5         | IO204NDB3        | P18        | IO106PDB1        |
| L15        | GCC0/IO91NPB1    | N6         | IO203NDB3        | P19        | IO107PDB1        |
| L16        | GCB1/IO92PPB1    | N7         | IO203PDB3        | P20        | NC               |
| L17        | GCA0/IO93NPB1    | N8         | VCCIB3           | P21        | IO104PDB1        |
| L18        | IO96NPB1         | N9         | VCC              | P22        | IO103NDB1        |
| L19        | GCB0/IO92NPB1    | N10        | GND              | R1         | NC               |
| L20        | IO97PDB1         | N11        | GND              | R2         | IO197PPB3        |
| L21        | IO97NDB1         | N12        | GND              | R3         | VCC              |
| L22        | IO99NPB1         | N13        | GND              | R4         | IO197NPB3        |
| M1         | NC               | N14        | VCC              | R5         | IO196NPB3        |
| M2         | IO200NDB3        | N15        | VCCIB1           | R6         | IO193NPB3        |
| M3         | IO206NDB3        | N16        | IO95NPB1         | R7         | GEC0/IO190NPB3   |

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| Pin Number | A3P1000 Function | Pin Number | A3P1000 Function | Pin Number | A3P1000 Function |
| R8         | VMV3             | T21        | IO108PDB1        | V12        | IO143RSB2        |
| R9         | VCCIB2           | T22        | IO105NDB1        | V13        | IO138RSB2        |
| R10        | VCCIB2           | U1         | IO195PDB3        | V14        | IO131RSB2        |
| R11        | IO147RSB2        | U2         | IO195NDB3        | V15        | IO125RSB2        |
| R12        | IO136RSB2        | U3         | IO194NPB3        | V16        | GDB2/IO115RSB2   |
| R13        | VCCIB2           | U4         | GEB1/IO189PDB3   | V17        | TDI              |
| R14        | VCCIB2           | U5         | GEB0/IO189NDB3   | V18        | GNDQ             |
| R15        | VMV2             | U6         | VMV2             | V19        | TDO              |
| R16        | IO110NDB1        | U7         | IO179RSB2        | V20        | GND              |
| R17        | GDB1/IO112PPB1   | U8         | IO171RSB2        | V21        | NC               |
| R18        | GDC1/IO111PDB1   | U9         | IO165RSB2        | V22        | IO109NDB1        |
| R19        | IO107NDB1        | U10        | IO159RSB2        | W1         | NC               |
| R20        | VCC              | U11        | IO151RSB2        | W2         | IO191PDB3        |
| R21        | IO104NDB1        | U12        | IO137RSB2        | W3         | NC               |
| R22        | IO105PDB1        | U13        | IO134RSB2        | W4         | GND              |
| T1         | IO198PDB3        | U14        | IO128RSB2        | W5         | IO183RSB2        |
| T2         | IO198NDB3        | U15        | VMV1             | W6         | GEB2/IO186RSB2   |
| T3         | NC               | U16        | TCK              | W7         | IO172RSB2        |
| T4         | IO194PPB3        | U17        | VPUMP            | W8         | IO170RSB2        |
| T5         | IO192PPB3        | U18        | TRST             | W9         | IO164RSB2        |
| T6         | GEC1/IO190PPB3   | U19        | GDA0/IO113NDB1   | W10        | IO158RSB2        |
| T7         | IO192NPB3        | U20        | NC               | W11        | IO153RSB2        |
| T8         | GNDQ             | U21        | IO108NDB1        | W12        | IO142RSB2        |
| T9         | GEA2/IO187RSB2   | U22        | IO109PDB1        | W13        | IO135RSB2        |
| T10        | IO161RSB2        | V1         | NC               | W14        | IO130RSB2        |
| T11        | IO155RSB2        | V2         | NC               | W15        | GDC2/IO116RSB2   |
| T12        | IO141RSB2        | V3         | GND              | W16        | IO120RSB2        |
| T13        | IO129RSB2        | V4         | GEA1/IO188PDB3   | W17        | GDA2/IO114RSB2   |
| T14        | IO124RSB2        | V5         | GEA0/IO188NDB3   | W18        | TMS              |
| T15        | GNDQ             | V6         | IO184RSB2        | W19        | GND              |
| T16        | IO110PDB1        | V7         | GEC2/IO185RSB2   | W20        | NC               |
| T17        | VJTAG            | V8         | IO168RSB2        | W21        | NC               |
| T18        | GDC0/IO111NDB1   | V9         | IO163RSB2        | W22        | NC               |
| T19        | GDA1/IO113PDB1   | V10        | IO157RSB2        | Y1         | VCCIB3           |
| T20        | NC               | V11        | IO149RSB2        | Y2         | IO191NDB3        |

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| Pin Number | A3P1000 Function | Pin Number | A3P1000 Function |
| Y3         | NC               | AA16       | IO122RSB2        |
| Y4         | IO182RSB2        | AA17       | IO119RSB2        |
| Y5         | GND              | AA18       | IO117RSB2        |
| Y6         | IO177RSB2        | AA19       | NC               |
| Y7         | IO174RSB2        | AA20       | NC               |
| Y8         | VCC              | AA21       | VCCIB1           |
| Y9         | VCC              | AA22       | GND              |
| Y10        | IO154RSB2        | AB1        | GND              |
| Y11        | IO148RSB2        | AB2        | GND              |
| Y12        | IO140RSB2        | AB3        | VCCIB2           |
| Y13        | NC               | AB4        | IO180RSB2        |
| Y14        | VCC              | AB5        | IO176RSB2        |
| Y15        | VCC              | AB6        | IO173RSB2        |
| Y16        | NC               | AB7        | IO167RSB2        |
| Y17        | NC               | AB8        | IO162RSB2        |
| Y18        | GND              | AB9        | IO156RSB2        |
| Y19        | NC               | AB10       | IO150RSB2        |
| Y20        | NC               | AB11       | IO145RSB2        |
| Y21        | NC               | AB12       | IO144RSB2        |
| Y22        | VCCIB1           | AB13       | IO132RSB2        |
| AA1        | GND              | AB14       | IO127RSB2        |
| AA2        | VCCIB3           | AB15       | IO126RSB2        |
| AA3        | NC               | AB16       | IO123RSB2        |
| AA4        | IO181RSB2        | AB17       | IO121RSB2        |
| AA5        | IO178RSB2        | AB18       | IO118RSB2        |
| AA6        | IO175RSB2        | AB19       | NC               |
| AA7        | IO169RSB2        | AB20       | VCCIB2           |
| AA8        | IO166RSB2        | AB21       | GND              |
| AA9        | IO160RSB2        | AB22       | GND              |
| AA10       | IO152RSB2        |            |                  |
| AA11       | IO146RSB2        |            |                  |
| AA12       | IO139RSB2        |            |                  |
| AA13       | IO133RSB2        |            |                  |
| AA14       | NC               |            |                  |
| AA15       | NC               |            |                  |

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| Pin Number | A3PE3000L Function | Pin Number | A3PE3000L Function | Pin Number | A3PE3000L Function |
| A1         | GND                | AA14       | IO170NDB4V2        | B5         | IO08PDB0V0         |
| A2         | GND                | AA15       | IO170PDB4V2        | B6         | IO14NDB0V1         |
| A3         | VCCIB0             | AA16       | IO166NDB4V1        | B7         | IO14PDB0V1         |
| A4         | IO10NDB0V1         | AA17       | IO166PDB4V1        | B8         | IO18NDB0V2         |
| A5         | IO10PDB0V1         | AA18       | IO160NDB4V0        | B9         | IO24NDB0V2         |
| A6         | IO16NDB0V1         | AA19       | IO160PDB4V0        | B10        | IO34PDB0V4         |
| A7         | IO16PDB0V1         | AA20       | IO158NPB4V0        | B11        | IO40PDB0V4         |
| A8         | IO18PDB0V2         | AA21       | VCCIB3             | B12        | IO46NDB1V0         |
| A9         | IO24PDB0V2         | AA22       | GND                | B13        | IO54NDB1V1         |
| A10        | IO28NDB0V3         | AB1        | GND                | B14        | IO62NDB1V2         |
| A11        | IO28PDB0V3         | AB2        | GND                | B15        | IO62PDB1V2         |
| A12        | IO46PDB1V0         | AB3        | VCCIB5             | B16        | IO68NDB1V3         |
| A13        | IO54PDB1V1         | AB4        | IO216NDB5V2        | B17        | IO68PDB1V3         |
| A14        | IO56NDB1V1         | AB5        | IO216PDB5V2        | B18        | IO72PDB1V3         |
| A15        | IO56PDB1V1         | AB6        | IO210NDB5V2        | B19        | IO74PDB1V4         |
| A16        | IO64NDB1V2         | AB7        | IO210PDB5V2        | B20        | IO76NPB1V4         |
| A17        | IO64PDB1V2         | AB8        | IO208NDB5V1        | B21        | VCCIB2             |
| A18        | IO72NDB1V3         | AB9        | IO208PDB5V1        | B22        | GND                |
| A19        | IO74NDB1V4         | AB10       | IO197NDB5V0        | C1         | VCCIB7             |
| A20        | VCCIB1             | AB11       | IO197PDB5V0        | C2         | IO303PDB7V3        |
| A21        | GND                | AB12       | IO174NDB4V2        | C3         | IO305PDB7V3        |
| A22        | GND                | AB13       | IO174PDB4V2        | C4         | IO06NPB0V0         |
| AA1        | GND                | AB14       | IO172NDB4V2        | C5         | GND                |
| AA2        | VCCIB6             | AB15       | IO172PDB4V2        | C6         | IO12NDB0V1         |
| AA3        | IO228PDB5V4        | AB16       | IO168NDB4V1        | C7         | IO12PDB0V1         |
| AA4        | IO224PDB5V3        | AB17       | IO168PDB4V1        | C8         | VCC                |
| AA5        | IO218NDB5V3        | AB18       | IO162NDB4V1        | C9         | VCC                |
| AA6        | IO218PDB5V3        | AB19       | IO162PDB4V1        | C10        | IO34NDB0V4         |
| AA7        | IO212NDB5V2        | AB20       | VCCIB4             | C11        | IO40NDB0V4         |
| AA8        | IO212PDB5V2        | AB21       | GND                | C12        | IO48NDB1V0         |
| AA9        | IO198PDB5V0        | AB22       | GND                | C13        | IO48PDB1V0         |
| AA10       | IO198NDB5V0        | B1         | GND                | C14        | VCC                |
| AA11       | IO188PPB4V4        | B2         | VCCIB7             | C15        | VCC                |
| AA12       | IO180NDB4V3        | B3         | IO06PPB0V0         | C16        | IO70NDB1V3         |
| AA13       | IO180PDB4V3        | B4         | IO08NDB0V0         | C17        | IO70PDB1V3         |

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| Pin Number | A3PE3000L Function | Pin Number | A3PE3000L Function | Pin Number | A3PE3000L Function |
| C18        | GND                | E9         | IO22NDB0V2         | F22        | IO98NDB2V2         |
| C19        | IO76PPB1V4         | E10        | IO30NDB0V3         | G1         | IO289NDB7V1        |
| C20        | IO88NDB2V0         | E11        | IO38PDB0V4         | G2         | IO289PDB7V1        |
| C21        | IO94PPB2V1         | E12        | IO44NDB1V0         | G3         | IO291PPB7V2        |
| C22        | VCCIB2             | E13        | IO58NDB1V2         | G4         | IO295PDB7V2        |
| D1         | IO293PDB7V2        | E14        | IO58PDB1V2         | G5         | IO297PDB7V2        |
| D2         | IO303NDB7V3        | E15        | GBC1/IO79PDB1V4    | G6         | GAC2/IO307PDB7V4   |
| D3         | IO305NDB7V3        | E16        | GGB0/IO80NDB1V4    | G7         | VCOMPLA            |
| D4         | GND                | E17        | GNDQ               | G8         | GNDQ               |
| D5         | GAA0/IO00NDB0V0    | E18        | GBA2/IO82PDB2V0    | G9         | IO26NDB0V3         |
| D6         | GAA1/IO00PDB0V0    | E19        | IO86NDB2V0         | G10        | IO26PDB0V3         |
| D7         | GAB0/IO01NDB0V0    | E20        | GND                | G11        | IO36PDB0V4         |
| D8         | IO20PDB0V2         | E21        | IO90NDB2V1         | G12        | IO42PDB1V0         |
| D9         | IO22PDB0V2         | E22        | IO98PDB2V2         | G13        | IO50PDB1V1         |
| D10        | IO30PDB0V3         | F1         | IO299NPB7V3        | G14        | IO60NDB1V2         |
| D11        | IO38NDB0V4         | F2         | IO301NDB7V3        | G15        | GNDQ               |
| D12        | IO52NDB1V1         | F3         | IO301PDB7V3        | G16        | VCOMPLB            |
| D13        | IO52PDB1V1         | F4         | IO308NDB7V4        | G17        | GGB2/IO83PDB2V0    |
| D14        | IO66NDB1V3         | F5         | IO309NDB7V4        | G18        | IO92PDB2V1         |
| D15        | IO66PDB1V3         | F6         | VMV7               | G19        | IO92NDB2V1         |
| D16        | GGB1/IO80PDB1V4    | F7         | VCCPLA             | G20        | IO102PDB2V2        |
| D17        | GBA0/IO81NDB1V4    | F8         | GAC0/IO02NDB0V0    | G21        | IO102NDB2V2        |
| D18        | GBA1/IO81PDB1V4    | F9         | GAC1/IO02PDB0V0    | G22        | IO105NDB2V2        |
| D19        | GND                | F10        | IO32NDB0V3         | H1         | IO286PSB7V1        |
| D20        | IO88PDB2V0         | F11        | IO32PDB0V3         | H2         | IO291NPB7V2        |
| D21        | IO90PDB2V1         | F12        | IO44PDB1V0         | H3         | VCC                |
| D22        | IO94NPB2V1         | F13        | IO50NDB1V1         | H4         | IO295NDB7V2        |
| E1         | IO293NDB7V2        | F14        | IO60PDB1V2         | H5         | IO297NDB7V2        |
| E2         | IO299PPB7V3        | F15        | GBC0/IO79NDB1V4    | H6         | IO307NDB7V4        |
| E3         | GND                | F16        | VCCPLB             | H7         | IO287PDB7V1        |
| E4         | GAB2/IO308PDB7V4   | F17        | VMV2               | H8         | VMV0               |
| E5         | GAA2/IO309PDB7V4   | F18        | IO82NDB2V0         | H9         | VCCIB0             |
| E6         | GNDQ               | F19        | IO86PDB2V0         | H10        | VCCIB0             |
| E7         | GAB1/IO01PDB0V0    | F20        | IO96PDB2V1         | H11        | IO36NDB0V4         |
| E8         | IO20NDB0V2         | F21        | IO96NDB2V1         | H12        | IO42NDB1V0         |

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| Pin Number | A3PE3000L Function |
| H13        | VCCIB1             |
| H14        | VCCIB1             |
| H15        | VMV1               |
| H16        | GBC2/IO84PDB2V0    |
| H17        | IO83NDB2V0         |
| H18        | IO100NDB2V2        |
| H19        | IO100PDB2V2        |
| H20        | VCC                |
| H21        | VMV2               |
| H22        | IO105PDB2V2        |
| J1         | IO285NDB7V1        |
| J2         | IO285PDB7V1        |
| J3         | VMV7               |
| J4         | IO279PDB7V0        |
| J5         | IO283PDB7V1        |
| J6         | IO281PDB7V0        |
| J7         | IO287NDB7V1        |
| J8         | VCCIB7             |
| J9         | GND                |
| J10        | VCC                |
| J11        | VCC                |
| J12        | VCC                |
| J13        | VCC                |
| J14        | GND                |
| J15        | VCCIB2             |
| J16        | IO84NDB2V0         |
| J17        | IO104NDB2V2        |
| J18        | IO104PDB2V2        |
| J19        | IO106PPB2V3        |
| J20        | GNDQ               |
| J21        | IO109PDB2V3        |
| J22        | IO107PDB2V3        |
| K1         | IO277NDB7V0        |
| K2         | IO277PDB7V0        |
| K3         | GNDQ               |

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| Pin Number | A3PE3000L Function |
| K4         | IO279NDB7V0        |
| K5         | IO283NDB7V1        |
| K6         | IO281NDB7V0        |
| K7         | GFC1/IO275PPB7V0   |
| K8         | VCCIB7             |
| K9         | VCC                |
| K10        | GND                |
| K11        | GND                |
| K12        | GND                |
| K13        | GND                |
| K14        | VCC                |
| K15        | VCCIB2             |
| K16        | GCC1/IO112PPB2V3   |
| K17        | IO108NDB2V3        |
| K18        | IO108PDB2V3        |
| K19        | IO110NPB2V3        |
| K20        | IO106NPB2V3        |
| K21        | IO109NDB2V3        |
| K22        | IO107NDB2V3        |
| L1         | IO257PSB6V2        |
| L2         | IO276PDB7V0        |
| L3         | IO276NDB7V0        |
| L4         | GFB0/IO274NPB7V0   |
| L5         | GFA0/IO273NDB6V4   |
| L6         | GFB1/IO274PPB7V0   |
| L7         | VCOMPLF            |
| L8         | GFC0/IO275NPB7V0   |
| L9         | VCC                |
| L10        | GND                |
| L11        | GND                |
| L12        | GND                |
| L13        | GND                |
| L14        | VCC                |
| L15        | GCC0/IO112NPB2V3   |
| L16        | GCB1/IO113PPB2V3   |

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| Pin Number | A3PE3000L Function |
| L17        | GCA0/IO114NPB3V0   |
| L18        | VCOMPLC            |
| L19        | GCB0/IO113NPB2V3   |
| L20        | IO110PPB2V3        |
| L21        | IO111NDB2V3        |
| L22        | IO111PDB2V3        |
| M1         | GNDQ               |
| M2         | IO255NPB6V2        |
| M3         | IO272NDB6V4        |
| M4         | GFA2/IO272PDB6V4   |
| M5         | GFA1/IO273PDB6V4   |
| M6         | VCCPLF             |
| M7         | IO271NDB6V4        |
| M8         | GFB2/IO271PDB6V4   |
| M9         | VCC                |
| M10        | GND                |
| M11        | GND                |
| M12        | GND                |
| M13        | GND                |
| M14        | VCC                |
| M15        | GCB2/IO116PPB3V0   |
| M16        | GCA1/IO114PPB3V0   |
| M17        | GCC2/IO117PPB3V0   |
| M18        | VCCPLC             |
| M19        | GCA2/IO115PDB3V0   |
| M20        | IO115NDB3V0        |
| M21        | IO126PDB3V1        |
| M22        | IO124PSB3V1        |
| N1         | IO255PPB6V2        |
| N2         | IO253NDB6V2        |
| N3         | VMV6               |
| N4         | GFC2/IO270PPB6V4   |
| N5         | IO261PPB6V3        |
| N6         | IO263PDB6V3        |
| N7         | IO263NDB6V3        |

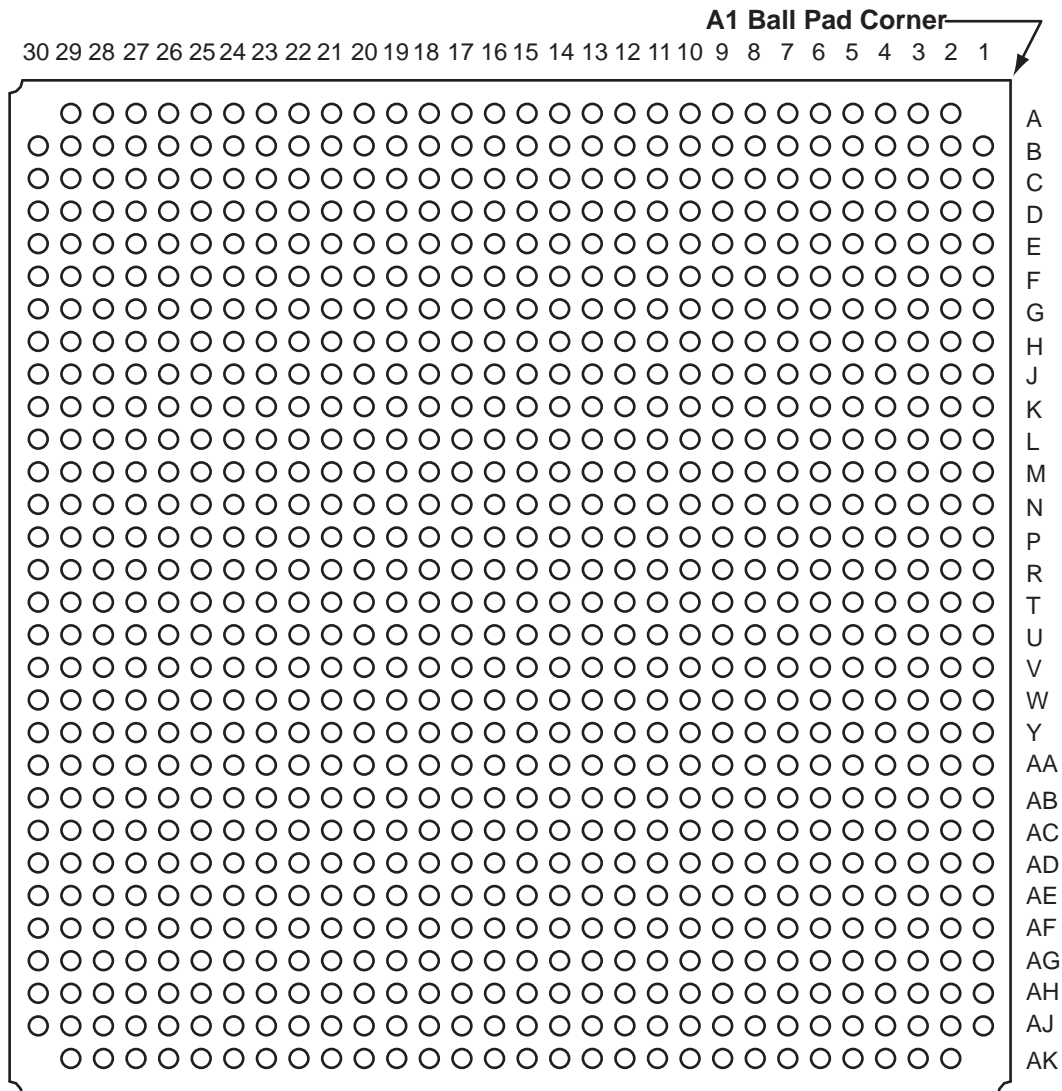


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| Pin Number | A3PE3000L Function | Pin Number | A3PE3000L Function | Pin Number | A3PE3000L Function |
| N8         | VCCIB6             | P21        | IO130PDB3V2        | T12        | IO194NDB5V0        |
| N9         | VCC                | P22        | IO128NDB3V1        | T13        | IO186NDB4V4        |
| N10        | GND                | R1         | IO247NDB6V1        | T14        | IO186PDB4V4        |
| N11        | GND                | R2         | IO245PDB6V1        | T15        | GNDQ               |
| N12        | GND                | R3         | VCC                | T16        | VCOMPLD            |
| N13        | GND                | R4         | IO249NPB6V1        | T17        | VJTAG              |
| N14        | VCC                | R5         | IO251NDB6V2        | T18        | GDC0/IO151NDB3V4   |
| N15        | VCCIB3             | R6         | IO251PDB6V2        | T19        | GDA1/IO153PDB3V4   |
| N16        | IO116NPB3V0        | R7         | GEC0/IO236NPB6V0   | T20        | IO144PDB3V3        |
| N17        | IO132NPB3V2        | R8         | VMV5               | T21        | IO140PDB3V3        |
| N18        | IO117NPB3V0        | R9         | VCCIB5             | T22        | IO134NDB3V2        |
| N19        | IO132PPB3V2        | R10        | VCCIB5             | U1         | IO240PPB6V0        |
| N20        | GNDQ               | R11        | IO196NDB5V0        | U2         | IO238PDB6V0        |
| N21        | IO126NDB3V1        | R12        | IO196PDB5V0        | U3         | IO238NDB6V0        |
| N22        | IO128PDB3V1        | R13        | VCCIB4             | U4         | GEB1/IO235PDB6V0   |
| P1         | IO247PDB6V1        | R14        | VCCIB4             | U5         | GEB0/IO235NDB6V0   |
| P2         | IO253PDB6V2        | R15        | VMV3               | U6         | VMV6               |
| P3         | IO270NPB6V4        | R16        | VCCPLD             | U7         | VCCPLE             |
| P4         | IO261NPB6V3        | R17        | GDB1/IO152PPB3V4   | U8         | IO233NPB5V4        |
| P5         | IO249PPB6V1        | R18        | GDC1/IO151PDB3V4   | U9         | IO222PPB5V3        |
| P6         | IO259PDB6V3        | R19        | IO138NDB3V3        | U10        | IO206PDB5V1        |
| P7         | IO259NDB6V3        | R20        | VCC                | U11        | IO202PDB5V1        |
| P8         | VCCIB6             | R21        | IO130NDB3V2        | U12        | IO194PDB5V0        |
| P9         | GND                | R22        | IO134PDB3V2        | U13        | IO176NDB4V2        |
| P10        | VCC                | T1         | IO243PPB6V1        | U14        | IO176PDB4V2        |
| P11        | VCC                | T2         | IO245NDB6V1        | U15        | VMV4               |
| P12        | VCC                | T3         | IO243NPB6V1        | U16        | TCK                |
| P13        | VCC                | T4         | IO241PDB6V0        | U17        | VPUMP              |
| P14        | GND                | T5         | IO241NDB6V0        | U18        | TRST               |
| P15        | VCCIB3             | T6         | GEC1/IO236PPB6V0   | U19        | GDA0/IO153NDB3V4   |
| P16        | GDB0/IO152NPB3V4   | T7         | VCOMPLE            | U20        | IO144NDB3V3        |
| P17        | IO136NDB3V2        | T8         | GNDQ               | U21        | IO140NDB3V3        |
| P18        | IO136PDB3V2        | T9         | GEA2/IO233PPB5V4   | U22        | IO142PDB3V3        |
| P19        | IO138PDB3V3        | T10        | IO206NDB5V1        | V1         | IO239PDB6V0        |
| P20        | VMV3               | T11        | IO202NDB5V1        | V2         | IO240NPB6V0        |

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|------------|---------------------|
| Pin Number | A3PE3000L Function  |
| V3         | GND                 |
| V4         | GEA1/IO234PDB6V0    |
| V5         | GEA0/IO234NDB6V0    |
| V6         | GNDQ                |
| V7         | GEC2/IO231PDB5V4    |
| V8         | IO222NPB5V3         |
| V9         | IO204NDB5V1         |
| V10        | IO204PDB5V1         |
| V11        | IO195NDB5V0         |
| V12        | IO195PDB5V0         |
| V13        | IO178NDB4V3         |
| V14        | IO178PDB4V3         |
| V15        | IO155NDB4V0         |
| V16        | GDB2/IO155PDB4V0    |
| V17        | TDI                 |
| V18        | GNDQ                |
| V19        | TDO                 |
| V20        | GND                 |
| V21        | IO146PDB3V4         |
| V22        | IO142NDB3V3         |
| W1         | IO239NDB6V0         |
| W2         | IO237PDB6V0         |
| W3         | IO230PSB5V4         |
| W4         | GND                 |
| W5         | IO232NDB5V4         |
| W6         | FF/GEB2/IO232PDB5V4 |
| W7         | IO231NDB5V4         |
| W8         | IO214NDB5V2         |
| W9         | IO214PDB5V2         |
| W10        | IO200NDB5V0         |
| W11        | IO192NDB4V4         |
| W12        | IO184NDB4V3         |
| W13        | IO184PDB4V3         |
| W14        | IO156NDB4V0         |
| W15        | GDC2/IO156PDB4V0    |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| W16        | IO154NDB4V0        |
| W17        | GDA2/IO154PDB4V0   |
| W18        | TMS                |
| W19        | GND                |
| W20        | IO150NDB3V4        |
| W21        | IO146NDB3V4        |
| W22        | IO148PPB3V4        |
| Y1         | VCCIB6             |
| Y2         | IO237NDB6V0        |
| Y3         | IO228NDB5V4        |
| Y4         | IO224NDB5V3        |
| Y5         | GND                |
| Y6         | IO220NDB5V3        |
| Y7         | IO220PDB5V3        |
| Y8         | VCC                |
| Y9         | VCC                |
| Y10        | IO200PDB5V0        |
| Y11        | IO192PDB4V4        |
| Y12        | IO188NPB4V4        |
| Y13        | IO187PSB4V4        |
| Y14        | VCC                |
| Y15        | VCC                |
| Y16        | IO164NDB4V1        |
| Y17        | IO164PDB4V1        |
| Y18        | GND                |
| Y19        | IO158PPB4V0        |
| Y20        | IO150PDB3V4        |
| Y21        | IO148NPB3V4        |
| Y22        | VCCIB3             |

# FG896



*Note:* This is the bottom view.

## Note

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.actel.com/products/solutions/package/docs.aspx>.

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| A2         | GND                |
| A3         | GND                |
| A4         | IO14NPB0V1         |
| A5         | GND                |
| A6         | IO07NPB0V0         |
| A7         | GND                |
| A8         | IO09NDB0V1         |
| A9         | IO17NDB0V2         |
| A10        | IO17PDB0V2         |
| A11        | IO21NDB0V2         |
| A12        | IO21PDB0V2         |
| A13        | IO33NDB0V4         |
| A14        | IO33PDB0V4         |
| A15        | IO35NDB0V4         |
| A16        | IO35PDB0V4         |
| A17        | IO41NDB1V0         |
| A18        | IO43NDB1V0         |
| A19        | IO43PDB1V0         |
| A20        | IO45NDB1V0         |
| A21        | IO45PDB1V0         |
| A22        | IO57NDB1V2         |
| A23        | IO57PDB1V2         |
| A24        | GND                |
| A25        | IO69PPB1V3         |
| A26        | GND                |
| A27        | GBC1/IO79PPB1V4    |
| A28        | GND                |
| A29        | GND                |
| AA1        | IO256PDB6V2        |
| AA2        | IO248PDB6V1        |
| AA3        | IO248NDB6V1        |
| AA4        | IO246NDB6V1        |
| AA5        | GEA1/IO234PDB6V0   |
| AA6        | GEA0/IO234NDB6V0   |
| AA7        | IO243PPB6V1        |
| AA8        | IO245NDB6V1        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AA9        | GEB1/IO235PPB6V0   |
| AA10       | VCC                |
| AA11       | IO226PPB5V4        |
| AA12       | VCCIB5             |
| AA13       | VCCIB5             |
| AA14       | VCCIB5             |
| AA15       | VCCIB5             |
| AA16       | VCCIB4             |
| AA17       | VCCIB4             |
| AA18       | VCCIB4             |
| AA19       | VCCIB4             |
| AA20       | IO174PDB4V2        |
| AA21       | VCC                |
| AA22       | IO142NPB3V3        |
| AA23       | IO144NDB3V3        |
| AA24       | IO144PDB3V3        |
| AA25       | IO146NDB3V4        |
| AA26       | IO146PDB3V4        |
| AA27       | IO147PDB3V4        |
| AA28       | IO139NDB3V3        |
| AA29       | IO139PDB3V3        |
| AA30       | IO133NDB3V2        |
| AB1        | IO256NDB6V2        |
| AB2        | IO244PDB6V1        |
| AB3        | IO244NDB6V1        |
| AB4        | IO241PDB6V0        |
| AB5        | IO241NDB6V0        |
| AB6        | IO243NPB6V1        |
| AB7        | VCCIB6             |
| AB8        | VCCPLE             |
| AB9        | VCC                |
| AB10       | IO222PDB5V3        |
| AB11       | IO218PPB5V3        |
| AB12       | IO206NDB5V1        |
| AB13       | IO206PDB5V1        |
| AB14       | IO198NDB5V0        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AB15       | IO198PDB5V0        |
| AB16       | IO192NDB4V4        |
| AB17       | IO192PDB4V4        |
| AB18       | IO178NDB4V3        |
| AB19       | IO178PDB4V3        |
| AB20       | IO174NDB4V2        |
| AB21       | IO162NPB4V1        |
| AB22       | VCC                |
| AB23       | VCCPLD             |
| AB24       | VCCIB3             |
| AB25       | IO150PDB3V4        |
| AB26       | IO148PDB3V4        |
| AB27       | IO147NDB3V4        |
| AB28       | IO145PDB3V3        |
| AB29       | IO143PDB3V3        |
| AB30       | IO137PDB3V2        |
| AC1        | IO254PDB6V2        |
| AC2        | IO254NDB6V2        |
| AC3        | IO240PDB6V0        |
| AC4        | GEC1/IO236PDB6V0   |
| AC5        | IO237PDB6V0        |
| AC6        | IO237NDB6V0        |
| AC7        | VCOMPLE            |
| AC8        | GND                |
| AC9        | IO226NPB5V4        |
| AC10       | IO222NDB5V3        |
| AC11       | IO216NPB5V2        |
| AC12       | IO210NPB5V2        |
| AC13       | IO204NDB5V1        |
| AC14       | IO204PDB5V1        |
| AC15       | IO194NDB5V0        |
| AC16       | IO188NDB4V4        |
| AC17       | IO188PDB4V4        |
| AC18       | IO182PPB4V3        |
| AC19       | IO170NPB4V2        |
| AC20       | IO164NDB4V1        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AC21       | IO164PDB4V1        |
| AC22       | IO162PPB4V1        |
| AC23       | GND                |
| AC24       | VCOMPLD            |
| AC25       | IO150NDB3V4        |
| AC26       | IO148NDB3V4        |
| AC27       | GDA1/IO153PDB3V4   |
| AC28       | IO145NDB3V3        |
| AC29       | IO143NDB3V3        |
| AC30       | IO137NDB3V2        |
| AD1        | GND                |
| AD2        | IO242NPB6V1        |
| AD3        | IO240NDB6V0        |
| AD4        | GEC0/IO236NDB6V0   |
| AD5        | VCCIB6             |
| AD6        | GNDQ               |
| AD6        | GNDQ               |
| AD7        | VCC                |
| AD8        | VMV5               |
| AD9        | VCCIB5             |
| AD10       | IO224PPB5V3        |
| AD11       | IO218NPB5V3        |
| AD12       | IO216PPB5V2        |
| AD13       | IO210PPB5V2        |
| AD14       | IO202PPB5V1        |
| AD15       | IO194PDB5V0        |
| AD16       | IO190PDB4V4        |
| AD17       | IO182NPB4V3        |
| AD18       | IO176NDB4V2        |
| AD19       | IO176PDB4V2        |
| AD20       | IO170PPB4V2        |
| AD21       | IO166PDB4V1        |
| AD22       | VCCIB4             |
| AD23       | TCK                |
| AD24       | VCC                |
| AD25       | TRST               |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AD26       | VCCIB3             |
| AD27       | GDA0/IO153NDB3V4   |
| AD28       | GDC0/IO151NDB3V4   |
| AD29       | GDC1/IO151PDB3V4   |
| AD30       | GND                |
| AE1        | IO242PPB6V1        |
| AE2        | VCC                |
| AE3        | IO239PDB6V0        |
| AE4        | IO239NDB6V0        |
| AE5        | VMV6               |
| AE5        | VMV6               |
| AE6        | GND                |
| AE7        | GNDQ               |
| AE8        | IO230NDB5V4        |
| AE9        | IO224NPB5V3        |
| AE10       | IO214NPB5V2        |
| AE11       | IO212NDB5V2        |
| AE12       | IO212PDB5V2        |
| AE13       | IO202NPB5V1        |
| AE14       | IO200NDB5V0        |
| AE15       | IO196PDB5V0        |
| AE16       | IO190NDB4V4        |
| AE17       | IO184PDB4V3        |
| AE18       | IO184NDB4V3        |
| AE19       | IO172PDB4V2        |
| AE20       | IO172NDB4V2        |
| AE21       | IO166NDB4V1        |
| AE22       | IO160PDB4V0        |
| AE23       | GNDQ               |
| AE24       | VMV4               |
| AE25       | GND                |
| AE26       | GDB0/IO152NDB3V4   |
| AE27       | GDB1/IO152PDB3V4   |
| AE28       | VMV3               |
| AE28       | VMV3               |
| AE29       | VCC                |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AE30       | IO149PDB3V4        |
| AF1        | GND                |
| AF2        | IO238PPB6V0        |
| AF3        | VCCIB6             |
| AF4        | IO220NPB5V3        |
| AF5        | VCC                |
| AF6        | IO228NDB5V4        |
| AF7        | VCCIB5             |
| AF8        | IO230PDB5V4        |
| AF9        | IO229NDB5V4        |
| AF10       | IO229PDB5V4        |
| AF11       | IO214PPB5V2        |
| AF12       | IO208NDB5V1        |
| AF13       | IO208PDB5V1        |
| AF14       | IO200PDB5V0        |
| AF15       | IO196NDB5V0        |
| AF16       | IO186NDB4V4        |
| AF17       | IO186PDB4V4        |
| AF18       | IO180NDB4V3        |
| AF19       | IO180PDB4V3        |
| AF20       | IO168NDB4V1        |
| AF21       | IO168PDB4V1        |
| AF22       | IO160NDB4V0        |
| AF23       | IO158NPB4V0        |
| AF24       | VCCIB4             |
| AF25       | IO154NPB4V0        |
| AF26       | VCC                |
| AF27       | TDO                |
| AF28       | VCCIB3             |
| AF29       | GNDQ               |
| AF29       | GNDQ               |
| AF30       | GND                |
| AG1        | IO238NPB6V0        |
| AG2        | VCC                |
| AG3        | IO232NPB5V4        |
| AG4        | GND                |

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|------------|---------------------|
| Pin Number | A3PE3000L Function  |
| AG5        | IO220PPB5V3         |
| AG6        | IO228PDB5V4         |
| AG7        | IO231NDB5V4         |
| AG8        | GEC2/IO231PDB5V4    |
| AG9        | IO225NPB5V3         |
| AG10       | IO223NPB5V3         |
| AG11       | IO221PDB5V3         |
| AG12       | IO221NDB5V3         |
| AG13       | IO205NPB5V1         |
| AG14       | IO199NDB5V0         |
| AG15       | IO199PDB5V0         |
| AG16       | IO187NDB4V4         |
| AG17       | IO187PDB4V4         |
| AG18       | IO181NDB4V3         |
| AG19       | IO171PPB4V2         |
| AG20       | IO165NPB4V1         |
| AG21       | IO161NPB4V0         |
| AG22       | IO159NDB4V0         |
| AG23       | IO159PDB4V0         |
| AG24       | IO158PPB4V0         |
| AG25       | GDB2/IO155PDB4V0    |
| AG26       | GDA2/IO154PPB4V0    |
| AG27       | GND                 |
| AG28       | VJTAG               |
| AG29       | VCC                 |
| AG30       | IO149NDB3V4         |
| AH1        | GND                 |
| AH2        | IO233NPB5V4         |
| AH3        | VCC                 |
| AH4        | FF/GEB2/IO232PPB5V4 |
| AH5        | VCCIB5              |
| AH6        | IO219NDB5V3         |
| AH7        | IO219PDB5V3         |
| AH8        | IO227NDB5V4         |
| AH9        | IO227PDB5V4         |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AH10       | IO225PPB5V3        |
| AH11       | IO223PPB5V3        |
| AH12       | IO211NDB5V2        |
| AH13       | IO211PDB5V2        |
| AH14       | IO205PPB5V1        |
| AH15       | IO195NDB5V0        |
| AH16       | IO185NDB4V3        |
| AH17       | IO185PDB4V3        |
| AH18       | IO181PDB4V3        |
| AH19       | IO177NDB4V2        |
| AH20       | IO171NPB4V2        |
| AH21       | IO165PPB4V1        |
| AH22       | IO161PPB4V0        |
| AH23       | IO157NDB4V0        |
| AH24       | IO157PDB4V0        |
| AH25       | IO155NDB4V0        |
| AH26       | VCCIB4             |
| AH27       | TDI                |
| AH28       | VCC                |
| AH29       | VPUMP              |
| AH30       | GND                |
| AJ1        | GND                |
| AJ2        | GND                |
| AJ3        | GEA2/IO233PPB5V4   |
| AJ4        | VCC                |
| AJ5        | IO217NPB5V2        |
| AJ6        | VCC                |
| AJ7        | IO215NPB5V2        |
| AJ8        | IO213NDB5V2        |
| AJ9        | IO213PDB5V2        |
| AJ10       | IO209NDB5V1        |
| AJ11       | IO209PDB5V1        |
| AJ12       | IO203NDB5V1        |
| AJ13       | IO203PDB5V1        |
| AJ14       | IO197NDB5V0        |
| AJ15       | IO195PDB5V0        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AJ16       | IO183NDB4V3        |
| AJ17       | IO183PDB4V3        |
| AJ18       | IO179NPB4V3        |
| AJ19       | IO177PDB4V2        |
| AJ20       | IO173NDB4V2        |
| AJ21       | IO173PDB4V2        |
| AJ22       | IO163NDB4V1        |
| AJ23       | IO163PDB4V1        |
| AJ24       | IO167NPB4V1        |
| AJ25       | VCC                |
| AJ26       | IO156NPB4V0        |
| AJ27       | VCC                |
| AJ28       | TMS                |
| AJ29       | GND                |
| AJ30       | GND                |
| AK2        | GND                |
| AK3        | GND                |
| AK4        | IO217PPB5V2        |
| AK5        | GND                |
| AK6        | IO215PPB5V2        |
| AK7        | GND                |
| AK8        | IO207NDB5V1        |
| AK9        | IO207PDB5V1        |
| AK10       | IO201NDB5V0        |
| AK11       | IO201PDB5V0        |
| AK12       | IO193NDB4V4        |
| AK13       | IO193PDB4V4        |
| AK14       | IO197PDB5V0        |
| AK15       | IO191NDB4V4        |
| AK16       | IO191PDB4V4        |
| AK17       | IO189NDB4V4        |
| AK18       | IO189PDB4V4        |
| AK19       | IO179PPB4V3        |
| AK20       | IO175NDB4V2        |
| AK21       | IO175PDB4V2        |
| AK22       | IO169NDB4V1        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| AK23       | IO169PDB4V1        |
| AK24       | GND                |
| AK25       | IO167PPB4V1        |
| AK26       | GND                |
| AK27       | GDC2/IO156PPB4V0   |
| AK28       | GND                |
| AK29       | GND                |
| B1         | GND                |
| B2         | GND                |
| B3         | GAA2/IO309PPB7V4   |
| B4         | VCC                |
| B5         | IO14PPB0V1         |
| B6         | VCC                |
| B7         | IO07PPB0V0         |
| B8         | IO09PDB0V1         |
| B9         | IO15PPB0V1         |
| B10        | IO19NDB0V2         |
| B11        | IO19PDB0V2         |
| B12        | IO29NDB0V3         |
| B13        | IO29PDB0V3         |
| B14        | IO31PPB0V3         |
| B15        | IO37NDB0V4         |
| B16        | IO37PDB0V4         |
| B17        | IO41PDB1V0         |
| B18        | IO51NDB1V1         |
| B19        | IO59PDB1V2         |
| B20        | IO53PDB1V1         |
| B21        | IO53NDB1V1         |
| B22        | IO61NDB1V2         |
| B23        | IO61PDB1V2         |
| B24        | IO69NPB1V3         |
| B25        | VCC                |
| B26        | GBC0/IO79NPB1V4    |
| B27        | VCC                |
| B28        | IO64NPB1V2         |
| B29        | GND                |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| B30        | GND                |
| C1         | GND                |
| C2         | IO309NPB7V4        |
| C3         | VCC                |
| C4         | GAA0/IO00NPB0V0    |
| C5         | VCCIB0             |
| C6         | IO03PDB0V0         |
| C7         | IO03NDB0V0         |
| C8         | GAB1/IO01PDB0V0    |
| C9         | IO05PDB0V0         |
| C10        | IO15NPB0V1         |
| C11        | IO25NDB0V3         |
| C12        | IO25PDB0V3         |
| C13        | IO31NPB0V3         |
| C14        | IO27NDB0V3         |
| C15        | IO39NDB0V4         |
| C16        | IO39PDB0V4         |
| C17        | IO55PPB1V1         |
| C18        | IO51PDB1V1         |
| C19        | IO59NDB1V2         |
| C20        | IO63NDB1V2         |
| C21        | IO63PDB1V2         |
| C22        | IO67NDB1V3         |
| C23        | IO67PDB1V3         |
| C24        | IO75NDB1V4         |
| C25        | IO75PDB1V4         |
| C26        | VCCIB1             |
| C27        | IO64PPB1V2         |
| C28        | VCC                |
| C29        | GBA1/IO81PPB1V4    |
| C30        | GND                |
| D1         | IO303PPB7V3        |
| D2         | VCC                |
| D3         | IO305NPB7V3        |
| D4         | GND                |
| D5         | GAA1/IO00PPB0V0    |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| D6         | GAC1/IO02PDB0V0    |
| D7         | IO06NPB0V0         |
| D8         | GAB0/IO01NDB0V0    |
| D9         | IO05NDB0V0         |
| D10        | IO11NDB0V1         |
| D11        | IO11PDB0V1         |
| D12        | IO23NDB0V2         |
| D13        | IO23PDB0V2         |
| D14        | IO27PDB0V3         |
| D15        | IO40PDB0V4         |
| D16        | IO47NDB1V0         |
| D17        | IO47PDB1V0         |
| D18        | IO55NPB1V1         |
| D19        | IO65NDB1V3         |
| D20        | IO65PDB1V3         |
| D21        | IO71NDB1V3         |
| D22        | IO71PDB1V3         |
| D23        | IO73NDB1V4         |
| D24        | IO73PDB1V4         |
| D25        | IO74NDB1V4         |
| D26        | GBB0/IO80NPB1V4    |
| D27        | GND                |
| D28        | GBA0/IO81NPB1V4    |
| D29        | VCC                |
| D30        | GBA2/IO82PPB2V0    |
| E1         | GND                |
| E2         | IO303NPB7V3        |
| E3         | VCCIB7             |
| E4         | IO305PPB7V3        |
| E5         | VCC                |
| E6         | GAC0/IO02NDB0V0    |
| E7         | VCCIB0             |
| E8         | IO06PPB0V0         |
| E9         | IO24NDB0V2         |
| E10        | IO24PDB0V2         |
| E11        | IO13NDB0V1         |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| E12        | IO13PDB0V1         |
| E13        | IO34NDB0V4         |
| E14        | IO34PDB0V4         |
| E15        | IO40NDB0V4         |
| E16        | IO49NDB1V1         |
| E17        | IO49PDB1V1         |
| E18        | IO50PDB1V1         |
| E19        | IO58PDB1V2         |
| E20        | IO60NDB1V2         |
| E21        | IO77PDB1V4         |
| E22        | IO68NDB1V3         |
| E23        | IO68PDB1V3         |
| E24        | VCCIB1             |
| E25        | IO74PDB1V4         |
| E26        | VCC                |
| E27        | GBB1/IO80PPB1V4    |
| E28        | VCCIB2             |
| E29        | IO82NPB2V0         |
| E30        | GND                |
| F1         | IO296PPB7V2        |
| F2         | VCC                |
| F3         | IO306PDB7V4        |
| F4         | IO297PDB7V2        |
| F5         | VMV7               |
| F5         | VMV7               |
| F6         | GND                |
| F7         | GNDQ               |
| F8         | IO12NDB0V1         |
| F9         | IO12PDB0V1         |
| F10        | IO10PDB0V1         |
| F11        | IO16PDB0V1         |
| F12        | IO22NDB0V2         |
| F13        | IO30NDB0V3         |
| F14        | IO30PDB0V3         |
| F15        | IO36PDB0V4         |
| F16        | IO48NDB1V0         |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| F17        | IO48PDB1V0         |
| F18        | IO50NDB1V1         |
| F19        | IO58NDB1V2         |
| F20        | IO60PDB1V2         |
| F21        | IO77NDB1V4         |
| F22        | IO72NDB1V3         |
| F23        | IO72PDB1V3         |
| F24        | GNDQ               |
| F25        | GND                |
| F26        | VMV2               |
| F26        | VMV2               |
| F27        | IO86PDB2V0         |
| F28        | IO92PDB2V1         |
| F29        | VCC                |
| F30        | IO100NPB2V2        |
| G1         | GND                |
| G2         | IO296NPB7V2        |
| G3         | IO306NDB7V4        |
| G4         | IO297NDB7V2        |
| G5         | VCCIB7             |
| G6         | GNDQ               |
| G6         | GNDQ               |
| G7         | VCC                |
| G8         | VMV0               |
| G9         | VCCIB0             |
| G10        | IO10NDB0V1         |
| G11        | IO16NDB0V1         |
| G12        | IO22PDB0V2         |
| G13        | IO26PPB0V3         |
| G14        | IO38NPB0V4         |
| G15        | IO36NDB0V4         |
| G16        | IO46NDB1V0         |
| G17        | IO46PDB1V0         |
| G18        | IO56NDB1V1         |
| G19        | IO56PDB1V1         |
| G20        | IO66NDB1V3         |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| G21        | IO66PDB1V3         |
| G22        | VCCIB1             |
| G23        | VMV1               |
| G24        | VCC                |
| G25        | GNDQ               |
| G25        | GNDQ               |
| G26        | VCCIB2             |
| G27        | IO86NDB2V0         |
| G28        | IO92NDB2V1         |
| G29        | IO100PPB2V2        |
| G30        | GND                |
| H1         | IO294PDB7V2        |
| H2         | IO294NDB7V2        |
| H3         | IO300NDB7V3        |
| H4         | IO300PDB7V3        |
| H5         | IO295PDB7V2        |
| H6         | IO299PDB7V3        |
| H7         | VCOMPLA            |
| H8         | GND                |
| H9         | IO08NDB0V0         |
| H10        | IO08PDB0V0         |
| H11        | IO18PDB0V2         |
| H12        | IO26NPB0V3         |
| H13        | IO28NDB0V3         |
| H14        | IO28PDB0V3         |
| H15        | IO38PPB0V4         |
| H16        | IO42NDB1V0         |
| H17        | IO52NDB1V1         |
| H18        | IO52PDB1V1         |
| H19        | IO62NDB1V2         |
| H20        | IO62PDB1V2         |
| H21        | IO70NDB1V3         |
| H22        | IO70PDB1V3         |
| H23        | GND                |
| H24        | VCOMPLB            |
| H25        | GBC2/IO84PDB2V0    |



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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| H26        | IO84NDB2V0         |
| H27        | IO96PDB2V1         |
| H28        | IO96NDB2V1         |
| H29        | IO89PDB2V0         |
| H30        | IO89NDB2V0         |
| J1         | IO290NDB7V2        |
| J2         | IO290PDB7V2        |
| J3         | IO302NDB7V3        |
| J4         | IO302PDB7V3        |
| J5         | IO295NDB7V2        |
| J6         | IO299NDB7V3        |
| J7         | VCCIB7             |
| J8         | VCCPLA             |
| J9         | VCC                |
| J10        | IO04NPB0V0         |
| J11        | IO18NDB0V2         |
| J12        | IO20NDB0V2         |
| J13        | IO20PDB0V2         |
| J14        | IO32NDB0V3         |
| J15        | IO32PDB0V3         |
| J16        | IO42PDB1V0         |
| J17        | IO44NDB1V0         |
| J18        | IO44PDB1V0         |
| J19        | IO54NDB1V1         |
| J20        | IO54PDB1V1         |
| J21        | IO76NPB1V4         |
| J22        | VCC                |
| J23        | VCCPLB             |
| J24        | VCCIB2             |
| J25        | IO90PDB2V1         |
| J26        | IO90NDB2V1         |
| J27        | GBB2/IO83PDB2V0    |
| J28        | IO83NDB2V0         |
| J29        | IO91PDB2V1         |
| J30        | IO91NDB2V1         |
| K1         | IO288NDB7V1        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| K2         | IO288PDB7V1        |
| K3         | IO304NDB7V3        |
| K4         | IO304PDB7V3        |
| K5         | GAB2/IO308PDB7V4   |
| K6         | IO308NDB7V4        |
| K7         | IO301PDB7V3        |
| K8         | IO301NDB7V3        |
| K9         | GAC2/IO307PPB7V4   |
| K10        | VCC                |
| K11        | IO04PPB0V0         |
| K12        | VCCIB0             |
| K13        | VCCIB0             |
| K14        | VCCIB0             |
| K15        | VCCIB0             |
| K16        | VCCIB1             |
| K17        | VCCIB1             |
| K18        | VCCIB1             |
| K19        | VCCIB1             |
| K20        | IO76PPB1V4         |
| K21        | VCC                |
| K22        | IO78PPB1V4         |
| K23        | IO88NDB2V0         |
| K24        | IO88PDB2V0         |
| K25        | IO94PDB2V1         |
| K26        | IO94NDB2V1         |
| K27        | IO85PDB2V0         |
| K28        | IO85NDB2V0         |
| K29        | IO93PDB2V1         |
| K30        | IO93NDB2V1         |
| L1         | IO286NDB7V1        |
| L2         | IO286PDB7V1        |
| L3         | IO298NDB7V3        |
| L4         | IO298PDB7V3        |
| L5         | IO283PDB7V1        |
| L6         | IO291NDB7V2        |
| L7         | IO291PDB7V2        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| L8         | IO293PDB7V2        |
| L9         | IO293NDB7V2        |
| L10        | IO307NPB7V4        |
| L11        | VCC                |
| L12        | VCC                |
| L13        | VCC                |
| L14        | VCC                |
| L15        | VCC                |
| L16        | VCC                |
| L17        | VCC                |
| L18        | VCC                |
| L19        | VCC                |
| L20        | VCC                |
| L21        | IO78NPB1V4         |
| L22        | IO104NPB2V2        |
| L23        | IO98NDB2V2         |
| L24        | IO98PDB2V2         |
| L25        | IO87PDB2V0         |
| L26        | IO87NDB2V0         |
| L27        | IO97PDB2V1         |
| L28        | IO101PDB2V2        |
| L29        | IO103PDB2V2        |
| L30        | IO119NDB3V0        |
| M1         | IO282NDB7V1        |
| M2         | IO282PDB7V1        |
| M3         | IO292NDB7V2        |
| M4         | IO292PDB7V2        |
| M5         | IO283NDB7V1        |
| M6         | IO285PDB7V1        |
| M7         | IO287PDB7V1        |
| M8         | IO289PDB7V1        |
| M9         | IO289NDB7V1        |
| M10        | VCCIB7             |
| M11        | VCC                |
| M12        | GND                |
| M13        | GND                |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| M14        | GND                |
| M15        | GND                |
| M16        | GND                |
| M17        | GND                |
| M18        | GND                |
| M19        | GND                |
| M20        | VCC                |
| M21        | VCCIB2             |
| M22        | NC                 |
| M23        | IO104PPB2V2        |
| M24        | IO102PDB2V2        |
| M25        | IO102NDB2V2        |
| M26        | IO95PDB2V1         |
| M27        | IO97NDB2V1         |
| M28        | IO101NDB2V2        |
| M29        | IO103NDB2V2        |
| M30        | IO119PDB3V0        |
| N1         | IO276PDB7V0        |
| N2         | IO278PDB7V0        |
| N3         | IO280PDB7V0        |
| N4         | IO284PDB7V1        |
| N5         | IO279PDB7V0        |
| N6         | IO285NDB7V1        |
| N7         | IO287NDB7V1        |
| N8         | IO281NDB7V0        |
| N9         | IO281PDB7V0        |
| N10        | VCCIB7             |
| N11        | VCC                |
| N12        | GND                |
| N13        | GND                |
| N14        | GND                |
| N15        | GND                |
| N16        | GND                |
| N17        | GND                |
| N18        | GND                |
| N19        | GND                |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| N20        | VCC                |
| N21        | VCCIB2             |
| N22        | IO106NDB2V3        |
| N23        | IO106PDB2V3        |
| N24        | IO108PDB2V3        |
| N25        | IO108NDB2V3        |
| N26        | IO95NDB2V1         |
| N27        | IO99NDB2V2         |
| N28        | IO99PDB2V2         |
| N29        | IO107PDB2V3        |
| N30        | IO107NDB2V3        |
| P1         | IO276NDB7V0        |
| P2         | IO278NDB7V0        |
| P3         | IO280NDB7V0        |
| P4         | IO284NDB7V1        |
| P5         | IO279NDB7V0        |
| P6         | GFC1/IO275PDB7V0   |
| P7         | GFC0/IO275NDB7V0   |
| P8         | IO277PDB7V0        |
| P9         | IO277NDB7V0        |
| P10        | VCCIB7             |
| P11        | VCC                |
| P12        | GND                |
| P13        | GND                |
| P14        | GND                |
| P15        | GND                |
| P16        | GND                |
| P17        | GND                |
| P18        | GND                |
| P19        | GND                |
| P20        | VCC                |
| P21        | VCCIB2             |
| P22        | GCC1/IO112PDB2V3   |
| P23        | IO110PDB2V3        |
| P24        | IO110NDB2V3        |
| P25        | IO109PPB2V3        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| P26        | IO111NPB2V3        |
| P27        | IO105PDB2V2        |
| P28        | IO105NDB2V2        |
| P29        | GCC2/IO117PDB3V0   |
| P30        | IO117NDB3V0        |
| R1         | GFC2/IO270PDB6V4   |
| R2         | GFB1/IO274PPB7V0   |
| R3         | VCOMPLF            |
| R4         | GFA0/IO273NDB6V4   |
| R5         | GFB0/IO274NPB7V0   |
| R6         | IO271NDB6V4        |
| R7         | GFB2/IO271PDB6V4   |
| R8         | IO269PDB6V4        |
| R9         | IO269NDB6V4        |
| R10        | VCCIB7             |
| R11        | VCC                |
| R12        | GND                |
| R13        | GND                |
| R14        | GND                |
| R15        | GND                |
| R16        | GND                |
| R17        | GND                |
| R18        | GND                |
| R19        | GND                |
| R20        | VCC                |
| R21        | VCCIB2             |
| R22        | GCC0/IO112NDB2V3   |
| R23        | GCB2/IO116PDB3V0   |
| R24        | IO118PDB3V0        |
| R25        | IO111PPB2V3        |
| R26        | IO122PPB3V1        |
| R27        | GCA0/IO114NPB3V0   |
| R28        | VCOMPLC            |
| R29        | GCB1/IO113PPB2V3   |
| R30        | IO115NPB3V0        |
| T1         | IO270NDB6V4        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| T2         | VCCPLF             |
| T3         | GFA2/IO272PPB6V4   |
| T4         | GFA1/IO273PDB6V4   |
| T5         | IO272NPB6V4        |
| T6         | IO267NDB6V4        |
| T7         | IO267PDB6V4        |
| T8         | IO265PDB6V3        |
| T9         | IO263PDB6V3        |
| T10        | VCCIB6             |
| T11        | VCC                |
| T12        | GND                |
| T13        | GND                |
| T14        | GND                |
| T15        | GND                |
| T16        | GND                |
| T17        | GND                |
| T18        | GND                |
| T19        | GND                |
| T20        | VCC                |
| T21        | VCCIB3             |
| T22        | IO109NPB2V3        |
| T23        | IO116NDB3V0        |
| T24        | IO118NDB3V0        |
| T25        | IO122NPB3V1        |
| T26        | GCA1/IO114PPB3V0   |
| T27        | GCB0/IO113NPB2V3   |
| T28        | GCA2/IO115PPB3V0   |
| T29        | VCCPLC             |
| T30        | IO121PDB3V0        |
| U1         | IO268PDB6V4        |
| U2         | IO264NDB6V3        |
| U3         | IO264PDB6V3        |
| U4         | IO258PDB6V3        |
| U5         | IO258NDB6V3        |
| U6         | IO257PPB6V2        |
| U7         | IO261PPB6V3        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| U8         | IO265NDB6V3        |
| U9         | IO263NDB6V3        |
| U10        | VCCIB6             |
| U11        | VCC                |
| U12        | GND                |
| U13        | GND                |
| U14        | GND                |
| U15        | GND                |
| U16        | GND                |
| U17        | GND                |
| U18        | GND                |
| U19        | GND                |
| U20        | VCC                |
| U21        | VCCIB3             |
| U22        | IO120PDB3V0        |
| U23        | IO128PDB3V1        |
| U24        | IO124PDB3V1        |
| U25        | IO124NDB3V1        |
| U26        | IO126PDB3V1        |
| U27        | IO129PDB3V1        |
| U28        | IO127PDB3V1        |
| U29        | IO125PDB3V1        |
| U30        | IO121NDB3V0        |
| V1         | IO268NDB6V4        |
| V2         | IO262PDB6V3        |
| V3         | IO260PDB6V3        |
| V4         | IO252PDB6V2        |
| V5         | IO257NPB6V2        |
| V6         | IO261NPB6V3        |
| V7         | IO255PDB6V2        |
| V8         | IO259PDB6V3        |
| V9         | IO259NDB6V3        |
| V10        | VCCIB6             |
| V11        | VCC                |
| V12        | GND                |
| V13        | GND                |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| V14        | GND                |
| V15        | GND                |
| V16        | GND                |
| V17        | GND                |
| V18        | GND                |
| V19        | GND                |
| V20        | VCC                |
| V21        | VCCIB3             |
| V22        | IO120NDB3V0        |
| V23        | IO128NDB3V1        |
| V24        | IO132PDB3V2        |
| V25        | IO130PPB3V2        |
| V26        | IO126NDB3V1        |
| V27        | IO129NDB3V1        |
| V28        | IO127NDB3V1        |
| V29        | IO125NDB3V1        |
| V30        | IO123PDB3V1        |
| W1         | IO266NDB6V4        |
| W2         | IO262NDB6V3        |
| W3         | IO260NDB6V3        |
| W4         | IO252NDB6V2        |
| W5         | IO251NDB6V2        |
| W6         | IO251PDB6V2        |
| W7         | IO255NDB6V2        |
| W8         | IO249PPB6V1        |
| W9         | IO253PDB6V2        |
| W10        | VCCIB6             |
| W11        | VCC                |
| W12        | GND                |
| W13        | GND                |
| W14        | GND                |
| W15        | GND                |
| W16        | GND                |
| W17        | GND                |
| W18        | GND                |
| W19        | GND                |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| W20        | VCC                |
| W21        | VCCIB3             |
| W22        | IO134PDB3V2        |
| W23        | IO138PDB3V3        |
| W24        | IO132NDB3V2        |
| W25        | IO136NPB3V2        |
| W26        | IO130NPB3V2        |
| W27        | IO141PDB3V3        |
| W28        | IO135PDB3V2        |
| W29        | IO131PDB3V2        |
| W30        | IO123NDB3V1        |
| Y1         | IO266PDB6V4        |
| Y2         | IO250PDB6V2        |
| Y3         | IO250NDB6V2        |
| Y4         | IO246PDB6V1        |
| Y5         | IO247NDB6V1        |
| Y6         | IO247PDB6V1        |
| Y7         | IO249NPB6V1        |
| Y8         | IO245PDB6V1        |
| Y9         | IO253NDB6V2        |
| Y10        | GEB0/IO235NPB6V0   |
| Y11        | VCC                |
| Y12        | VCC                |
| Y13        | VCC                |
| Y14        | VCC                |
| Y15        | VCC                |
| Y16        | VCC                |
| Y17        | VCC                |
| Y18        | VCC                |
| Y19        | VCC                |
| Y20        | VCC                |
| Y21        | IO142PPB3V3        |
| Y22        | IO134NDB3V2        |
| Y23        | IO138NDB3V3        |
| Y24        | IO140NDB3V3        |
| Y25        | IO140PDB3V3        |

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|------------|--------------------|
| Pin Number | A3PE3000L Function |
| Y26        | IO136PPB3V2        |
| Y27        | IO141NDB3V3        |
| Y28        | IO135NDB3V2        |
| Y29        | IO131NDB3V2        |
| Y30        | IO133PDB3V2        |

## 5 – Datasheet Information

### List of Changes

The following table lists critical changes that were made in each revision of the datasheet.

| Revision                       | Changes   | Page  |
|--------------------------------|---|---|
| Revision 3<br>(September 2012) | The "Security" section was modified to clarify that Microsemi does not support read-back of programmed data.  | 1-2   |
| Revision 2<br>(June 2012)      | The FG484 package was added for A3P1000 in <a href="#">Table 1 • Military ProASIC3/EL Low-Power Devices</a> , the <a href="#">I/Os Per Package 1</a> table, and the "Temperature Grade Offerings" table (SAR 39010).  | I, II, IV   |
|                                | The "FG484" pin table for A3P1000 has been added (SAR 39010).   | 4-15  |
| Revision 1<br>(June 2011)      | In the "High Performance" section, 66-Bit PCI was corrected to 64-Bit PCI (SAR 31977).  | I   |
|                                | The A3P250 device and VQ100 package were added to product tables in the "Military ProASIC3/EL Low Power Flash FPGAs" chapter (SAR 30526).   | I   |
|                                | The Y security option and Licensed DPA Logo were added to the "Military ProASIC3/EL Ordering Information" section. The trademarked Licensed DPA Logo identifies that a product is covered by a DPA counter-measures license from Cryptography Research (SAR 32151).   | III   |
|                                | The A3P250 device was added to applicable tables in the "Military ProASIC3/EL DC and Switching Characteristics" chapter (SAR 30526).  | 2-1   |
|                                | The VPUMP voltage for operation mode was changed from "0 to 3.45 V" to "0 to 3.6 V" in <a href="#">Table 2-2 • Recommended Operating Conditions 1</a> (SAR 25220).  | 2-2   |
|                                | 3.3 V LVCMOS wide range and 1.2 V LVCMOS wide range were added to applicable tables in the following sections (SAR 28061):<br><a href="#">Table 2-2 • Recommended Operating Conditions 1</a><br>"Power per I/O Pin"<br>"Overview of I/O Performance"<br>"Summary of I/O Timing Characteristics – Default I/O Software Settings"<br>"User I/O Characteristics"<br>"Detailed I/O DC Characteristics"<br>"Single-Ended I/O Characteristics" (SAR 31925)  | 2-2<br>2-11<br>2-24<br>2-27<br>2-20<br>2-31<br>2-39 |
|                                | The "Quiescent Supply Current" section was updated.<br><a href="#">Table 2-7 • Power Supply State Per Mode</a> is new (SAR 24882, 24112, 32549).<br>New values were added to the following tables (SAR 30619):<br><a href="#">Table 2-8 • Quiescent Supply Current (IDD) Characteristics, Flash*Freeze Mode*</a><br><a href="#">Table 2-10 • Quiescent Supply Current (IDD) Characteristics, Shutdown Mode*</a><br><a href="#">Table 2-11 • Quiescent Supply Current (IDD), Static Mode and Active Mode 1</a> (the name of this table changed from "No Flash*Freeze Mode" to "Static Mode and Active Mode" per SAR 32549)<br><a href="#">Table 2-12 • Quiescent Supply Current (IDD) Characteristics for A3P250 and A3P1000</a><br>The military maximum current for A3P1000 was revised in the following table (SAR 30620):<br><a href="#">Table 2-12 • Quiescent Supply Current (IDD) Characteristics for A3P250 and A3P1000</a> | 2-9   |

| Revision                  | Changes   | Page   |
|---------------------------|---|--|
| Revision 1<br>(continued) | All timing and power tables were updated to reflect changes in the software resulting from characterization and bug fixes (SAR 32394).  | 2-11<br>to<br>2-14<br>8                              |
|                           | In the following tables for A3P250 and A3P1000, the note regarding dynamic power was revised to, "Dynamic Power consumption is given for software default drive strength and output slew. Output load is lower than the software default" (SAR 32449).<br>Table 2-17 • Summary of I/O Output Buffer Power (per pin) – Default I/O Software Settings 1<br>Table 2-18 • Summary of I/O Output Buffer Power (per pin) – Default I/O Software Settings  | 2-14,<br>2-14  |
|                           | Values for A3PE600L and A3P250 were added to Table 2-20 • Different Components Contributing to Dynamic Power Consumption in Military ProASIC3 and ProASIC3/EL Devices at 1.5 V VCC. Values in the table, and in Table 2-19 • Different Components Contributing to Dynamic Power Consumption in Military ProASIC3/EL Devices Operating at 1.2 V VCC, were updated were updated to reflect changes in the software resulting from characterization and bug fixes (SAR 30528).   | 2-15,<br>2-16  |
|                           | Table 2-21 • Different Components Contributing to the Static Power Consumption in Military ProASIC3/EL Devices and the "Total Static Power Consumption—PSTAT" calculation were updated to add PDC0 (SAR 32549).   | 2-16,<br>2-17  |
|                           | The "Timing Model" was updated (SAR 29793).   | 2-20   |
|                           | The title of Table 2-28 • Summary of AC Measuring Points was changed from "Summary of AC Memory Points" (SAR 32446).  | 2-27   |
|                           | The following note was added to Table 2-30, Table 2-31, and Table 2-31, Summary of I/O Timing Characteristics (SAR 32449):<br>"Output delays provided in this table were extracted with an output load indicated in the Capacitive Load column. For a specific output load, refer to Designer software."  | 2-28   |
|                           | Resistances and short circuit currents were updated (SARs 29793, 31717):<br>Table 2-35 • I/O Output Buffer Maximum Resistances 1 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only<br>Table 2-39 • I/O Short Currents IOSH/IOSL Applicable to Pro I/Os for A3PE600L and A3PE3000L Only (SAR 31717)<br>Tables for Pro I/Os in the "Single-Ended I/O Characteristics" section (SAR 31717).   | 2-32<br>through<br>2-35                              |
|                           | The drive strength was changed from 25 mA to 20 mA for 3.3 V and 2.5 V GTL (SAR 31978). This affects the following tables:<br>Table 2-24 • Summary of Maximum and Minimum DC Input and Output Levels<br>Table 2-30 • Summary of I/O Timing Characteristics—Software Default Settings (SAR 32394)<br>Table 2-31 • Summary of I/O Timing Characteristics—Software Default Settings<br>Table 2-35 • I/O Output Buffer Maximum Resistances 1 Applicable to Pro I/Os for A3PE600L and A3PE3000L Only<br>Table 2-39 • I/O Short Currents IOSH/IOSL Applicable to Pro I/Os for A3PE600L and A3PE3000L Only<br>Table 2-119 • Minimum and Maximum DC Input and Output Levels<br>Table 2-123 • Minimum and Maximum DC Input and Output Levels | 2-24<br>2-28<br>2-29<br>2-32<br>2-35<br>2-75<br>2-77 |
|                           | The values in Table 2-38 • I/O Weak Pull-Up/Pull-Down Resistances were revised (SAR 29793, 28061).  | 2-34   |

| Revision                  | Changes   | Page                                  |
|---------------------------|---|---------------------------------------|
| Revision 1<br>(continued) | The AC Loading diagrams in the "Single-Ended I/O Characteristics" section were updated to match summary of I/O timing tables in the "Summary of I/O Timing Characteristics – Default I/O Software Settings" section (SAR 32449).  | 2-39                                  |
|                           | The tables in the "Voltage-Referenced I/O Characteristics" section and "Differential I/O Characteristics" section were updated with current values (SARs 29793, 32391, 32394).  | 2-75<br>2-87                          |
|                           | Two note references were added to Table 2-159 • Minimum and Maximum DC Input and Output Levels to clarify the following notes: $\pm 5\%$ [VCCI] and differential input voltage = $\pm 350$ mV [VDIFF] (SAR 29428).  | 2-88                                  |
|                           | The "Global Tree Timing Characteristics" section was updated.<br>Table 2-198 • A3P250 Global Resource is new (SAR 30526).<br>Available values were added or revised in the following tables (SAR 30698):<br>Table 2-194 • A3PE600L Global Resource<br>Table 2-199 • A3P1000 Global Resource<br>Table 2-196 • A3PE600L Global Resource | 2-12<br>2                             |
|                           | Table 2-200 • Military ProASIC3/EL CCC/PLL Specification and Table 2-201 • Military ProASIC3/EL CCC/PLL Specification were updated with current values (SAR 32521).   | 2-12<br>5                             |
|                           | The following figures were removed (SAR 29991):<br>Figure 2-49 • Write Access after Write onto Same Address<br>Figure 2-50 • Read Access after Write onto Same Address<br>Figure 2-51 • Write Access after Read onto Same Address   | N/A                                   |
|                           | The naming of the address collision parameters in the SRAM "Timing Characteristics" section was changed, and values were updated accordingly (SAR 29991).   | 2-13<br>1                             |
|                           | The values for $t_{CKQ1}$ in Table 2-202 • RAM4K9, Table 2-203 • RAM4K9, and Table 2-204 • RAM4K9 were reversed with respect to WMODE and have been corrected (SAR 32343).  | 2-13<br>1,<br>2-13<br>2,<br>2-13<br>3 |
|                           | Table 2-211 • FIFO through Table 2-215 • FIFO are new (SAR 32394).  | 2-14<br>3,<br>2-14<br>7               |
|                           | Tables in the "Embedded FlashROM Characteristics" section were updated (SAR 32392).   | 2-14<br>8                             |
|                           | The "Pin Descriptions and Packaging" chapter was added (SAR 21642).   | 3-1                                   |
|                           | Package names used in the "Package Pin Assignments" section were revised to match standards given in <i>Package Mechanical Drawings</i> (SAR 27395).  | 4-1                                   |
|                           | The "VQ100*" pin table for A3P250 is new (SAR 31975).   | 4-2                                   |
|                           | The "FG144" pin table for A3P1000 was updated to remove the Flash*Freeze (FF) designation from pin L3. This package does not support Flash*Freeze functionality. Pin W6 of the "FG484" for A3PE600L was designated as the Flash*Freeze control pin for that package (SAR 24084).  | 4-7,<br>4-10                          |

## Datasheet Categories

### **Categories**

In order to provide the latest information to designers, some datasheet parameters are published before data has been fully characterized from silicon devices. The data provided for a given device, as highlighted in the "[Military ProASIC3/EL Device Status](#)" table on page II, is designated as either "Product Brief," "Advance," "Preliminary," or "Production." The definitions of these categories are as follows:

#### **Product Brief**

The product brief is a summarized version of a datasheet (advance or production) and contains general product information. This document gives an overview of specific device and family information.

#### **Advance**

This version contains initial estimated information based on simulation, other products, devices, or speed grades. This information can be used as estimates, but not for production. This label only applies to the DC and Switching Characteristics chapter of the datasheet and will only be used when the data has not been fully characterized.

#### **Preliminary**

The datasheet contains information based on simulation and/or initial characterization. The information is believed to be correct, but changes are possible.

#### **Unmarked (production)**

This version contains information that is considered to be final.

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