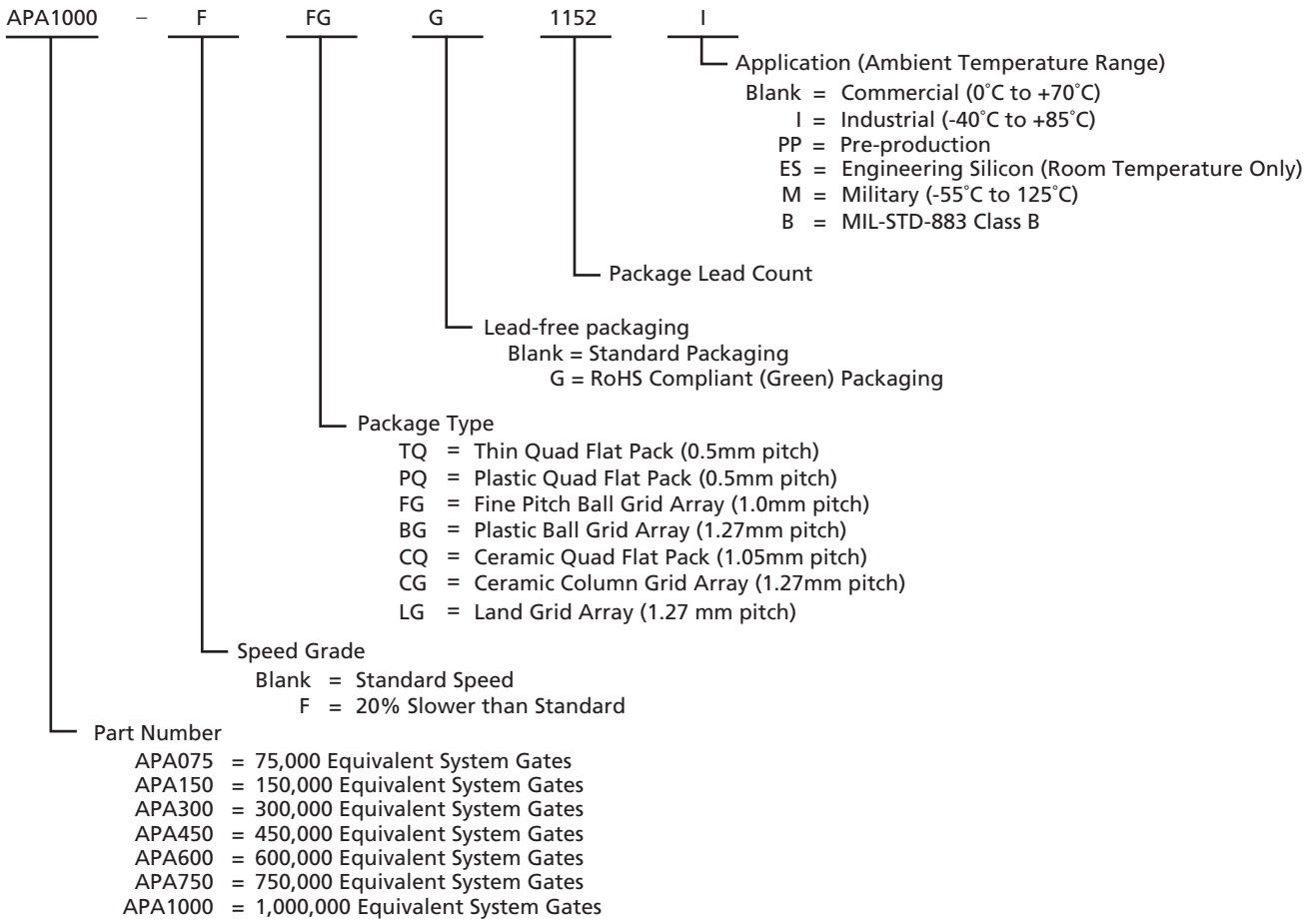
# Ordering Information




# Plastic Device Resources

| | User I/Os[2] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Commercial/Industrial | | | | | | | | | | Military | | |
| Device | TQFP 100-Pin | TQFP 144-Pin | PQFP 208-Pin | PBGA 456-Pin | FBGA 144-Pin | FBGA 256-Pin | FBGA 484-Pin | FBGA 676-Pin | FBGA 896-Pin | FBGA 1152-Pin | CQFP 208-Pin | CQFP 352-Pin | CCGA/LGA 624-Pin |
| APA075 | 66 | 107 | 158 | | 100 | | | | | | | | |
| APA150 | 66 | | 158 | 242 | 100 | 186 [3] | | | | | | | |
| APA300 | | | 158 | 290 | 100 | 186 [3] | | | | | 158 | 248 | |
| APA450 | | | 158 | 344 | 100 | 186 [3] | 344 [3] | | | | | | |
| APA600 | | | 158 | 356 | | 186 [3] | 370 [3] | 454 | | | 158 | 248 | 440 |
| APA750 | | | 158 | 356 | | | | 454 | 562 [4] | | | | |
| APA1000 | | | 158 | 356 | | | | | 642 [4] | 712 [4] | 158 | 248 | 440 |

***Notes:***

1. *Package Definitions: TQFP = Thin Quad Flat Pack, PQFP = Plastic Quad Flat Pack, PBGA = Plastic Ball Grid Array, FBGA = Fine Pitch Ball Grid Array, CQFP = Ceramic Quad Flat Pack, CCGA = Ceramic Column Grid Array, LGA = Land Grid Array*
2. *Each pair of PECL I/Os is counted as one user I/O.*
3. *FG256 and FG484 are footprint-compatible packages.*
4. *FG896 and FG1152 are footprint-compatible packages.*

## General Guideline

Maximum performance numbers in this datasheet are based on characterized data. Actel does not guarantee performance beyond the limits specified within the datasheet.

## Temperature Grade Offerings

| Package | APA075 | APA150 | APA300 | APA450 | APA600 | APA750 | APA1000 |
|---|---|---|---|---|---|---|---|
| **Commercial/Industrial** | | | | | | | |
| TQ100 | C, I | C, I | | | | | |
| TQ144 | C, I | | | | | | |
| PQ208 | C, I | C, I | C, I, M | C, I | C, I, M | C, I | C, I, M |
| BG456 | | C, I | C, I, M | C, I | C, I, M | C, I | C, I, M |
| FG144 | C, I | C, I | C, I | C, I | | | |
| FG256 | | C, I | C, I | C, I | C, I | | |
| FG484 | | | | C, I | C, I | | |
| FG676 | | | | | C, I | C, I | |
| FG896 | | | | | | C, I | C, I |
| FG1152 | | | | | | | C, I |
| **Military** | | | | | | | |
| CQ208 | | | M, B | | M, B | | M, B |
| CQ352 | | | M, B | | M, B | | M, B |
| CG624 | | | | | M, B | | M, B |

***Note:*** *C = Commercial*
*I = Industrial*
*M = Military*
*B = MIL-STD-883*

## Speed Grade and Temperature Matrix

| | –F | Std. |
|---|---|---|
| C | ✓ | ✓ |
| I | | ✓ |
| M, B | | ✓ |

***Note:*** *C = Commercial*
*I = Industrial*
*M = Military*
*B = MIL-STD-883*

# Table of Contents

# General Description

The ProASIC^PLUS family of devices, Actel's second-generation Flash FPGAs, offers enhanced performance over Actel's ProASIC family. It combines the advantages of ASICs with the benefits of programmable devices through nonvolatile Flash technology. This enables engineers to create high-density systems using existing ASIC or FPGA design flows and tools. In addition, the ProASIC^PLUS family offers a unique clock conditioning circuit based on two on-board phase-locked loops (PLLs). The family offers up to one million system gates, supported with up to 198 kbits of two-port SRAM and up to 712 user I/Os, all providing 50 MHz PCI performance.

Advantages to the designer extend beyond performance. Unlike SRAM-based FPGAs, four levels of routing hierarchy simplify routing, while the use of Flash technology allows all functionality to be live at power-up. No external boot PROM is required to support device programming. While on-board security mechanisms prevent access to the program information, reprogramming can be performed in-system to support future design iterations and field upgrades. The device's architecture mitigates the complexity of ASIC migration at higher user volume. This makes ProASIC^PLUS a cost-effective solution for applications in the networking, communications, computing, and avionics markets.

The ProASIC^PLUS family achieves its nonvolatility and reprogrammability through an advanced Flash-based 0.22 µm LVCMOS process with four layers of metal. Standard CMOS design techniques are used to implement logic and control functions, including the PLLs and LVPECL inputs. This results in predictable performance compatible with gate arrays.

The ProASIC^PLUS architecture provides granularity comparable to gate arrays. The device core consists of a Sea-of-Tiles™. Each tile can be configured as a flip-flop, latch, or three-input/one-output logic function by programming the appropriate Flash switches. The combination of fine granularity, flexible routing resources, and abundant Flash switches allow 100% utilization and over 95% routability for highly congested designs. Tiles and larger functions are interconnected through a four-level routing hierarchy.

Embedded two-port SRAM blocks with built-in FIFO/RAM control logic can have user-defined depths and widths. Users can also select programming for synchronous or asynchronous operation, as well as parity generations or checking.

The unique clock conditioning circuitry in each device includes two clock conditioning blocks. Each block provides a PLL core, delay lines, phase shifts (0°, 90°, 180°, 270°), and clock multipliers/dividers, as well as the circuitry needed to provide bidirectional access to the PLL. The PLL block contains four programmable frequency dividers which allow the incoming clock signal to be divided by a wide range of factors from 1 to 64. The clock conditioning circuit also delays or advances the incoming reference clock up to 8 ns (in increments of 0.25 ns). The PLL can be configured internally or externally during operation without redesigning or reprogramming the part. In addition to the PLL, there are two LVPECL differential input pairs to accommodate high-speed clock and data inputs.

To support customer needs for more comprehensive, lower-cost, board-level testing, Actel's ProASIC^PLUS devices are fully compatible with IEEE Standard 1149.1 for test access port and boundary-scan test architecture. For more information concerning the Flash FPGA implementation, please refer to the "Boundary Scan (JTAG)" section on page 1-11.

ProASIC^PLUS devices are available in a variety of high-performance plastic packages. Those packages and the performance features discussed above are described in more detail in the following sections.

# ProASIC^PLUS Architecture

The proprietary ProASIC^PLUS architecture provides granularity comparable to gate arrays.

The ProASIC^PLUS device core consists of a Sea-of-Tiles (Figure 1-1). Each tile can be configured as a three-input logic function (e.g., NAND gate, D-Flip-Flop, etc.) by programming the appropriate Flash switch interconnections (Figure 1-2 and Figure 1-3 on page 1-3). Tiles and larger functions are connected with any of the four levels of routing hierarchy. Flash switches are distributed throughout the device to provide nonvolatile, reconfigurable interconnect programming. Flash switches are programmed to connect signal lines to the appropriate logic cell inputs and outputs. Dedicated high-performance lines are connected as needed for fast, low-skew global signal distribution throughout the core. Maximum core utilization is possible for virtually any design.

ProASIC^PLUS devices also contain embedded, two-port SRAM blocks with built-in FIFO/RAM control logic. Programming options include synchronous or asynchronous operation, two-port RAM configurations, user defined depth and width, and parity generation or checking. Please see the "Embedded Memory Configurations" section on page 1-22 for more information.

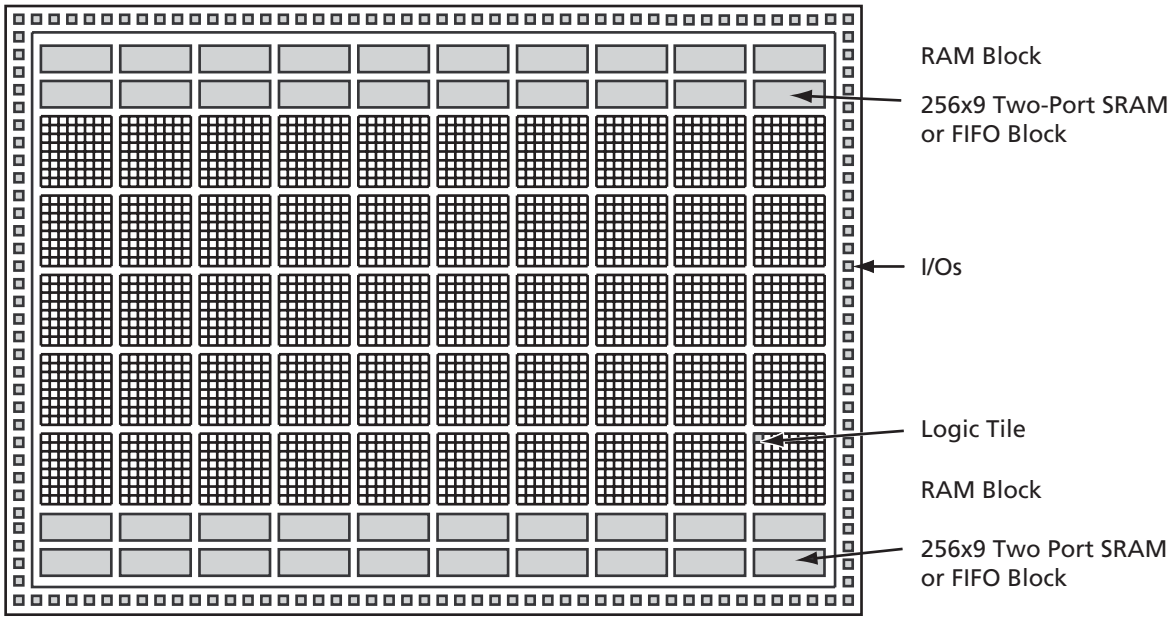



*Figure 1-1* • **The ProASIC^PLUS Device Architecture**

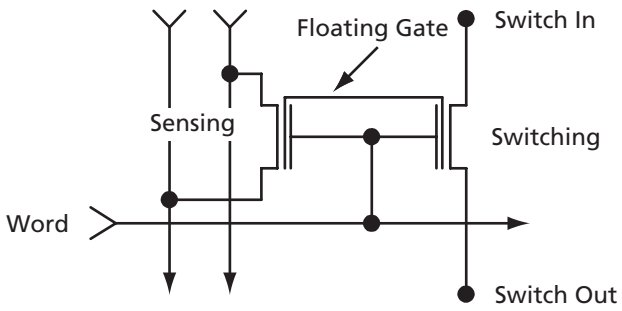



*Figure 1-2* • **Flash Switch**

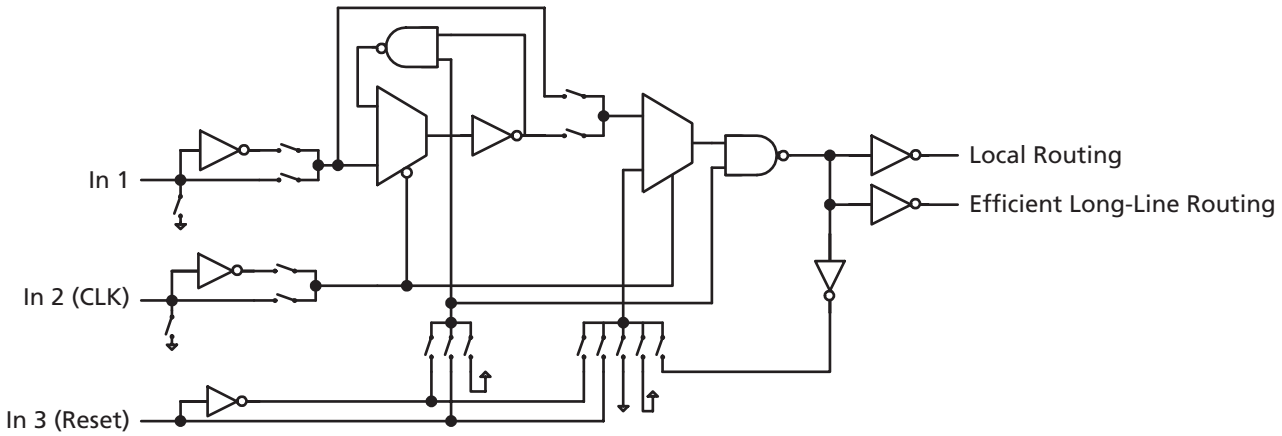



*Figure 1-3* • **Core Logic Tile**

## Live at Power-Up

The Actel Flash-based ProASIC^PLUS devices support Level 0 of the live at power-up (LAPU) classification standard. This feature helps in system component initialization, executing critical tasks before the processor wakes up, setting up and configuring memory blocks, clock generation, and bus activity management. The LAPU feature of Flash-based ProASIC^PLUS devices greatly simplifies total system design and reduces total system cost, often eliminating the need for Complex Programmable Logic Device (CPLD) and clock generation PLLs that are used for this purpose in a system. In addition, glitches and brownouts in system power will not corrupt the ProASIC^PLUS 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 ProASIC^PLUS devices simplify total system design, and reduce cost and design risk, while increasing system reliability and improving system initialization time.

## Flash Switch

Unlike SRAM FPGAs, ProASIC^PLUS uses a live-on-power-up ISP Flash switch as its programming element.

In the ProASIC^PLUS Flash switch, two transistors share the floating gate, which stores the programming information. One is the sensing transistor, which is only used for writing and verification of the floating gate voltage. The other is the switching transistor. It can be used in the architecture to connect/separate routing nets or to configure logic. It is also used to erase the floating gate (Figure 1-2 on page 1-2).

## Logic Tile

The logic tile cell (Figure 1-3) has three inputs (any or all of which can be inverted) and one output (which can connect to both ultra-fast local and efficient long-line routing resources). Any three-input, one-output logic function (except a three-input XOR) can be configured as one tile. The tile can be configured as a latch with clear or set or as a flip-flop with clear or set. Thus, the tiles can flexibly map logic and sequential gates of a design.

## Routing Resources

The routing structure of ProASIC^PLUS devices is designed to provide high performance through a flexible four-level hierarchy of routing resources: ultra-fast local resources, efficient long-line resources, high-speed, very long-line resources, and high performance global networks.

The ultra-fast local resources are dedicated lines that allow the output of each tile to connect directly to every input of the eight surrounding tiles (Figure 1-4).

The efficient long-line resources provide routing for longer distances and higher fanout connections. These resources vary in length (spanning 1, 2, or 4 tiles), run both vertically and horizontally, and cover the entire ProASIC^PLUS device (Figure 1-5 on page 1-5). Each tile can drive signals onto the efficient long-line resources, which can in turn access every input of every tile. Active buffers are inserted automatically by routing software to limit the loading effects due to distance and fanout.

The high-speed, very long-line resources, which span the entire device with minimal delay, are used to route very long or very high fanout nets. (Figure 1-6 on page 1-6).

The high-performance global networks are low-skew, high fanout nets that are accessible from external pins or from internal logic (Figure 1-7 on page 1-7). These nets are typically used to distribute clocks, resets, and other high fanout nets requiring a minimum skew. The global networks are implemented as clock trees, and signals can be introduced at any junction. These can be employed hierarchically with signals accessing every input on all tiles.

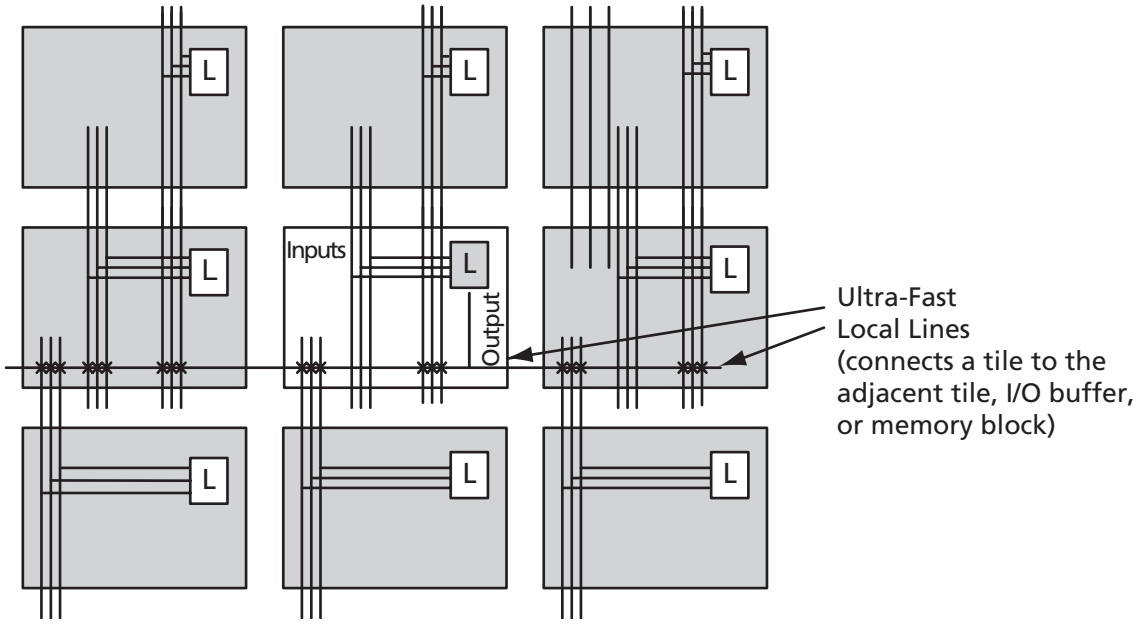



*Figure 1-4* • **Ultra-Fast Local Resources**

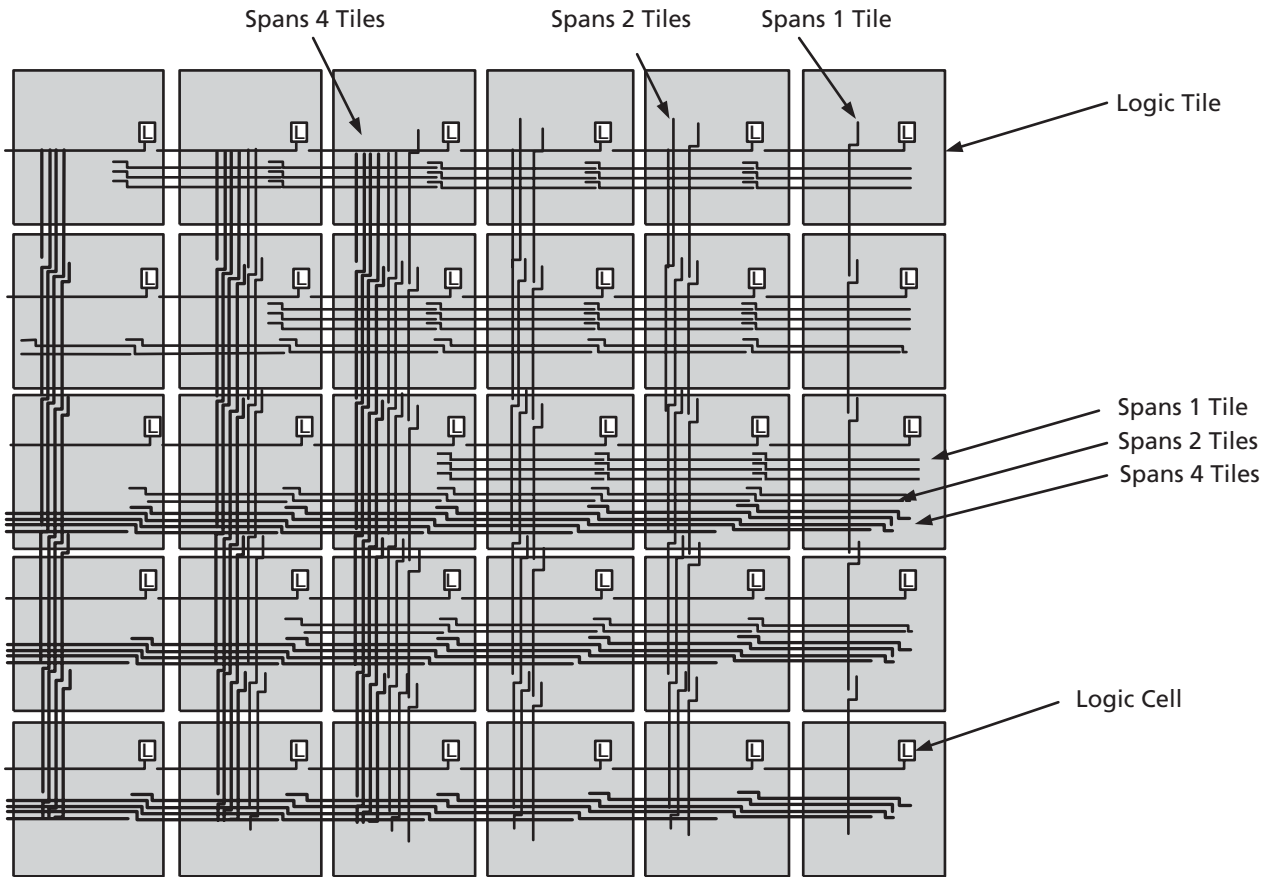



*Figure 1-5* • **Efficient Long-Line Resources**

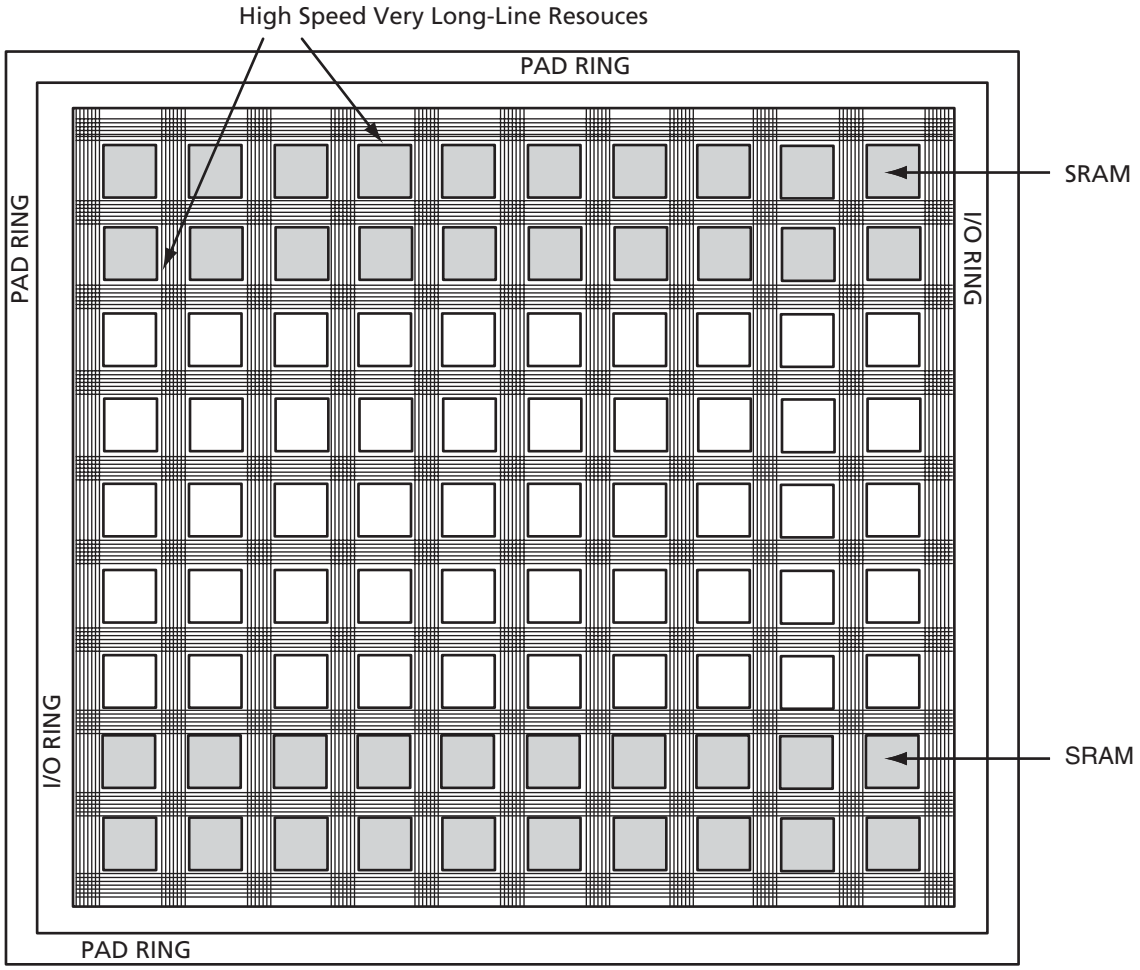



*Figure 1-6* • **High-Speed, Very Long-Line Resources**

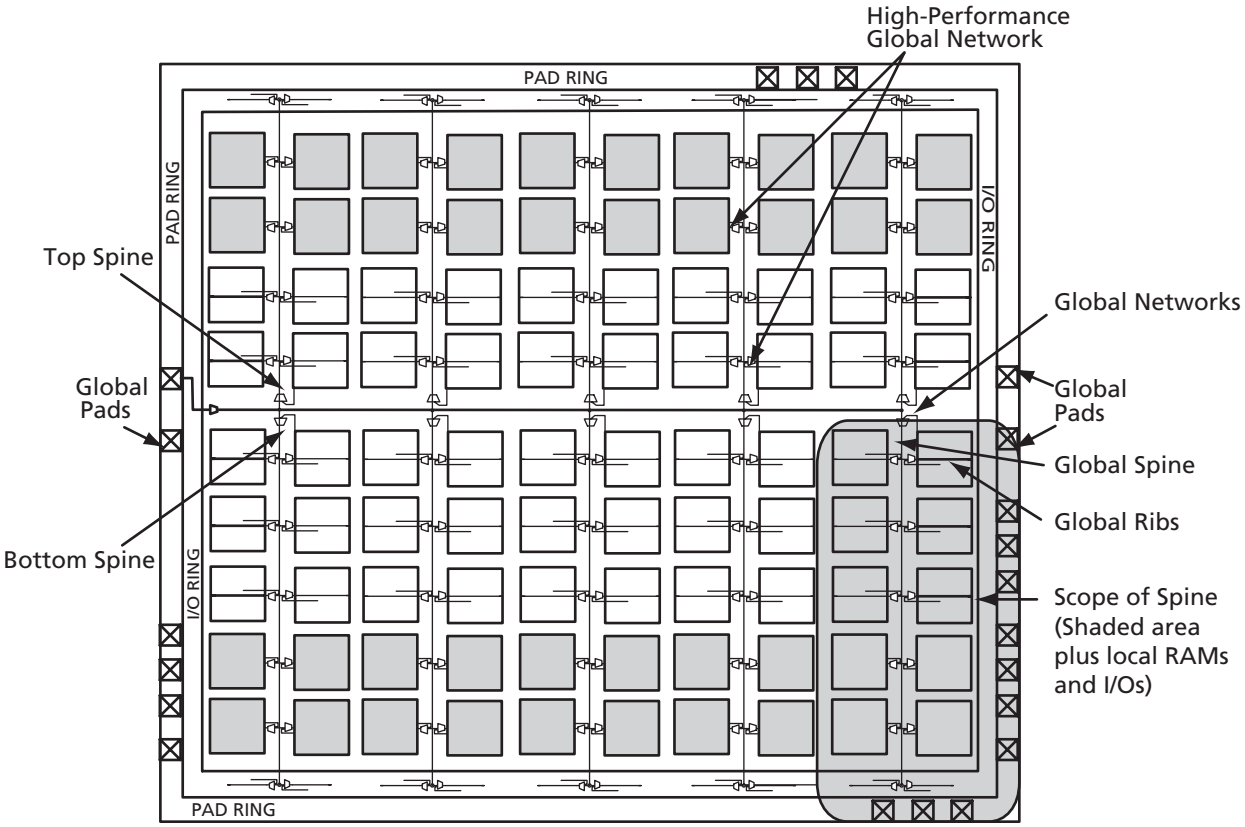
## Clock Resources

The ProASIC^PLUS family offers powerful and flexible control of circuit timing through the use of analog circuitry. Each chip has two clock conditioning blocks containing a phase-locked loop (PLL) core, delay lines, phase shifter (0°, 90°, 180°, 270°), clock multiplier/ dividers, and all the circuitry needed for the selection and interconnection of inputs to the global network (thus providing bidirectional access to the PLL). This permits the PLL block to drive inputs and/or outputs via the two global lines on each side of the chip (four total lines). This circuitry is discussed in more detail in the "ProASICPLUS Clock Management System" section on page 1-13.

## Clock Trees

One of the main architectural benefits of ProASIC^PLUS is the set of power- and delay-friendly global networks. ProASIC^PLUS offers four global trees. Each of these trees is based on a network of spines and ribs that reach all the tiles in their regions (Figure 1-7 on page 1-7). This flexible clock tree architecture allows users to map up to 88 different internal/external clocks in an APA1000 device. Details on the clock spines and various numbers of the family are given in Table 1-1 on page 1-7.

The flexible use of the ProASIC^PLUS clock spine allows the designer to cope with several design requirements. Users implementing clock-resource intensive applications can easily route external or gated internal clocks using global routing spines. Users can also drastically reduce delay penalties and save buffering resources by mapping critical high fanout nets to spines. For design hints on using these features, refer to Actel's *Efficient Use of ProASIC Clock Trees* application note.




***Note:*** *This figure shows routing for only one global path.*

*Figure 1-7* • **High-Performance Global Network**

*Table 1-1* • **Clock Spines**

| | APA075 | APA150 | APA300 | APA450 | APA600 | APA750 | APA1000 |
|---|---|---|---|---|---|---|---|
| Global Clock Networks (Trees) | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Clock Spines/Tree | 6 | 8 | 8 | 12 | 14 | 16 | 22 |
| Total Spines | 24 | 32 | 32 | 48 | 56 | 64 | 88 |
| Top or Bottom Spine Height (Tiles) | 16 | 24 | 32 | 32 | 48 | 64 | 80 |
| Tiles in Each Top or Bottom Spine | 512 | 768 | 1,024 | 1,024 | 1,536 | 2,048 | 2,560 |
| Total Tiles | 3,072 | 6,144 | 8,192 | 12,288 | 21,504 | 32,768 | 56,320 |

## Array Coordinates

During many place-and-route operations in Actel's Designer software tool, it is possible to set constraints that require array coordinates.

Table 1-2 is provided as a reference. The array coordinates are measured from the lower left (0,0). They can be used in region constraints for specific groups of core cells, I/Os, and RAM blocks. Wild cards are also allowed.

I/O and cell coordinates are used for placement constraints. Two coordinate systems are needed because there is not a one-to-one correspondence between I/O cells and core cells. In addition, the I/O coordinate system changes depending on the die/package combination.

Core cell coordinates start at the lower left corner (represented as (1,1)) or at (1,5) if memory blocks are present at the bottom. Memory coordinates use the same system and are indicated in Table 1-2. The memory coordinates for an APA1000 are illustrated in Figure 1-8. For more information on how to use constraints, see the *Designer User's Guide* or online help for ProASIC^PLUS software tools.

*Table 1-2* • **Array Coordinates**

| | Logic Tile | | | | Memory Rows | | All | |
|---|---|---|---|---|---|---|---|---|
| | Min. | | Max. | | Bottom | Top | | |
| **Device** | **x** | **y** | **x** | **y** | **y** | **y** | **Min.** | **Max.** |
| APA075 | 1 | 1 | 96 | 32 | – | (33,33) or (33, 35) | 0,0 | 97, 37 |
| APA150 | 1 | 1 | 128 | 48 | – | (49,49) or (49, 51) | 0,0 | 129, 53 |
| APA300 | 1 | 5 | 128 | 68 | (1,1) or (1,3) | (69,69) or (69, 71) | 0,0 | 129, 73 |
| APA450 | 1 | 5 | 192 | 68 | (1,1) or (1,3) | (69,69) or (69, 71) | 0,0 | 193, 73 |
| APA600 | 1 | 5 | 224 | 100 | (1,1) or (1,3) | (101,101) or (101, 103) | 0,0 | 225, 105 |
| APA750 | 1 | 5 | 256 | 132 | (1,1) or (1,3) | (133,133) or (133, 135) | 0,0 | 257, 137 |
| APA1000 | 1 | 5 | 352 | 164 | (1,1) or (1,3) | (165,165) or (165, 167) | 0,0 | 353, 169 |

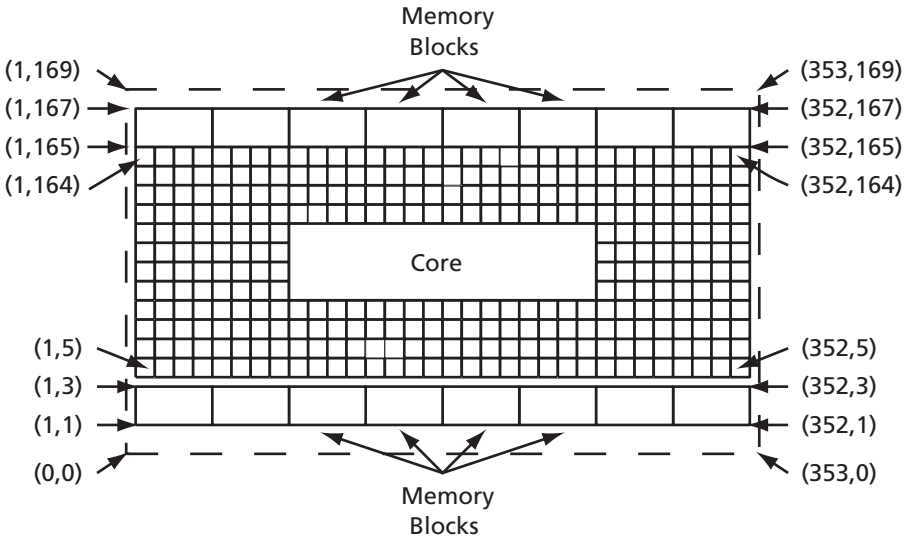



*Figure 1-8* • **Core Cell Coordinates for the APA1000**

## Input/Output Blocks

To meet complex system demands, the ProASIC^PLUS family offers devices with a large number of user I/O pins, up to 712 on the APA1000. Table 1-3 shows the available supply voltage configurations (the PLL block uses an independent 2.5 V supply on the AVDD and AGND pins). All I/Os include ESD protection circuits. Each I/O has been tested to 2000 V to the human body model (per JESD22 (HBM)).

Six or seven standard I/O pads are grouped with a GND pad and either a $V_{DD}$ (core power) or $V_{DDP}$ (I/O power) pad. Two reference bias signals circle the chip. One protects the cascaded output drivers, while the other creates a virtual $V_{DD}$ supply for the I/O ring.

I/O pads are fully configurable to provide the maximum flexibility and speed. Each pad can be configured as an input, an output, a tristate driver, or a bidirectional buffer (Figure 1-9 and Table 1-4).

*Table 1-3 •* **ProASIC^PLUS I/O Power Supply Voltages**

| | $V_{DDP}$ | |
|---|---|---|
| | **2.5 V** | **3.3 V** |
| **Input Compatibility** | 2.5 V | 3.3 V |
| **Output Drive** | 2.5 V | 3.3 V |

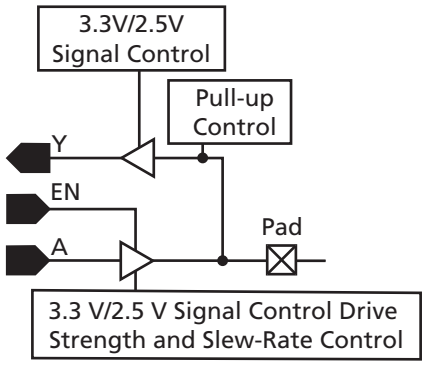



*Figure 1-9 •* **I/O Block Schematic Representation**

*Table 1-4 •* **I/O Features**

| Function | Description |
|---|---|
| I/O pads configured as inputs | • Selectable 2.5 V or 3.3 V threshold levels<br>• Optional pull-up resistor<br>• Optionally configurable as Schmitt trigger input. The Schmitt trigger input option can be configured as an input only, not a bidirectional buffer. This input type may be slower than a standard input under certain conditions and has a typical hysteresis of 0.35 V. I/O macros with an "S" in the standard I/O library have added Schmitt capabilities.<br>• 3.3 V PCI Compliant (except Schmitt trigger inputs) |
| I/O pads configured as outputs | • Selectable 2.5 V or 3.3 V compliant output signals<br>• 2.5 V – JEDEC JESD 8-5<br>• 3.3 V – JEDEC JESD 8-A (LVTTL and LVCMOS)<br>• 3.3 V PCI compliant<br>• Ability to drive LVTTL and LVCMOS levels<br>• Selectable drive strengths<br>• Selectable slew rates<br>• Tristate |
| I/O pads configured as bidirectional buffers | • Selectable 2.5 V or 3.3 V compliant output signals<br>• 2.5 V – JEDEC JESD 8-5<br>• 3.3 V – JEDEC JESD 8-A (LVTTL and LVCMOS)<br>• 3.3 V PCI compliant<br>• Optional pull-up resistor<br>• Selectable drive strengths<br>• Selectable slew rates<br>• Tristate |

## Power-Up Sequencing

While ProASIC^PLUS devices are live at power-up, the order of $V_{DD}$ and $V_{DDP}$ power-up is important during system start-up. $V_{DD}$ should be powered up simultaneously with $V_{DDP}$ on ProASIC^PLUS devices. Failure to follow these guidelines may result in undesirable pin behavior during system start-up. For more information, refer to Actel's *Power-Up Behavior of ProASIC^PLUS Devices* application note.

## LVPECL Input Pads

In addition to standard I/O pads and power pads, ProASIC^PLUS devices have a single LVPECL input pad on both the east and west sides of the device, along with AVDD and AGND pins to power the PLL block. The LVPECL pad cell consists of an input buffer (containing a low voltage differential amplifier) and a signal and its complement, PPECL (I/P) (PECLN) and NPECL (PECLREF). The LVPECL input pad cell differs from the standard I/O cell in that it is operated from $V_{DD}$ only.

Since it is exclusively an input, it requires no output signal, output enable signal, or output configuration bits. As a special high-speed differential input, it also does not require pull ups. Recommended termination for LVPECL inputs is shown in Figure 1-10. The LVPECL pad cell compares voltages on the PPECL (I/P) pad (as illustrated in Figure 1-11) and the NPECL pad and sends the results to the global MUX (Figure 1-14 on page 1-14). This high-speed, low-skew output essentially controls the clock conditioning circuit.

LVPECLs are designed to meet LVPECL JEDEC receiver standard levels (Table 1-5).

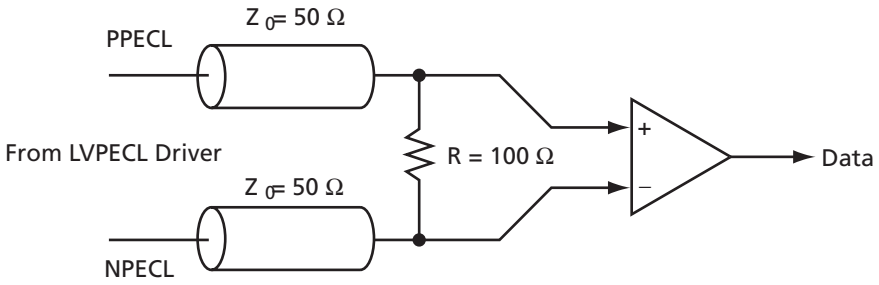



*Figure 1-10* • **Recommended Termination for LVPECL Inputs**

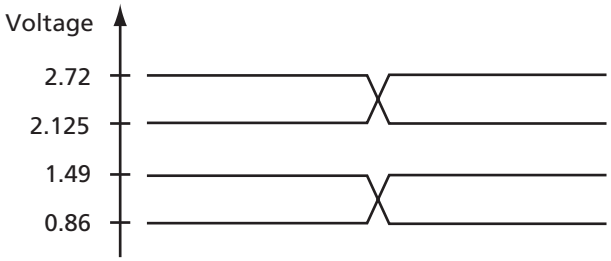



*Figure 1-11* • **LVPECL High and Low Threshold Values**

*Table 1-5* • **LVPECL Receiver Specifications**

| Symbol | Parameter | Min. | Max | Units |
|---|---|---|---|---|
| $V_{IH}$ | Input High Voltage | 1.49 | 2.72 | V |
| $V_{IL}$ | Input Low Voltage | 0.86 | 2.125 | V |
| $V_{ID}$ | Differential Input Voltage | 0.3 | $V_{DD}$ | V |

## Boundary Scan (JTAG)

ProASIC^PLUS devices are compatible with IEEE Standard 1149.1, which defines a set of hardware architecture and mechanisms for cost-effective, board-level testing. The basic ProASIC^PLUS boundary-scan logic circuit is composed of the TAP (test access port), TAP controller, test data registers, and instruction register (Figure 1-12). This circuit supports all mandatory IEEE 1149.1 instructions (EXTEST, SAMPLE/PRELOAD and BYPASS) and the optional IDCODE instruction (Table 1-6).

Each test section is accessed through the TAP, which has five associated pins: TCK (test clock input), TDI and TDO (test data input and output), TMS (test mode selector) and TRST (test reset input). TMS, TDI and TRST are equipped with pull-up resistors to ensure proper operation when no input data is supplied to them. These pins are dedicated for boundary-scan test usage. Actel recommends that a nominal 20 kΩ pull-up resistor is added to TDO and TCK pins.

The TAP controller is a four-bit state machine (16 states) that operates as shown in Figure 1-13 on page 1-12. The '1's and '0's represent the values that must be present at TMS at a rising edge of TCK for the given state transition to occur. IR and DR indicate that the instruction register or the data register is operating in that state.

ProASIC^PLUS devices have to be programmed at least once for complete boundary-scan functionality to be available. If boundary-scan functionality is required prior to programming, refer to online technical support on the Actel website and search for ProASIC^PLUS BSDL.

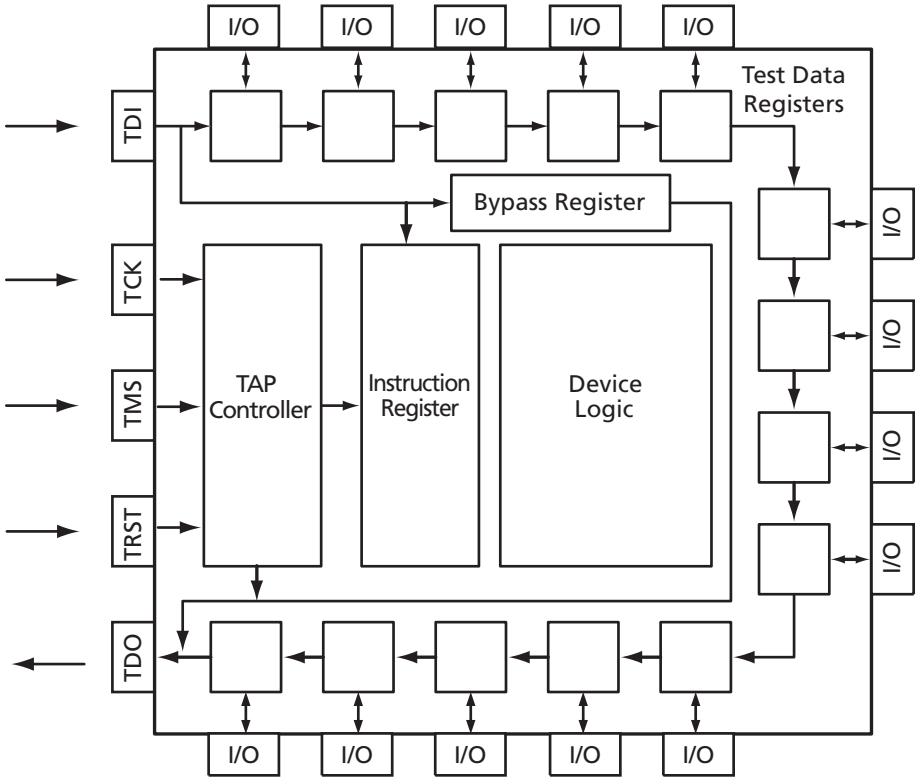



*Figure 1-12* • **ProASIC^PLUS JTAG Boundary Scan Test Logic Circuit**

*Table 1-6* • **Boundary-Scan Opcodes**

| | Hex Opcode |
|---|---|
| EXTEST | 00 |
| SAMPLE/PRELOAD | 01 |
| IDCODE | 0F |
| CLAMP | 05 |
| BYPASS | FF |

The TAP controller receives two control inputs (TMS and TCK) and generates control and clock signals for the rest of the test logic architecture. On power-up, the TAP controller enters the Test-Logic-Reset state. To guarantee a reset of the controller from any of the possible states, TMS must remain high for five TCK cycles. The TRST pin may also be used to asynchronously place the TAP controller in the Test-Logic-Reset state.

ProASIC^PLUS devices support three types of test data registers: bypass, device identification, and boundary scan. The bypass register is selected when no other register needs to be accessed in a device. This speeds up test data transfer to other devices in a test data path. The 32-bit device identification register is a shift register with four fields (lowest significant byte (LSB), ID number, part number and version). The boundary-scan register observes and controls the state of each I/O pin.

Each I/O cell has three boundary-scan register cells, each with a serial-in, serial-out, parallel-in, and parallel-out pin. The serial pins are used to serially connect all the boundary-scan register cells in a device into a boundary-scan register chain, which starts at the TDI pin and ends at the TDO pin. The parallel ports are connected to the internal core logic tile and the input, output, and control ports of an I/O buffer to capture and load data into the register to control or observe the logic state of each I/O.

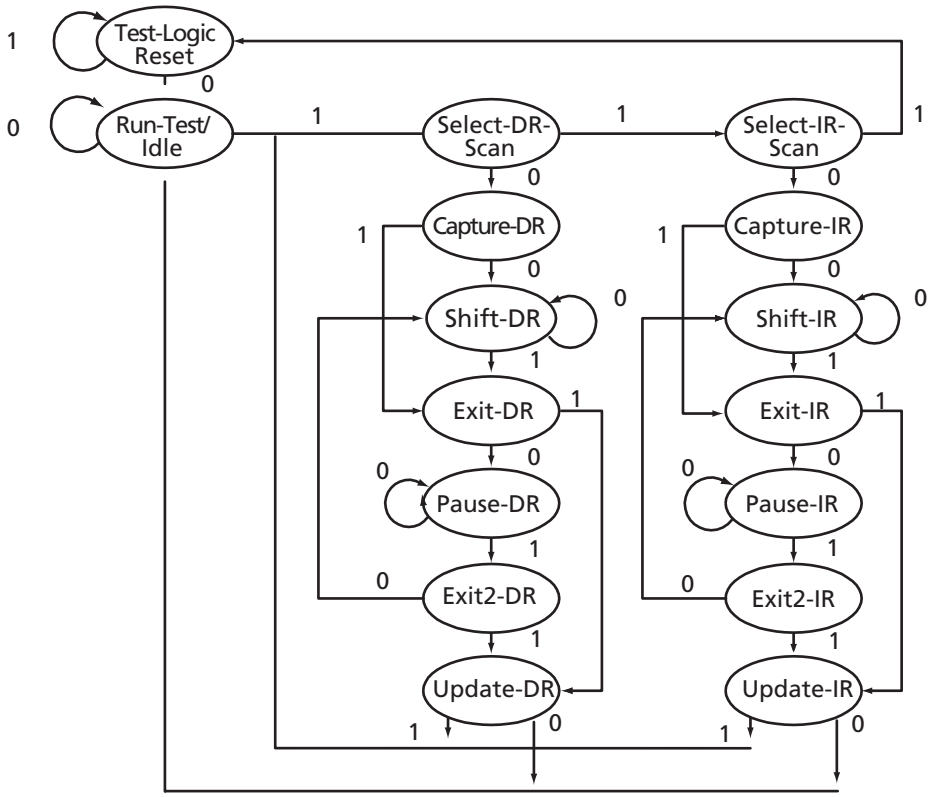



*Figure 1-13* • **TAP Controller State Diagram**

# Timing Control and Characteristics

## ProASIC^PLUS Clock Management System

ProASIC^PLUS devices provide designers with very flexible clock conditioning capabilities. Each member of the ProASIC^PLUS family contains two phase-locked loop (PLL) blocks which perform the following functions:

- Clock Phase Adjustment via Programmable Delay (250 ps steps from –7 ns to +8 ns)
- Clock Skew Minimization
- Clock Frequency Synthesis

Each PLL has the following key features:

- Input Frequency Range ($f_{IN}$) = 1.5 to 180 MHz
- Feedback Frequency Range ($f_{VCO}$) = 1.5 to 180 MHz
- Output Frequency Range ($f_{OUT}$) = 6 to 180 MHz
- Output Phase Shift = 0 °, 90 °, 180 °, and 270 °
- Output Duty Cycle = 50%
- Low Output Jitter (max at 25°C)
  - $f_{VCO}$ <10 MHz. Jitter ±1% or better
  - 10 MHz < $f_{VCO}$ < 60 MHz. Jitter ±2% or better
  - $f_{VCO}$ > 60 MHz. Jitter ±1% or better

**Note:** Jitter(ps) = Jitter(%)* period

For Example:

Jitter in picoseconds at 100 MHz = 0.01 * (1/100E6) = 100 ps

- Maximum Acquisition Time = 80 µs for $f_{VCO}$ > 40 MHz
  = 30 µs for $f_{VCO}$ < 40 MHz
- Low Power Consumption – 6.9 mW (max – analog supply) + 7.0µW/MHz (max – digital supply)

## Physical Implementation

Each side of the chip contains a clock conditioning circuit based on a 180 MHz PLL block (Figure 1-14 on page 1-14). Two global multiplexed lines extend along each side of the chip to provide bidirectional access to the PLL on that side (neither MUX can be connected to the opposite side's PLL). Each global line has optional LVPECL input pads (described below). The global lines may be driven by either the LVPECL global input pad or the outputs from the PLL block, or both. Each global line can be driven by a different output from the PLL. Unused global pins can be configured as regular I/Os or left unconnected. They default to an input with pull-up. The two signals available to drive the global networks are as follows (Figure 1-15 on page 1-15, Table 1-7 on page 1-15, and Table 1-8 on page 1-16):

### Global A (secondary clock)

- Output from Global MUX A
- Conditioned version of PLL output ($f_{OUT}$) – delayed or advanced
- Divided version of either of the above
- Further delayed version of either of the above (0.25 ns, 0.50 ns, or 4.00 ns delay)[1]

### Global B

- Output from Global MUX B
- Delayed or advanced version of $f_{OUT}$
- Divided version of either of the above
- Further delayed version of either of the above (0.25 ns, 0.50 ns, or 4.00 ns delay)[2]

## Functional Description

Each PLL block contains four programmable dividers as shown in Figure 1-14 on page 1-14. These allow frequency scaling of the input clock signal as follows:

- The n divider divides the input clock by integer factors from 1 to 32.
- The m divider in the feedback path allows multiplication of the input clock by integer factors ranging from 1 to 64.
- The two dividers together can implement any combination of multiplication and division resulting in a clock frequency between 24 and 180 MHz exiting the PLL core. This clock has a fixed 50% duty cycle.
- The output frequency of the PLL core is given by the formula EQ 1-1 ($f_{REF}$ is the reference clock frequency):

$$f_{OUT} = f_{REF} * m/n \quad \textit{EQ 1-1}$$

- The third and fourth dividers (u and v) permit the signals applied to the global network to each be further divided by integer factors ranging from 1 to 4.

The implementations shown in EQ2 and EQ3 enable the user to define a wide range of frequency multiplier and divisors.

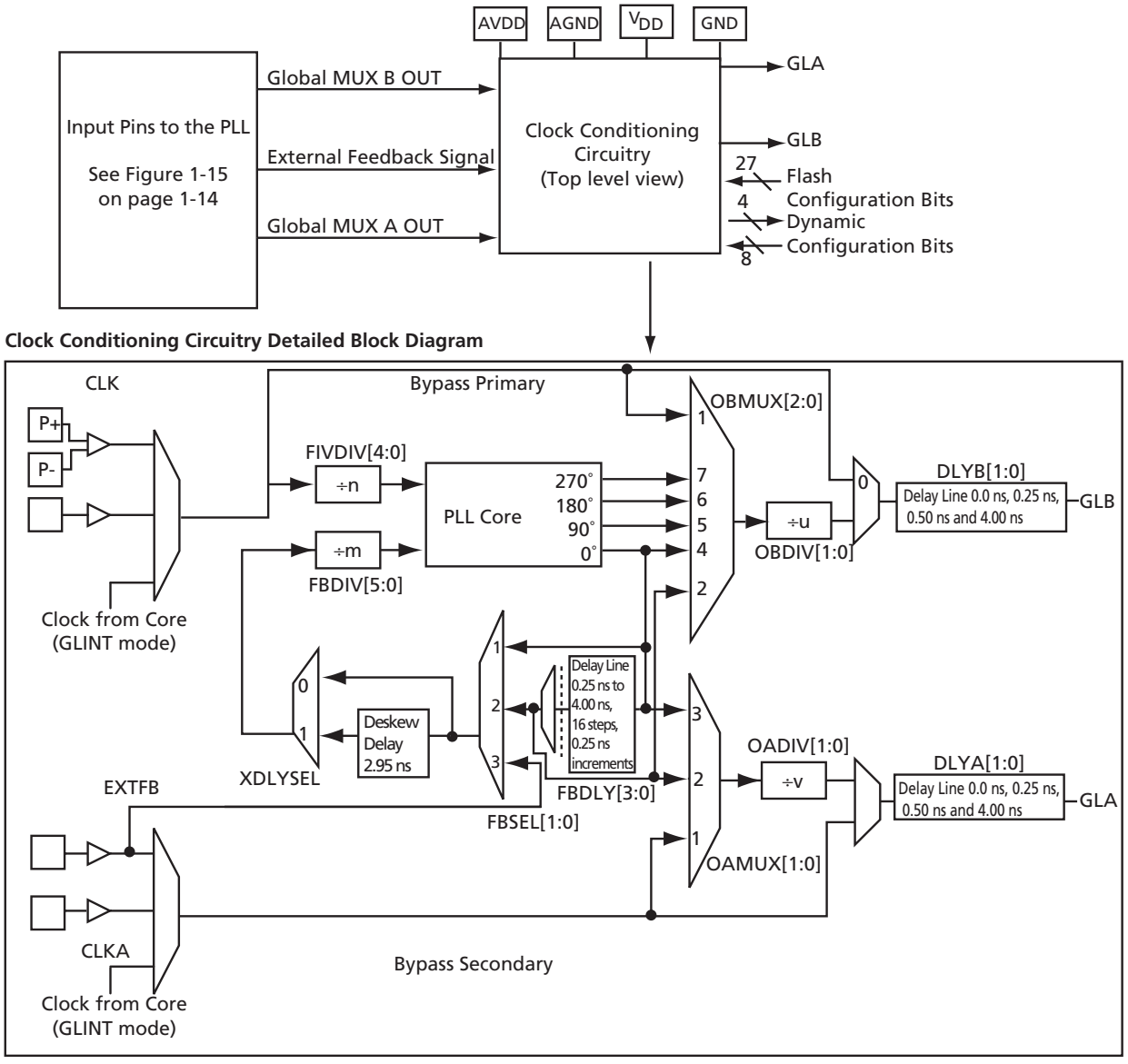
$$f_{GLB} = m/(n*u) \quad \textit{EQ 1-2}$$

$$f_{GLA} = m/(n*v) \quad \textit{EQ 1-3}$$

1. *This mode is available through the delay feature of the Global MUX driver.*

enable the user to define a wide range of frequency multipliers and divisors. The clock conditioning circuit can advance or delay the clock up to 8 ns (in increments of 0.25 ns) relative to the positive edge of the incoming reference clock. The system also allows for the selection of output frequency clock phases of 0°, 90°, 180°, and 270°.

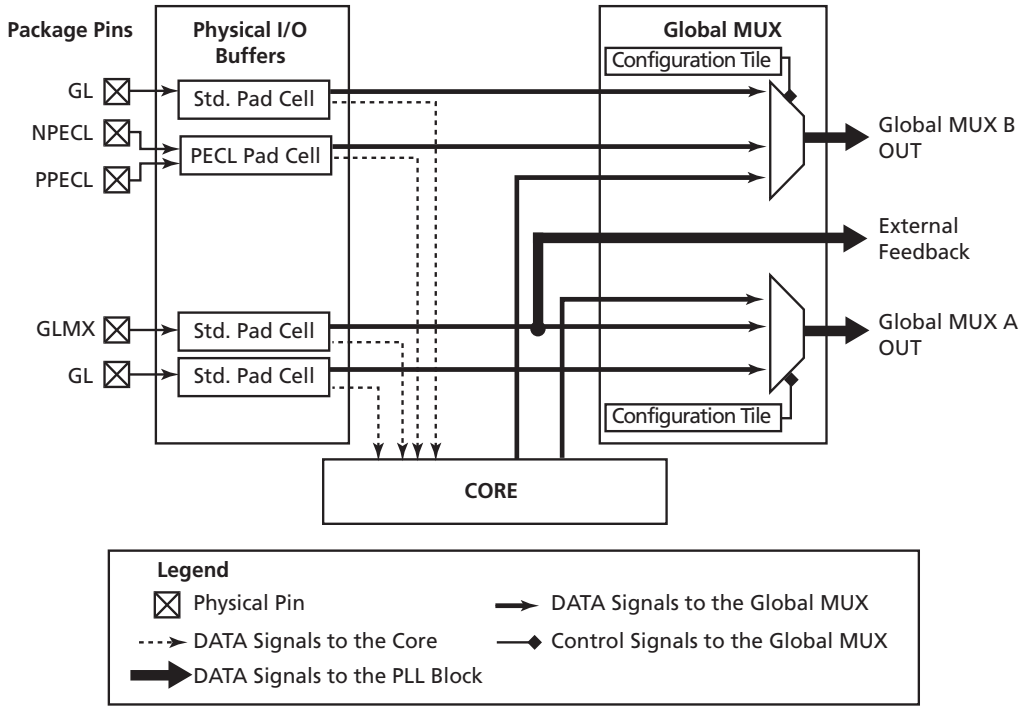
Prior to the application of signals to the rib drivers, they pass through programmable delay units, one per global network. These units permit the delaying of global signals relative to other signals to assist in the control of input set-up times. Not all possible combinations of input and output modes can be used. The degrees of freedom available in the bidirectional global pad system and in the clock conditioning circuit have been restricted. This avoids unnecessary and unwieldy design kit and software work.




***Notes:***

1. *FBDLY is a programmable delay line from 0 to 4 ns in 250 ps increments.*
2. *DLYA and DLYB are programmable delay lines, each with selectable values 0 ps, 250 ps, 500 ps, and 4 ns.*
3. *OBDIV will also divide the phase-shift since it takes place after the PLL Core.*

*Figure 1-14* • **PLL Block – Top-Level View and Detailed PLL Block Diagram**




***Note:*** *When a signal from an I/O tile is connected to the core, it cannot be connected to the Global MUX at the same time.*

*Figure 1-15* • **Input Connectors to ProASIC^PLUS Clock Conditioning Circuitry**

*Table 1-7* • **Clock-Conditioning Circuitry MUX Settings**

| MUX | Datapath | Comments |
|---|---|---|
| **FBSEL** | | |
| 1 | Internal Feedback | |
| 2 | Internal Feedback and Advance Clock Using FBDLY | –0.25 to –4 ns in 0.25 ns increments |
| 3 | External Feedback (EXTFB) | |
| **XDLYSEL** | | |
| 0 | Feedback Unchanged | |
| 1 | Deskew feedback by advancing clock by system delay | Fixed delay of -2.95 ns |
| **OBMUX** | **GLB** | |
| 0 | Primary bypass, no divider | |
| 1 | Primary bypass, use divider | |
| 2 | Delay Clock Using FBDLY | +0.25 to +4 ns in 0.25 ns increments |
| 4 | Phase Shift Clock by 0° | |
| 5 | Phase Shift Clock by +90° | |
| 6 | Phase Shift Clock by +180° | |
| 7 | Phase Shift Clock by +270° | |
| **OAMUX** | **GLA** | |
| 0 | Secondary bypass, no divider | |
| 1 | Secondary bypass, use divider | |
| 2 | Delay Clock Using FBDLY | +0.25 to +4 ns in 0.25 ns increments |
| 3 | Phase Shift Clock by 0° | |

*Table 1-8 •* **Clock-Conditioning Circuitry Delay-Line Settings**

| Delay Line | Delay Value (ns) |
|---|---|
| **DLYB** | |
| 0 | 0 |
| 1 | +0.25 |
| 2 | +0.50 |
| 3 | +4.0 |
| **DLYA** | |
| 0 | 0 |
| 1 | +0.25 |
| 2 | +0.50 |
| 3 | +4.0 |

## Lock Signal

An active-high Lock signal (added via the ACTgen PLL development tool) indicates that the PLL has locked to the incoming clock signal. The PLL will acquire and maintain lock even when there is jitter on the incoming clock signal. The PLL will maintain lock with an input jitter up to 5% of the input period, with a maximum of 5 ns. Users can employ the Lock signal as a soft reset of the logic driven by GLB and/or GLA. Note if $F_{IN}$ is not within specified frequencies, then both the $F_{OUT}$ and lock signal are indeterminate.

## PLL Configuration Options

The PLL can be configured during design (via Flash-configuration bits set in the programming bitstream) or dynamically during device operation, thus eliminating the need to reprogram the device. The dynamic configuration bits are loaded into a serial-in/parallel-out shift register provided in the clock conditioning circuit. The shift register can be accessed either from user logic within the device or via the JTAG port. Another option is internal dynamic configuration via user-designed hardware. Refer to Actel's *ProASIC^PLUS PLL Dynamic Reconfiguration Using JTAG* application note for more information.

For information on the clock conditioning circuit, refer to Actel's *Using ProASIC^PLUS Clock Conditioning Circuits* application note.

# Sample Implementations

## Frequency Synthesis

Figure 1-16 on page 1-17 illustrates an example where the PLL is used to multiply a 33 MHz external clock up to 133 MHz. Figure 1-17 on page 1-17 uses two dividers to synthesize a 50 MHz output clock from a 40 MHz input reference clock. The input frequency of 40 MHz is multiplied by five and divided by four, giving an output clock (GLB) frequency of 50 MHz. When dividers are used, a given ratio can be generated in multiple ways, allowing the user to stay within the operating frequency ranges of the PLL. For example, in this case the input divider could have been two and the output divider also two, giving us a division of the input frequency by four to go with the feedback loop division (effective multiplication) by five.

# Adjustable Clock Delay

Figure 1-18 on page 1-18 illustrates the delay of the input clock by employing one of the adjustable delay lines. This is easily done in ProASIC^PLUS by bypassing the PLL core entirely and using the output delay line. Notice also that the output clock can be effectively advanced relative to the input clock by using the delay line in the feedback path. This is shown in Figure 1-19 on page 1-18.

# Clock Skew Minimization

Figure 1-20 on page 1-19 indicates how feedback from the clock network can be used to create minimal skew between the distributed clock network and the input clock. The input clock is fed to the reference clock input of the PLL. The output clock (GLA) feeds a clock network. The feedback input to the PLL uses a clock input delayed by a routing network. The PLL then adjusts the phase of the input clock to match the delayed clock, thus providing nearly zero effective skew between the two clocks. Refer to Actel's *Using ProASIC^PLUS Clock Conditioning Circuits* application note for more information.

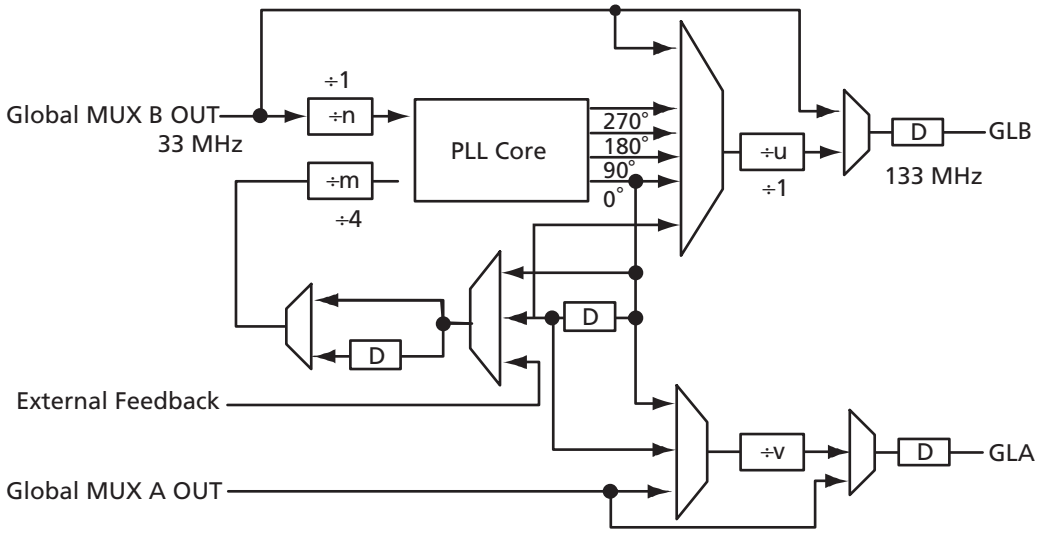



*Figure 1-16* • **Using the PLL 33 MHz In, 133 MHz Out**

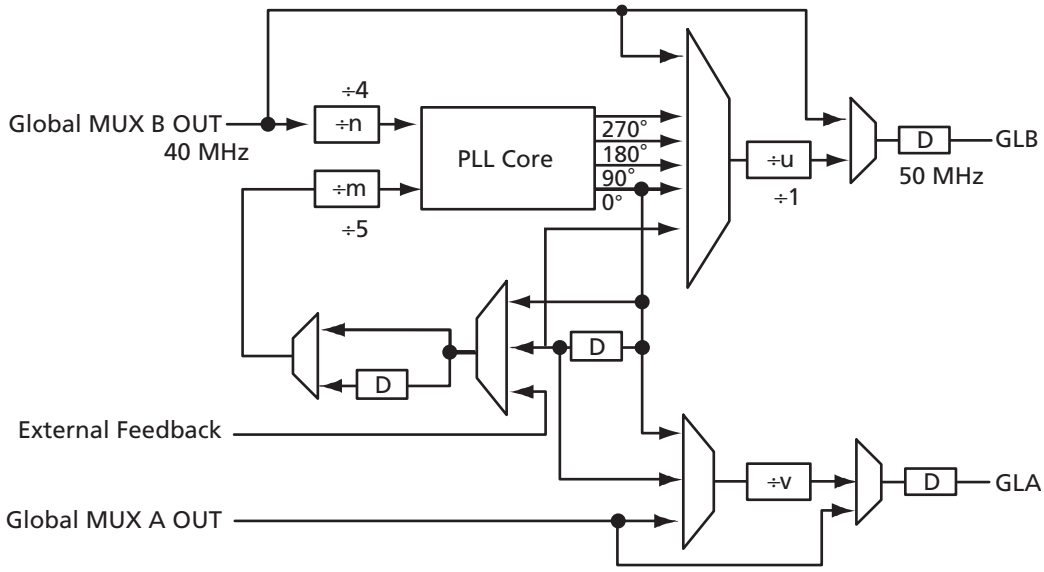



*Figure 1-17* • **Using the PLL 40 MHz In, 50 MHz Out**

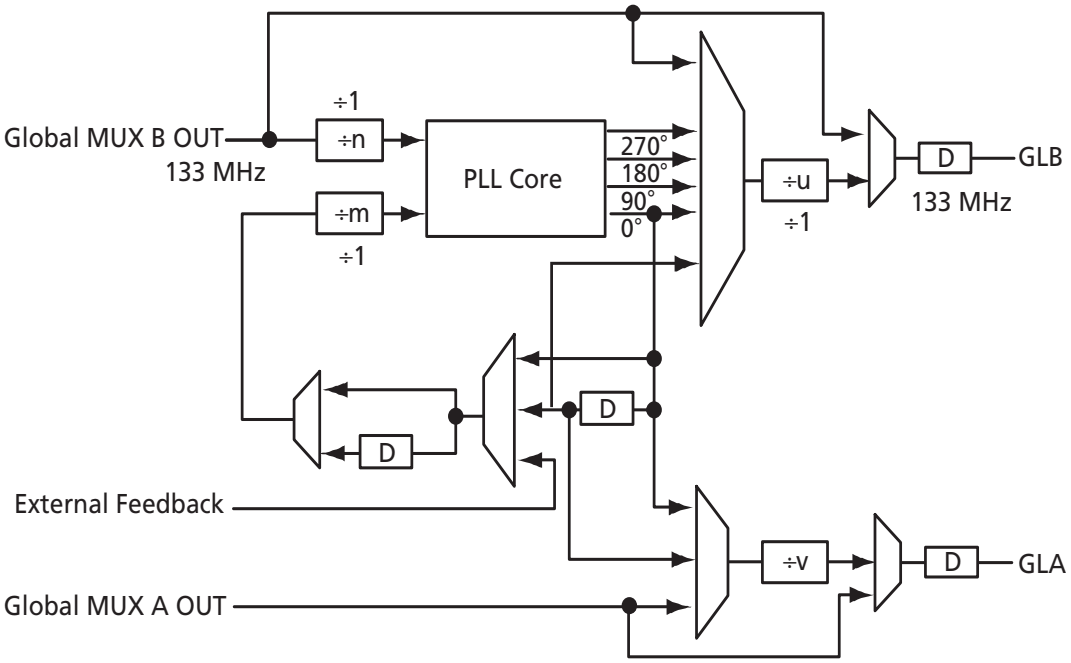



*Figure 1-18* • **Using the PLL to Delay the Input Clock**

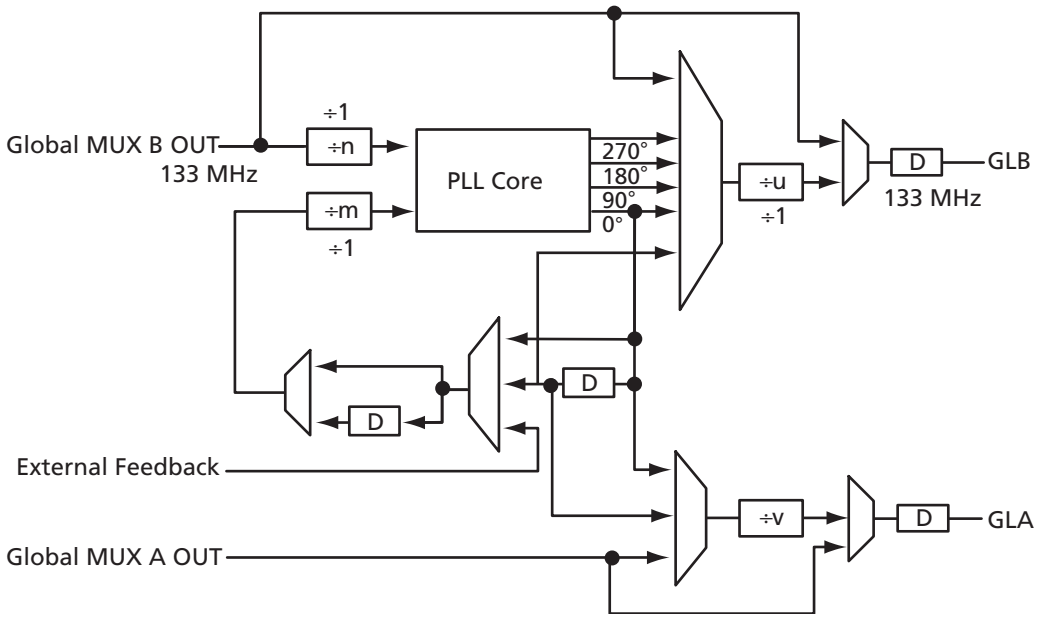



*Figure 1-19* • **Using the PLL to Advance the Input Clock**

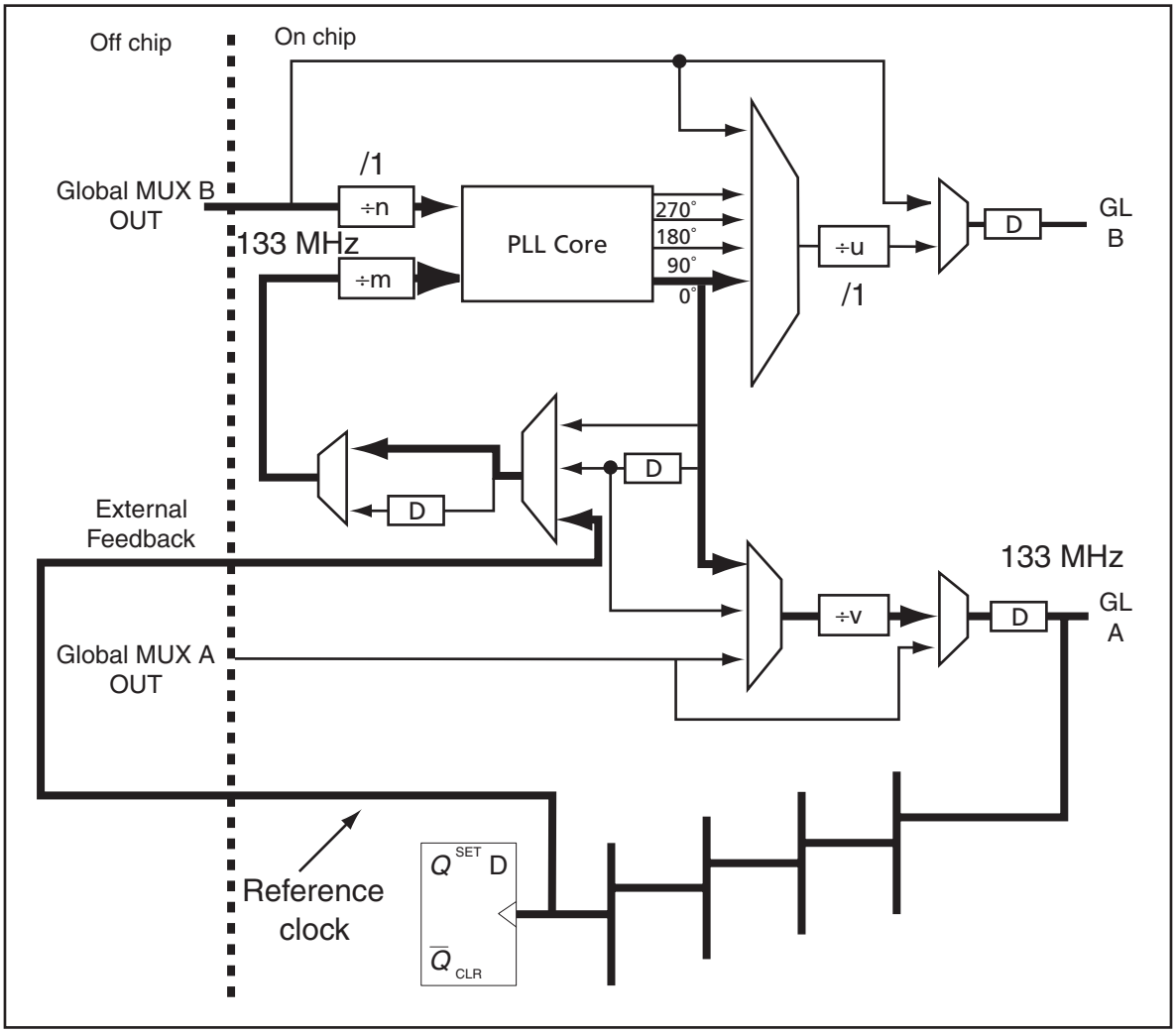



*Figure 1-20* • **Using the PLL for Clock Deskewing**

## Logic Tile Timing Characteristics

Timing characteristics for ProASIC^PLUS devices fall into three categories: family dependent, device dependent, and design dependent. The input and output buffer characteristics are common to all ProASIC^PLUS family members. Internal routing delays are device dependent. Design dependency means that actual delays are not determined until after placement and routing of the user's design are complete. Delay values may then be determined by using the Timer utility or by performing simulation with post-layout delays.

## Critical Nets and Typical Nets

Propagation delays are expressed only for typical nets, which are used for initial design performance evaluation. Critical net delays can then be applied to the most timing-critical paths. Critical nets are determined by net property assignment prior to place-and-route. Refer to the Actel *Designer User's Guide* or online help for details on using constraints.

## Timing Derating

Since ProASIC^PLUS devices are manufactured with a CMOS process, device performance will vary with temperature, voltage, and process. Minimum timing parameters reflect maximum operating voltage, minimum operating temperature, and optimal process variations. Maximum timing parameters reflect minimum operating voltage, maximum operating temperature, and worst-case process variations (within process specifications). The derating factors shown in Table 1-9 should be applied to all timing data contained within this datasheet.

All timing numbers listed in this datasheet represent sample timing characteristics of ProASIC^PLUS devices. Actual timing delay values are design-specific and can be derived from the Timer tool in Actel's Designer software after place-and-route.

*Table 1-9* • **Temperature and Voltage Derating Factors (Normalized to Worst-Case Commercial, $T_J$ = 70°C, $V_{DD}$ = 2.3 V)**

| | –55°C | –40°C | 0°C | 25°C | 70°C | 85°C | 110°C | 125°C | 135°C | 150°C |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.3 V | 0.84 | 0.86 | 0.91 | 0.94 | 1.00 | 1.02 | 1.05 | 1.13 | 1.18 | 1.27 |
| 2.5 V | 0.81 | 0.82 | 0.87 | 0.90 | 0.95 | 0.98 | 1.01 | 1.09 | 1.13 | 1.21 |
| 2.7 V | 0.77 | 0.79 | 0.83 | 0.86 | 0.91 | 0.93 | 0.96 | 1.04 | 1.08 | 1.16 |

***Notes:***

1. *The user can set the junction temperature in Designer software to be any integer value in the range of –55°C to 175°C.*
2. *The user can set the core voltage in Designer software to be any value between 1.4 V and 1.6 V.*

# PLL Electrical Specifications

| Parameter | Value | | | Notes |
|---|---|---|---|---|
| **Frequency Ranges** | | | | |
| Reference Frequency $f_{IN}$ (min.) | 1.5 MHz | | | Clock conditioning circuitry (min.) lowest input frequency |
| Reference Frequency $f_{IN}$ (max.) | 180 MHz | | | Clock conditioning circuitry (max.) highest input frequency |
| OSC Frequency $f_{VCO}$ (min.) | 24 MHz | | | Lowest output frequency voltage controlled oscillator |
| OSC Frequency $f_{VCO}$ (max.) | 180 MHz | | | Highest output frequency voltage controlled oscillator |
| Clock Conditioning Circuitry $f_{OUT}$ (min.) | 6 MHz | | | Lowest output frequency clock conditioning circuitry |
| Clock Conditioning Circuitry $f_{OUT}$ (max.) | 180 MHz | | | Highest output frequency clock conditioning circuitry |
| **Long Term Jitter Peak-to-Peak Max.*** | | | | |
| **Temperature** | **Frequency MHz** | | | |
| | **$f_{VCO}$<10** | **10<$f_{VCO}$<60** | **$f_{VCO}$>60** | |
| 25°C (or higher) | ±1% | ±2% | ±1% | Jitter(ps) = Jitter(%)*period<br>For example:<br>Jitter in picoseconds at 100 MHz<br>= 0.01 * (1/100E6) = 100 ps |
| 0°C | ±1.5% | ±2.5% | ±1% | |
| –40°C | ±2.5% | ±3.5% | ±1% | |
| –55°C | ±2.5% | ±3.5% | ±1% | |
| **Acquisition Time from Cold Start** | | | | |
| Acquisition Time (max.) | 30 µs | | | $f_{VCO} \leq 40$ MHz |
| Acquisition Time (max.) | 80 µs | | | $f_{VCO} > 40$ MHz |
| **Power Consumption** | | | | |
| Analog Supply Power (max.*) | 6.9 mW per PLL | | | |
| Digital Supply Current (max.) | 7 µW/MHz | | | |
| **Duty Cycle** | 50% ±0.5% | | | |
| **Input Jitter Tolerance** | 5% input period (max. 5 ns) | | | Maximum jitter allowable on an input clock to acquire and maintain lock. |

***Note:*** **High clock frequencies (>60 MHz) under typical setup conditions*

## User Security

FlashLock®

ProASIC^PLUS devices have FlashLock protection bits that, once programmed, block the entire programmed contents from being read externally. Please refer to Table 1-10 for details on the number of bits in the key for each device. If locked, the user can only reprogram the device employing the user-defined security key. This protects the device from being read back and duplicated. Since programmed data is stored in nonvolatile memory cells (actually very small capacitors) rather than in the wiring, physical deconstruction cannot be used to compromise data. This type of security breach is further discouraged by the placement of the memory cells beneath the four metal layers (whose removal cannot be accomplished without disturbing the charge in the capacitor). This is the highest security provided in the industry. For more information, refer to Actel's *Design Security in Nonvolatile Flash and Antifuse FPGAs* white paper.

*Table 1-10* • **Flashlock Key Size by Device**

| Device | Key Size |
|---|---|
| APA075 | 79 bits |
| APA150 | 79 bits |
| APA300 | 79 bits |
| APA450 | 119 bits |
| APA600 | 167 bits |
| APA750 | 191 bits |
| APA1000 | 263 bits |

## Embedded Memory Floorplan

The embedded memory is located across the top and bottom of the device in 256x9 blocks (Figure 1-1 on page 1-2). Depending on the device, up to 88 blocks are available to support a variety of memory configurations. Each block can be programmed as an independent memory array or combined (using dedicated memory routing resources) to form larger, more complex memory configurations. A single memory configuration could include blocks from both the top and bottom memory locations.

## Embedded Memory Configurations

The embedded memory in the ProASIC^PLUS family provides great configuration flexibility (Table 1-11). Each ProASIC^PLUS block is designed and optimized as a two-port memory (one read, one write). This provides 198 kbits of two-port and/or single port memory in the APA1000 device.

Each memory block can be configured as FIFO or SRAM, with independent selection of synchronous or asynchronous read and write ports (Table 1-12). Additional characteristics include programmable flags as well as parity checking and generation. Figure 1-21 on page 1-24 and Figure 1-22 on page 1-25 show the block diagrams of the basic SRAM and FIFO blocks. Table 1-13 on page 1-24 and Table 1-14 on page 1-25 describe memory block SRAM and FIFO interface signals, respectively. A single memory block is designed to operate at up to 150 MHz (standard speed grade typical conditions). Each block is comprised of 256 9-bit words (one read port, one write port). The memory blocks may be cascaded in width and/or depth to create the desired memory organization. (Figure 1-23 on page 1-26). This provides optimal bit widths of 9 (one block), 18, 36, and 72, and optimal depths of 256, 512, 768, and 1,024. Refer to Actel's *ACTgen User's Guide* for more information.

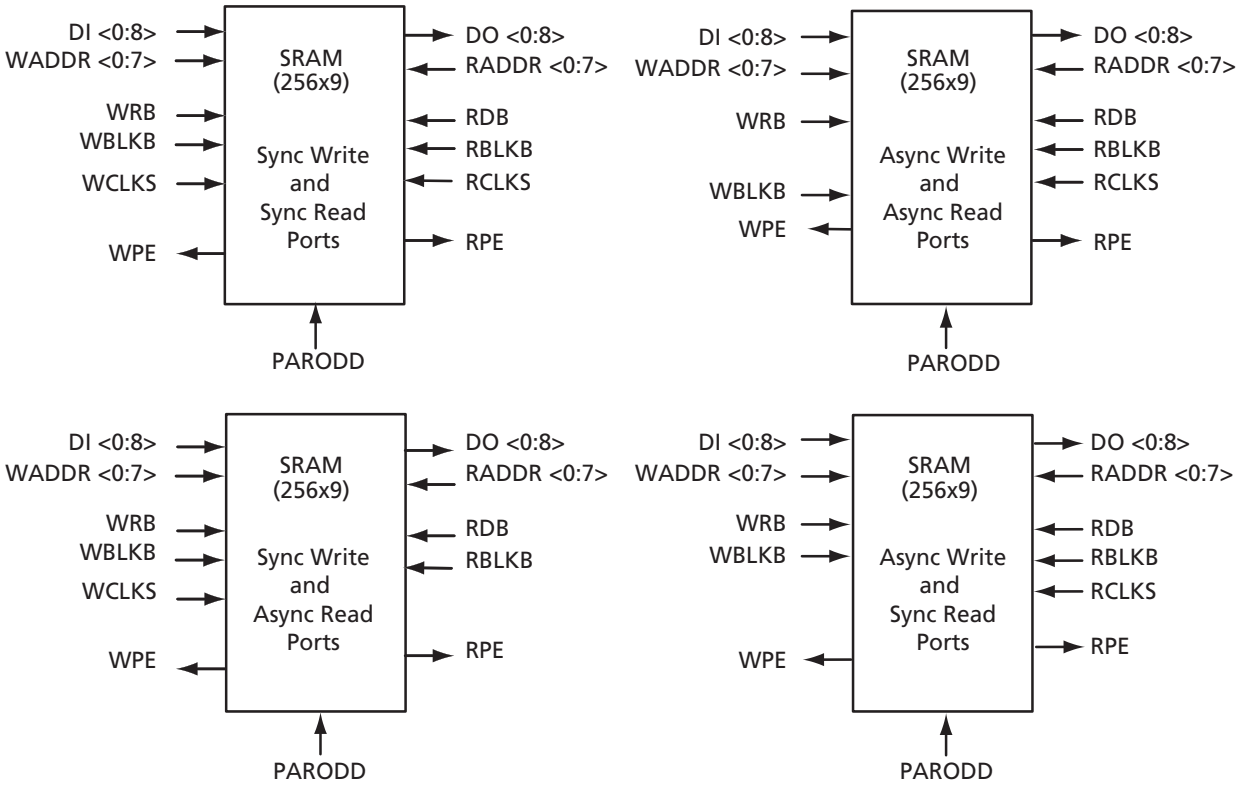
Figure 1-24 on page 1-26 gives an example of optimal memory usage. Ten blocks with 23,040 bits have been used to generate three arrays of various widths and depths. Figure 1-25 on page 1-26 shows how RAM blocks can be used in parallel to create extra read ports. In this example, using only 10 of the 88 available blocks of the APA1000 yields an effective 6,912 bits of multiple port RAM. The Actel ACTgen software facilitates building wider and deeper memory configurations for optimal memory usage.

*Table 1-11* • **ProASIC^PLUS Memory Configurations by Device**

| Device | Bottom | Top | Maximum Width | | Maximum Depth | |
|---|---|---|---|---|---|---|
| | | | D | W | D | W |
| APA075 | 0 | 12 | 256 | 108 | 1,536 | 9 |
| APA150 | 0 | 16 | 256 | 144 | 2,048 | 9 |
| APA300 | 16 | 16 | 256 | 144 | 2,048 | 9 |
| APA450 | 24 | 24 | 256 | 216 | 3,072 | 9 |
| APA600 | 28 | 28 | 256 | 252 | 3,584 | 9 |
| APA750 | 32 | 32 | 256 | 288 | 4,096 | 9 |
| APA1000 | 44 | 44 | 256 | 396 | 5,632 | 9 |

*Table 1-12* • **Basic Memory Configurations**

| Type | Write Access | Read Access | Parity | Library Cell Name |
|---|---|---|---|---|
| RAM | Asynchronous | Asynchronous | Checked | RAM256x9AA |
| RAM | Asynchronous | Asynchronous | Generated | RAM256x9AAP |
| RAM | Asynchronous | Synchronous Transparent | Checked | RAM256x9AST |
| RAM | Asynchronous | Synchronous Transparent | Generated | RAM256x9ASTP |
| RAM | Asynchronous | Synchronous Pipelined | Checked | RAM256x9ASR |
| RAM | Asynchronous | Synchronous Pipelined | Generated | RAM256x9ASRP |
| RAM | Synchronous | Asynchronous | Checked | RAM256x9SA |
| RAM | Synchronous | Asynchronous | Generated | RAM256xSAP |
| RAM | Synchronous | Synchronous Transparent | Checked | RAM256x9SST |
| RAM | Synchronous | Synchronous Transparent | Generated | RAM256x9SSTP |
| RAM | Synchronous | Synchronous Pipelined | Checked | RAM256x9SSR |
| RAM | Synchronous | Synchronous Pipelined | Generated | RAM256x9SSRP |
| FIFO | Asynchronous | Asynchronous | Checked | FIFO256x9AA |
| FIFO | Asynchronous | Asynchronous | Generated | FIFO256x9AAP |
| FIFO | Asynchronous | Synchronous Transparent | Checked | FIFO256x9AST |
| FIFO | Asynchronous | Synchronous Transparent | Generated | FIFO256x9ASTP |
| FIFO | Asynchronous | Synchronous Pipelined | Checked | FIFO256x9ASR |
| FIFO | Asynchronous | Synchronous Pipelined | Generated | FIFO256x9ASRP |
| FIFO | Synchronous | Asynchronous | Checked | FIFO256x9SA |
| FIFO | Synchronous | Asynchronous | Generated | FIFO256x9SAP |
| FIFO | Synchronous | Synchronous Transparent | Checked | FIFO256x9SST |
| FIFO | Synchronous | Synchronous Transparent | Generated | FIFO256x9SSTP |
| FIFO | Synchronous | Synchronous Pipelined | Checked | FIFO256x9SSR |
| FIFO | Synchronous | Synchronous Pipelined | Generated | FIFO256x9SSRP |



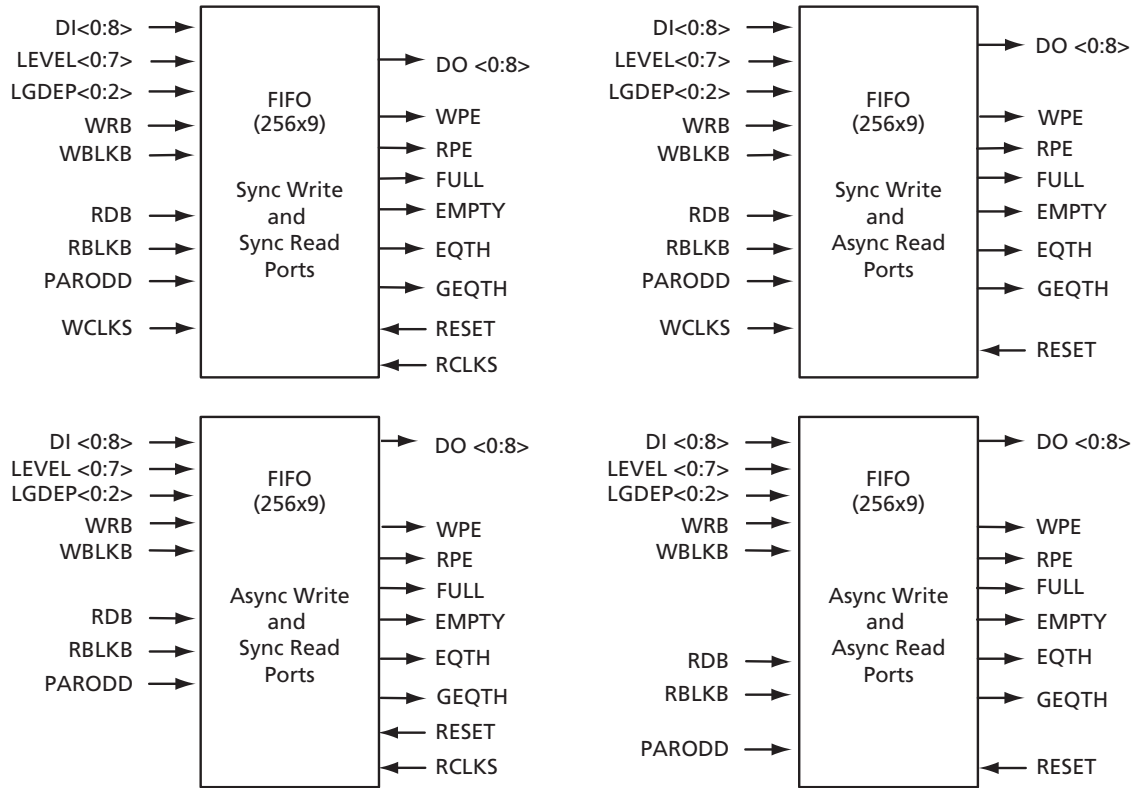

***Note:*** *Each RAM block contains a multiplexer (called DMUX) for each output signal, increasing design efficiency. These DMUX cells do not consume any core logic tiles and connect directly to high-speed routing resources between the RAM blocks. They are used when RAM blocks are cascaded and are automatically inserted by the software tools.*

*Figure 1-21* • **Example SRAM Block Diagrams**

*Table 1-13* • **Memory Block SRAM Interface Signals**

| SRAM Signal | Bits | In/Out | Description |
|---|---|---|---|
| WCLKS | 1 | In | Write clock used on synchronization on write side |
| RCLKS | 1 | In | Read clock used on synchronization on read side |
| RADDR<0:7> | 8 | In | Read address |
| RBLKB | 1 | In | Read block select (active Low) |
| RDB | 1 | In | Read pulse (active Low) |
| WADDR<0:7> | 8 | In | Write address |
| WBLKB | 1 | In | Write block select (active Low) |
| DI<0:8> | 9 | In | Input data bits <0:8>, <8> can be used for parity In |
| WRB | 1 | In | Write pulse (active Low) |
| DO<0:8> | 9 | Out | Output data bits <0:8>, <8> can be used for parity Out |
| RPE | 1 | Out | Read parity error (active High) |
| WPE | 1 | Out | Write parity error (active High) |
| PARODD | 1 | In | Selects Odd parity generation/detect when High, Even parity when Low |

***Note:*** *Not all signals shown are used in all modes.*




***Note:*** *Each RAM block contains a multiplexer (called DMUX) for each output signal, increasing design efficiency. These DMUX cells do not consume any core logic tiles and connect directly to high-speed routing resources between the RAM blocks. They are used when RAM blocks are cascaded and are automatically inserted by the software tools.*

*Figure 1-22* • **Basic FIFO Block Diagrams**

*Table 1-14* • **Memory Block FIFO Interface Signals**

| FIFO Signal | Bits | In/Out | Description |
|---|---|---|---|
| WCLKS | 1 | In | Write clock used for synchronization on write side |
| RCLKS | 1 | In | Read clock used for synchronization on read side |
| LEVEL <0:7> | 8 | In | Direct configuration implements static flag logic |
| RBLKB | 1 | In | Read block select (active Low) |
| RDB | 1 | In | Read pulse (active Low) |
| RESET | 1 | In | Reset for FIFO pointers (active Low) |
| WBLKB | 1 | In | Write block select (active Low) |
| DI<0:8> | 9 | In | Input data bits <0:8>, <8> will be generated parity if PARGEN is true |
| WRB | 1 | In | Write pulse (active Low) |
| FULL, EMPTY | 2 | Out | FIFO flags. FULL prevents write and EMPTY prevents read |
| EQTH, GEQTH | 2 | Out | EQTH is true when the FIFO holds the number of words specified by the LEVEL signal. GEQTH is true when the FIFO holds (LEVEL) words or more |
| DO<0:8> | 9 | Out | Output data bits <0:8>. <8> will be parity output if PARGEN is true. |
| RPE | 1 | Out | Read parity error (active High) |
| WPE | 1 | Out | Write parity error (active High) |
| LGDEP <0:2> | 3 | In | Configures DEPTH of the FIFO to $2^{(LGDEP+1)}$ |
| PARODD | 1 | In | Parity generation/detect – Even when Low, Odd when High |

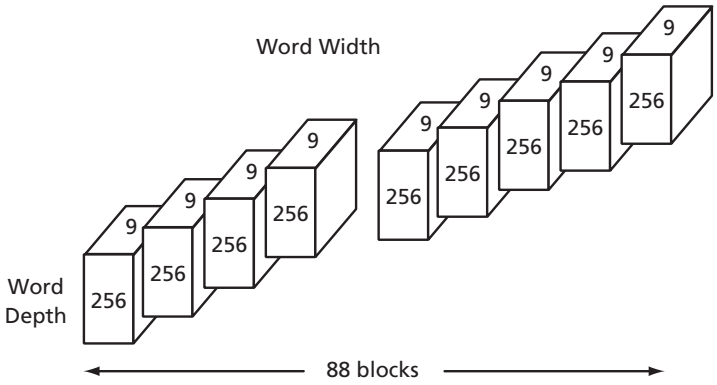



*Figure 1-23* • **APA1000 Memory Block Architecture**

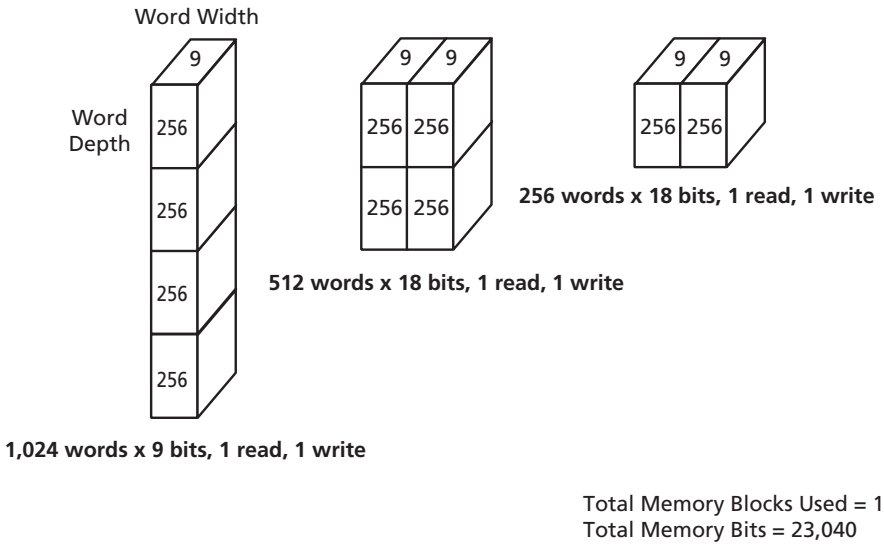



*Figure 1-24* • **Example Showing Memory Arrays with Different Widths and Depths**

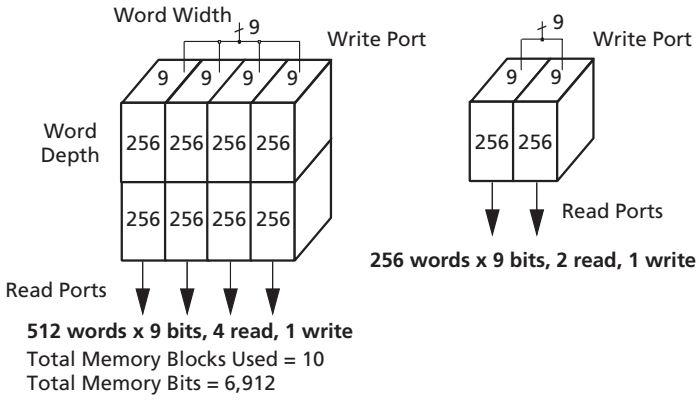



*Figure 1-25* • **Multi-Port Memory Usage**

## Design Environment

The ProASIC^PLUS family of FPGAs is fully supported by both Actel's Libero® Integrated Design Environment (IDE) and Designer FPGA Development software. Actel Libero IDE is an integrated design manager that seamlessly integrates design tools while guiding the user through the design flow, managing all design and log files, and passing necessary design data among tools. Additionally, Libero IDE allows users to integrate both schematic and HDL synthesis into a single flow and verify the entire design in a single environment (see Actel's website for more information about *Libero IDE*). Libero IDE includes Synplify® AE from Synplicity®, ViewDraw® AE from Mentor Graphics®, Model*Sim*® HDL Simulator from Mentor Graphics, WaveFormer Lite™ AE from SynaptiCAD®, PALACE™ AE Physical Synthesis from Magma, and Designer software from Actel.

PALACE is an effective tool when designing with ProASIC^PLUS. PALACE AE Physical Synthesis from Magma takes an EDIF netlist and optimizes the performance of ProASIC^PLUS devices through a physical placement-driven process, ensuring that timing closure is easily achieved.

Actel's Designer software is a place-and-route tool that provides a comprehensive suite of back-end support tools for FPGA development. The Designer software includes the following:

- Timer – a world-class integrated static timing analyzer and constraints editor that support timing-driven place-and-route
- NetlistViewer – a design netlist schematic viewer
- ChipPlanner – a graphical floorplanner viewer and editor
- SmartPower – allows the designer to quickly estimate the power consumption of a design
- PinEditor – a graphical application for editing pin assignments and I/O attributes
- I/O Attribute Editor – displays all assigned and unassigned I/O macros and their attributes in a spreadsheet format

With the Designer software, a user can lock the design pins before layout while minimally impacting the results of place-and-route. Additionally, Actel's back-annotation flow is compatible with all the major simulators. Another tool included in the Designer software is the ACTgen macro builder, which easily creates popular and commonly used logic functions for implementation into your schematic or HDL design.

Actel's Designer software is compatible with the most popular FPGA design entry and verification tools from EDA vendors, such as Mentor Graphics, Synplicity, Synopsys, and Cadence Design Systems. The Designer software is available for both the Windows and UNIX operating systems.

## ISP

The user can generate *.bit or *.stp programming files from the Designer software and can use these files to program a device.

ProASIC^PLUS devices can be programmed in-system. For more information on ISP of ProASIC^PLUS devices, refer to the *In-System Programming ProASIC^PLUS Devices* and *Performing Internal In-System Programming Using Actel's ProASIC^PLUS Devices* application notes. Prior to being programmed for the first time, the ProASIC^PLUS device I/Os are in a tristate condition with the pull-up resistor option enabled.

# Related Documents

## Application Notes

*Efficient Use of ProASIC Clock Trees*
http://www.actel.com/documents/A500K_Clocktree_AN.pdf
*I/O Features in ProASIC^PLUS Flash FPGAs*
http://www.actel.com/documents/APA_LVPECL_AN.pdf
*Power-Up Behavior of ProASIC^PLUS Devices*
http://www.actel.com/documents/APA_PowerUp.pdf
*ProASIC^PLUS PLL Dynamic Reconfiguration Using JTAG*
http://www.actel.com/documents/APA_PLLdynamic_AN.pdf
*Using ProASIC^PLUS Clock Conditioning Circuits*
http://www.actel.com/documents/APA_PLL_AN.pdf
*In-System Programming ProASIC^PLUS Devices*
http://www.actel.com/documents/APA_External_ISP_AN.pdf
*Performing Internal In-System Programming Using Actel's ProASIC^PLUS Devices*
http://www.actel.com/documents/APA_Microprocessor_AN.pdf
*ProASIC^PLUS RAM and FIFO Blocks*
http://www.actel.com/documents/APA_RAM_FIFO_AN.pdf

## White Paper

*Design Security in Nonvolatile Flash and Antifuse FPGAs*
http://www.actel.com/documents/DesignSecurity_WP.pdf

## User's Guide

*Designer User's Guide*
http://www.actel.com/documents/designer_UG.pdf
*ACTgen User's Guide*
http://www.actel.com/documents/genguide_UG.pdf
*ProASIC and ProASIC^PLUS Macro Library Guide*
http://www.actel.com/documents/pa_libguide_UG.pdf

## Additional Information

The following link contains additional information on ProASIC^PLUS Devices.
http://www.actel.com/products/proasicplus/info.aspx

# Package Thermal Characteristics

The ProASIC^PLUS family is available in several package types with a range of pin counts. Actel has selected packages based on high pin count, reliability factors, and superior thermal characteristics.

Thermal resistance defines the ability of a package to conduct heat away from the silicon, through the package to the surrounding air. Junction-to-ambient thermal resistance is measured in degrees Celsius/Watt and is represented as Theta ja ($\Theta_{ja}$). The lower the thermal resistance, the more efficiently a package will dissipate heat.

A package's maximum allowed power (P) is a function of maximum junction temperature ($T_J$), maximum ambient operating temperature ($T_A$), and junction-to-ambient thermal resistance $\Theta_{ja}$. Maximum junction temperature is the maximum allowable temperature on the active surface of the IC and is 110° C. P is defined as:

$$P = \frac{T_J - T_A}{\Theta_{ja}}$$

*EQ 1-4*

$\Theta_{ja}$ is a function of the rate (in linear feet per minute (lfpm)) of airflow in contact with the package. When the estimated power consumption exceeds the maximum allowed power, other means of cooling, such as increasing the airflow rate, must be used. The maximum power dissipation allowed for a Military temperature device is specified as a function of $\Theta_{jc}$. The absolute maximum junction temperature is 150°C.

The calculation of the absolute maximum power dissipation allowed for a Military temperature application is illustrated in the following example for a 456-pin PBGA package:

$$\text{Maximum Power Allowed} = \frac{\text{Max. junction temp. (°C)} - \text{Max. case temp. (°C)}}{\theta_{jc}\text{(°C/W)}} = \frac{150\text{°C} - 125\text{°C}}{3.0\text{°C/W}} = 8.333\text{W}$$

*EQ 1-5*

*Table 1-15* • **Package Thermal Characteristics**

| Plastic Packages | Pin Count | $\theta_{jc}$ | $\theta_{ja}$ Still Air | $\theta_{ja}$ 1.0 m/s 200 ft./min. | $\theta_{ja}$ 2.5 m/s 500 ft./min. | Units |
|---|---|---|---|---|---|---|
| Thin Quad Flat Pack (TQFP) | 100 | 14.0 | 33.5 | 27.4 | 25.0 | °C/W |
| Thin Quad Flat Pack (TQFP) | 144 | 11.0 | 33.5 | 28.0 | 25.7 | °C/W |
| Plastic Quad Flat Pack (PQFP)[1] | 208 | 8.0 | 26.1 | 22.5 | 20.8 | °C/W |
| PQFP with Heat spreader[2] | 208 | 3.8 | 16.2 | 13.3 | 11.9 | °C/W |
| Plastic Ball Grid Array (PBGA) | 456 | 3.0 | 15.6 | 12.5 | 11.6 | °C/W |
| Fine Pitch Ball Grid Array (FBGA) | 144 | 3.8 | 26.9 | 22.9 | 21.5 | °C/W |
| Fine Pitch Ball Grid Array (FBGA) | 256 | 3.8 | 26.6 | 22.8 | 21.5 | °C/W |
| Fine Pitch Ball Grid Array (FBGA)[3] | 484 | 3.2 | 18.0 | 14.7 | 13.6 | °C/W |
| Fine Pitch Ball Grid Array (FBGA)[4] | 484 | 3.2 | 20.5 | 17.0 | 15.9 | °C/W |
| Fine Pitch Ball Grid Array (FBGA) | 676 | 3.2 | 16.4 | 13.0 | 12.0 | °C/W |
| Fine Pitch Ball Grid Array (FBGA) | 896 | 2.4 | 13.6 | 10.4 | 9.4 | °C/W |
| Fine Pitch Ball Grid Array (FBGA) | 1152 | 1.8 | 12.0 | 8.9 | 7.9 | °C/W |
| Ceramic Quad Flat Pack (CQFP) | 208 | 2.0 | 22.0 | 19.8 | 18.0 | °C/W |
| Ceramic Quad Flat Pack (CQFP) | 352 | 2.0 | 17.9 | 16.1 | 14.7 | °C/W |
| Ceramic Column Grid Array (CCGA/LGA) | 624 | 6.5 | 8.9 | 8.5 | 8.0 | °C/W |

***Notes:***

1. *Valid for the following devices irrespective of temperature grade: APA075, APA150, and APA300*
2. *Valid for the following devices irrespective of temperature grade: APA450, APA600, APA750, and APA1000*
3. *Depopulated Array*
4. *Full array*

# Calculating Typical Power Dissipation

ProASIC^PLUS device power is calculated with both a static and an active component. The active component is a function of both the number of tiles utilized and the system speed. Power dissipation can be calculated using the following formula:

**Total Power Consumption—$P_{total}$**

$$P_{total} = P_{dc} + P_{ac}$$

where:

$P_{dc}$ = 7 mW for the APA075
8 mW for the APA150
11 mW for the APA300
12 mW for the APA450
12 mW for the APA600
13 mW for the APA750
19 mW for the APA1000
$P_{dc}$ includes the static components of $P_{VDDP} + P_{VDD} + P_{AVDD}$

$P_{ac}$ = $P_{clock} + P_{storage} + P_{logic} + P_{outputs} + P_{inputs} + P_{pll} + P_{memory}$

**Global Clock Contribution—$P_{clock}$**

$P_{clock}$, the clock component of power dissipation, is given by the piece-wise model:

for R < 15000 the model is: (P1 + (P2*R) - (P7*R2)) * Fs (lightly-loaded clock trees)

for R > 15000 the model is: (P10 + P11*R) * Fs (heavily-loaded clock trees)

where:

P1 = 100 µW/MHz is the basic power consumption of the clock tree per MHz of the clock

P2 = 1.3 µW/MHz is the incremental power consumption of the clock tree per storage tile – also per MHz of the clock

P7 = 0.00003 µW/MHz is a correction factor for partially-loaded clock trees

P10 = 6850 µW/MHz is the basic power consumption of the clock tree per MHz of the clock

P11 = 0.4 µW/MHz is the incremental power consumption of the clock tree per storage tile – also per MHz of the clock

R = the number of storage tiles clocked by this clock

Fs = the clock frequency

**Storage-Tile Contribution—$P_{storage}$**

$P_{storage}$, the storage-tile (Register) component of AC power dissipation, is given by

$$P_{storage} = P5 * ms * Fs$$

where:

P5 = 1.1 µW/MHz is the average power consumption of a storage tile per MHz of its output toggling rate. The maximum output toggling rate is Fs/2.

ms = the number of storage tiles (Register) switching during each Fs cycle

Fs = the clock frequency

### Logic-Tile Contribution—$P_{logic}$

$P_{logic}$, the logic-tile component of AC power dissipation, is given by

$$P_{logic} = P3 * mc * Fs$$

where:

- P3 = 1.4 µW/MHz is the average power consumption of a logic tile per MHz of its output toggling rate. The maximum output toggling rate is Fs/2.
- mc = the number of logic tiles switching during each Fs cycle
- Fs = the clock frequency

### I/O Output Buffer Contribution—$P_{outputs}$

$P_{outputs}$, the I/O component of AC power dissipation, is given by

$$P_{outputs} = (P4 + (C_{load} * V_{DDP}^2)) * p * Fp$$

where:

- P4 = 326 µW/MHz is the intrinsic power consumption of an output pad normalized per MHz of the output frequency. This is the total I/O current $V_{DDP}$.
- $C_{load}$ = the output load
- p = the number of outputs
- Fp = the average output frequency

### I/O Input Buffer's Buffer Contribution—$P_{inputs}$

The input's component of AC power dissipation is given by

$$P_{inputs} = P8 * q * Fq$$

where:

- P8 = 29 µW/MHz is the intrinsic power consumption of an input pad normalized per MHz of the input frequency.
- q = the number of inputs
- Fq = the average input frequency

### PLL Contribution—$P_{pll}$

$$P_{pll} = P9 * N_{pll}$$

where:

- P9 = 7.5 mW. This value has been estimated at maximum PLL clock frequency.
- $N_{PII}$ = number of PLLs used

### RAM Contribution—$P_{memory}$

Finally, $P_{memory}$, the memory component of AC power consumption, is given by

$$P_{memory} = P6 * N_{memory} * F_{memory} * E_{memory}$$

where:

- P6 = 175 µW/MHz is the average power consumption of a memory block per MHz of the clock
- $N_{memory}$ = the number of RAM/FIFO blocks (1 block = 256 words * 9 bits)
- $F_{memory}$ = the clock frequency of the memory
- $E_{memory}$ = the average number of active blocks divided by the total number of blocks (N) of the memory.
  - Typical values for $E_{memory}$ would be 1/4 for a 1k x 8,9,16, 32 memory and 1/16 for a 4kx8, 9, 16, and 32 memory configuration
  - In addition, an application-dependent component to $E_{memory}$ can be considered. For example, for a 1kx8 memory configuration using only 1 cycle out of 2, $E_{memory}$ = 1/4*1/2 = 1/8

The following is an APA750 example using a shift register design with 13,440 storage tiles (Register) and 0 logic tiles. This design has one clock at 10 MHz, and 24 outputs toggling at 5 MHz. We then calculate the various components as follows:

**$P_{clock}$**

Fs = 10 MHz

R = 13,440

=> $P_{clock} = (P1 + (P2*R) - (P7*R^2)) * Fs = 121.5$ mW

**$P_{storage}$**

ms = 13,440 (in a shift register 100% of storage tiles are toggling at each clock cycle and Fs = 10 MHz)

=> $P_{storage} = P5 * ms * Fs = 147.8$ mW

**$P_{logic}$**

mc = 0 (no logic tiles in this shift register)

=> $P_{logic} = 0$ mW

**$P_{outputs}$**

$C_{load}$ = 40 pF

$V_{DDP}$ = 3.3 V

p = 24

Fp = 5 MHz

=> $P_{outputs} = (P4 + (C_{load} * V_{DDP}^2)) * p * Fp = 91.4$ mW

**$P_{inputs}$**

q = 1

Fq = 10 MHz

=> $P_{inputs} = P8 * q * Fq = 0.3$ mW

**$P_{memory}$**

$N_{memory}$ = 0 (no RAM/FIFO blocks in this shift register)

=> $P_{memory} = 0$ mW

**$P_{ac}$**

=> 361 mW

**$P_{total}$**

$P_{dc} + P_{ac} = 374$ mW (typical)

# Operating Conditions

Standard and –F parts are the same unless otherwise noted. All –F parts are only available as commercial.

*Table 1-16* • **Absolute Maximum Ratings***

| Parameter | Condition | Minimum | Maximum | Units |
|---|---|---|---|---|
| Supply Voltage Core ($V_{DD}$) | | –0.3 | 3.0 | V |
| Supply Voltage I/O Ring ($V_{DDP}$) | | –0.3 | 4.0 | V |
| DC Input Voltage | | –0.3 | $V_{DDP}$ + 0.3 | V |
| PCI DC Input Voltage | | –1.0 | $V_{DDP}$ + 1.0 | V |
| PCI DC Input Clamp Current (absolute) | $V_{IN}$ < –1 or $V_{IN}$ = $V_{DDP}$ + 1 V | 10 | | mA |
| LVPECL Input Voltage | | –0.3 | $V_{DDP}$ + 0.5 | V |
| GND | | 0 | 0 | V |

***Note:*** **Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to absolute maximum rated conditions for extended periods may affect device reliability. Devices should not be operated outside the Recommended Operating Conditions.*

*Table 1-17* • **Programming, Storage, and Operating Limits**

| | | | Storage Temperature | | Operating |
|---|---|---|---|---|---|
| Product Grade | Programming Cycles (min.) | Program Retention (min.) | Min. | Max. | $T_J$ Max. Junction Temperature |
| Commercial | 500 | 20 years | –55°C | 110°C | 110°C |
| Industrial | 500 | 20 years | –55°C | 110°C | 110°C |
| Military | 100 | – | –65°C | 150°C | 150°C |
| MIL-STD-883 | 100 | – | –65°C | 150°C | 150°C |

## Performance Retention

For devices operated and stored at 110°C or less, the performance retention period is 20 years after programming. For devices operated and stored at temperatures greater than 110°C, refer to Table 1-18 on page 1-34 to determine the performance retention period. Actel does not guarantee performance if the performance retention period is exceeded. Designers can determine the performance retention period from the following table.

Evaluate the percentage of time spent at the highest temperature, then determine the next highest temperature to which the device will be exposed. In Table 1-18 on page 1-34, find the temperature profile that most closely matches the application.

Example – the ambient temperature of a system cycles between 100°C (25% of the time) and 50°C (75% of the time). No forced ventilation cooling system is in use. An APA600-PQ208M FPGA operates in the system, dissipating 1 W. The package thermal resistance (junction-to-ambient) in still air $\Theta_{ja}$ is 20°C/W, indicating that the junction temperature of the FPGA will be 120°C (25% of the time) and 70°C (75% of the time). The entry in Table 1-18 on page 1-34, which most closely matches the application, is 25% at 125°C with 75% at 110°C. Performance retention in this example is at least 16.0 years.

Note that exceeding the stated retention period may result in a performance degradation in the FPGA below the worst-case performance indicated in the Actel Timer. To ensure that performance does not degrade below the worst-case values in the Actel Timer, the FPGA must be reprogrammed within the performance retention period. In addition, note that performance retention is independent of whether or not the FPGA is operating. The retention period of a device in storage at a given temperature will be the same as the retention period of a device operating at that junction temperature.

*Table 1-18* • **Performance Retention**

| Minimum Time at $T_J$ 110°C or below | Minimum Time at $T_J$ 125°C or below | Minimum Time at $T_J$ 135°C or below | Minimum Time at $T_J$ 150°C or below | Minimum Performance Retention (Years) |
|---|---|---|---|---|
| 100% | | | | 20.0 |
| 90% | 10% | | | 18.2 |
| 75% | 25% | | | 16 |
| 90% | | 10% | | 15.4 |
| 50% | 50% | | | 13.3 |
| 90% | | | 10% | 11.8 |
| 75% | | 25% | | 11.4 |
| | 100% | | | 10 |
| | 90% | 10% | | 9.1 |
| 50% | | 50% | | 8 |
| | 75% | 25% | | 8 |
| | 90% | | 10% | 7.7 |
| 75% | | | 25% | 7.3 |
| | 50% | 50% | | 6.7 |
| | 75% | | 25% | 5.7 |
| | | 100% | | 5 |
| | | 90% | 10% | 4.5 |
| 50% | | | 50% | 4.4 |
| | 50% | | 50% | 4 |
| | | 75% | 25% | 4 |
| | | 50% | 50% | 3.3 |
| | | | 100% | 2.5 |

*Table 1-19* • **Recommended Maximum Operating Conditions Programming and PLL Supplies**

| Parameter | Condition | Commercial/Industrial/Military/MIL-STD-883 | | Units |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| $V_{PP}$ | During Programming | 15.8 | 16.5 | V |
| | Normal Operation[1] | 0 | 16.5 | V |
| $V_{PN}$ | During Programming | –13.8 | –13.2 | V |
| | Normal Operation[2] | –13.8 | 0.5 | V |
| $I_{PP}$ | During Programming | | 25 | mA |
| $I_{PN}$ | During Programming | | 10 | mA |
| AVDD | | $V_{DD}$ | $V_{DD}$ | V |
| AGND | | GND | GND | V |

***Notes:***
1. *Please refer to the "VPP Programming Supply Pin" section on page 1-74 for more information.*
2. *Please refer to the "VPN Programming Supply Pin" section on page 1-74 for more information.*

*Table 1-20* • **Recommended Operating Conditions**

| Parameter | Symbol | Limits | | |
|---|---|---|---|---|
| | | Commercial | Industrial | Military/MIL-STD-883 |
| DC Supply Voltage (2.5 V I/Os) | $V_{DD}$ and $V_{DDP}$ | 2.5 V ± 0.2 V | 2.5 V ± 0.2 V | 2.5 V ± 0.2 V |
| DC Supply Voltage (3.3 V I/Os) | $V_{DDP}$<br>$V_{DD}$ | 3.3 V ± 0.3 V<br>2.5 V ± 0.2 V | 3.3 V ± 0.3 V<br>2.5 V ± 0.2 V | 3.3 V ± 0.3 V<br>2.5 V ± 0.2 V |
| Operating Ambient Temperature Range | $T_A$, $T_C$ | 0°C to 70°C | –40°C to 85°C | –55°C ($T_A$) to 125°C ($T_C$) |
| Maximum Operating Junction Temperature | $T_J$ | 110°C | 110°C | 150°C |

***Note:*** *For I/O long-term reliability, external pull-up resistors cannot be used to increase output voltage above $V_{DDP}$.*

*Table 1-21* • **DC Electrical Specifications ($V_{DDP}$ = 2.5 V ±0.2V)**

| Symbol | Parameter | Conditions | | Commercial/Industrial/ Military/MIL-STD-883[1, 2] Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | Output High Voltage<br>High Drive (OB25LPH)<br><br><br>Low Drive (OB25LPL) | <br>$I_{OH}$ = –6 mA<br>$I_{OH}$ = –12 mA<br>$I_{OH}$ = –24 mA<br><br>$I_{OH}$ = –3 mA<br>$I_{OH}$ = –6 mA<br>$I_{OH}$ = –8 mA | | <br>2.1<br>2.0<br>1.7<br><br>2.1<br>1.9<br>1.7 | | | <br>V<br><br><br><br><br><br> |
| $V_{OL}$ | Output Low Voltage<br>High Drive (OB25LPH)<br><br><br>Low Drive (OB25LPL) | <br>$I_{OL}$ = 8 mA<br>$I_{OL}$ = 15 mA<br>$I_{OL}$ = 24 mA<br><br>$I_{OL}$ = 4 mA<br>$I_{OL}$ = 8 mA<br>$I_{OL}$ = 15 mA | | | | <br>0.2<br>0.4<br>0.7<br><br>0.2<br>0.4<br>0.7 | <br>V<br><br><br><br><br><br> |
| $V_{IH}$[6] | Input High Voltage | | | 1.7 | | $V_{DDP}$ + 0.3 | V |
| $V_{IL}$[7] | Input Low Voltage | | | –0.3 | | 0.7 | V |
| $R_{WEAKPULLUP}$ | Weak Pull-up Resistance (OTB25LPU) | $V_{IN} \geq$ 1.25 V | | 6 | | 56 | kΩ |
| HYST | Input Hysteresis Schmitt | See Table 1-4 on page 1-9 | | 0.3 | 0.35 | 0.45 | V |
| $I_{IN}$ | Input Current | with pull up ($V_{IN}$ = GND) | | –240 | | – 20 | µA |
| | | without pull up ($V_{IN}$ = GND or $V_{DD}$) | | –10 | | 10 | µA |
| $I_{DDQ}$ | Quiescent Supply Current (standby) Commercial | $V_{IN}$ = GND[4] or $V_{DD}$ | Std. | | 5.0 | 15 | mA |
| | | | –F[3] | | 5.0 | 25 | mA |
| $I_{DDQ}$ | Quiescent Supply Current (standby) Industrial | $V_{IN}$ = GND[4] or $V_{DD}$ | Std. | | 5.0 | 20 | mA |
| $I_{DDQ}$ | Quiescent Supply Current (standby) Military/MIL-STD-883 | $V_{IN}$ = GND[4] or $V_{DD}$ | Std. | | 5.0 | 25 | mA |
| $I_{OZ}$ | Tristate Output Leakage Current | $V_{OH}$ = GND or $V_{DD}$ | Std. | –10 | | 10 | µA |
| | | | –F[3, 5] | –10 | | 100 | µA |

***Notes:***

1. *All process conditions. Commercial/Industrial: Junction Temperature: –40 to +110°C.*
2. *All process conditions. Military: Junction Temperature: –55 to +150°C.*
3. *All –F parts are available only as commercial.*
4. *No pull-up resistor.*
5. *This will not exceed 2 mA total per device.*
6. *During transitions, the input signal may overshoot to $V_{DDP}$ +1.0V for a limited time of no larger than 10% of the duty cycle.*
7. *During transitions, the input signal may undershoot to -1.0V for a limited time of no larger than 10% of the duty cycle.*

*Table 1-21* • **DC Electrical Specifications ($V_{DDP}$ = 2.5 V ±0.2V) (Continued)**

| Symbol | Parameter | Conditions | Commercial/Industrial/ Military/MIL-STD-883[1, 2] | | | |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Units |
| $I_{OSH}$ | Output Short Circuit Current High<br>High Drive (OB25LPH)<br>Low Drive (OB25LPL) | <br>$V_{IN} = V_{SS}$<br>$V_{IN} = V_{SS}$ | <br>–120<br>–100 | | | mA |
| $I_{OSL}$ | Output Short Circuit Current Low<br>High Drive (OB25LPH)<br>Low Drive (OB25LPL) | <br>$V_{IN} = V_{DDP}$<br>$V_{IN} = V_{DDP}$ | | | <br>100<br>30 | mA |
| $C_{I/O}$ | I/O Pad Capacitance | | | | 10 | pF |
| $C_{CLK}$ | Clock Input Pad Capacitance | | | | 10 | pF |

***Notes:***

1. *All process conditions. Commercial/Industrial: Junction Temperature: –40 to +110°C.*
2. *All process conditions. Military: Junction Temperature: –55 to +150°C.*
3. *All –F parts are available only as commercial.*
4. *No pull-up resistor.*
5. *This will not exceed 2 mA total per device.*
6. *During transitions, the input signal may overshoot to $V_{DDP}$ +1.0V for a limited time of no larger than 10% of the duty cycle.*
7. *During transitions, the input signal may undershoot to -1.0V for a limited time of no larger than 10% of the duty cycle.*

*Table 1-22* • **DC Electrical Specifications ($V_{DDP}$ = 3.3 V ±0.3 V and $V_{DD}$ = 2.5 V ±0.2 V)**

| Symbol | Parameter | Conditions | | Commercial/Industrial/ Military/MIL-STD-883[1, 2] Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | Output High Voltage<br>3.3 V I/O, High Drive (OB33P)<br><br><br>3.3 V I/O, Low Drive (OB33L) | <br>$I_{OH}$ = –14 mA<br>$I_{OH}$ = –24 mA<br><br>$I_{OH}$ = –6 mA<br>$I_{OH}$ = –12 mA | | <br>0.9*$V_{DDP}$<br>2.4<br><br>0.9*$V_{DDP}$<br>2.4 | | | V |
| $V_{OL}$ | Output Low Voltage<br>3.3 V I/O, High Drive (OB33P)<br><br><br>3.3 V I/O, Low Drive (OB33L) | <br>$I_{OL}$ = 15 mA<br>$I_{OL}$ = 20 mA<br>$I_{OL}$ = 28 mA<br><br>$I_{OL}$ = 7 mA<br>$I_{OL}$ = 10 mA<br>$I_{OL}$ = 15 mA | | | | <br>0.1$V_{DDP}$<br>0.4<br>0.7<br><br>0.1$V_{DDP}$<br>0.4<br>0.7 | V |
| $V_{IH}$[6] | Input High Voltage<br>3.3 V Schmitt Trigger Inputs<br>3.3 V LVTTL/LVCMOS<br>2.5 V Mode | | | <br>1.6<br>2<br>1.7 | | <br>$V_{DDP}$ + 0.3<br>$V_{DDP}$ + 0.3<br>$V_{DDP}$ + 0.3 | V |
| $V_{IL}$[7] | Input Low Voltage<br>3.3 V Schmitt Trigger Inputs<br>3.3 V LVTTL/LVCMOS<br>2.5 V Mode | | | <br>–0.3<br>–0.3<br>–0.3 | | <br>0.8<br>0.8<br>0.7 | V |
| $R_{WEAKPULLUP}$ | Weak Pull-up Resistance (IOB33U) | $V_{IN} \geq$ 1.5 V | | 7 | | 43 | kΩ |
| $R_{WEAKPULLUP}$ | Weak Pull-up Resistance (IOB25U) | $V_{IN} \geq$ 1.5 V | | 7 | | 43 | kΩ |
| $I_{IN}$ | Input Current | with pull up ($V_{IN}$ = GND) | | –300 | | –40 | µA |
| | | without pull up ($V_{IN}$ = GND or $V_{DD}$) | | –10 | | 10 | µA |
| $I_{DDQ}$ | Quiescent Supply Current (standby)<br>Commercial | $V_{IN}$ = GND[4] or $V_{DD}$ | Std. | | 5.0 | 15 | mA |
| | | | –F[3] | | 5.0 | 25 | mA |
| $I_{DDQ}$ | Quiescent Supply Current (standby)<br>Industrial | $V_{IN}$ = GND[4] or $V_{DD}$ | Std. | | 5.0 | 20 | mA |
| $I_{DDQ}$ | Quiescent Supply Current (standby)<br>Military | $V_{IN}$ = GND[4] or $V_{DD}$ | Std. | | 5.0 | 25 | mA |

***Notes:***

1. *All process conditions. Commercial/Industrial: Junction Temperature: –40 to +110°C.*
2. *All process conditions. Military: Junction Temperature: –55 to +150°C.*
3. *All –F parts are only available as commercial.*
4. *No pull-up resistor required.*
5. *This will not exceed 2 mA total per device.*
6. *During transitions, the input signal may overshoot to $V_{DDP}$ +1.0 V for a limited time of no larger than 10% of the duty cycle.*
7. *During transitions, the input signal may undershoot to –1.0 V for a limited time of no larger than 10% of the duty cycle.*

*Table 1-22* • **DC Electrical Specifications ($V_{DDP}$ = 3.3 V ±0.3 V and $V_{DD}$ = 2.5 V ±0.2 V) (Continued)**

| Symbol | Parameter | Conditions | | Commercial/Industrial/ Military/MIL-STD-883[1, 2] Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $I_{OZ}$ | Tristate Output Leakage Current | $V_{OH}$ = GND or $V_{DD}$ | Std. | –10 | | 10 | µA |
| | | | –F[3, 5] | –10 | | 100 | µA |
| $I_{OSH}$ | Output Short Circuit Current High<br>3.3 V High Drive (OB33P)<br>3.3 V Low Drive (OB33L) | <br>$V_{IN}$ = GND<br>$V_{IN}$ = GND | | <br>–200<br>–100 | | | |
| $I_{OSL}$ | Output Short Circuit Current Low<br>3.3 V High Drive<br>3.3 V Low Drive | <br>$V_{IN}$ = $V_{DD}$<br>$V_{IN}$ = $V_{DD}$ | | | | <br>200<br>100 | |
| $C_{I/O}$ | I/O Pad Capacitance | | | | | 10 | pF |
| $C_{CLK}$ | Clock Input Pad Capacitance | | | | | 10 | pF |

***Notes:***

1. *All process conditions. Commercial/Industrial: Junction Temperature: –40 to +110°C.*
2. *All process conditions. Military: Junction Temperature: –55 to +150°C.*
3. *All –F parts are only available as commercial.*
4. *No pull-up resistor required.*
5. *This will not exceed 2 mA total per device.*
6. *During transitions, the input signal may overshoot to $V_{DDP}$ +1.0 V for a limited time of no larger than 10% of the duty cycle.*
7. *During transitions, the input signal may undershoot to –1.0 V for a limited time of no larger than 10% of the duty cycle.*

*Table 1-23* • **DC Specifications (3.3 V PCI Operation)[1]**

| Symbol | Parameter | Condition | | Commercial/ Industrial[2,3] | | Military/MIL-STD- 883[2,3] | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Max. | Min. | Max. | |
| $V_{DD}$ | Supply Voltage for Core | | | 2.3 | 2.7 | 2.3 | 2.7 | V |
| $V_{DDP}$ | Supply Voltage for I/O Ring | | | 3.0 | 3.6 | 3.0 | 3.6 | V |
| $V_{IH}$ | Input High Voltage | | | $0.5V_{DDP}$ | $V_{DDP}$ + 0.5 | $0.5V_{DDP}$ | $V_{DDP}$ + 0.5 | V |
| $V_{IL}$ | Input Low Voltage | | | –0.5 | $0.3V_{DDP}$ | –0.5 | $0.3V_{DDP}$ | V |
| $I_{IPU}$ | Input Pull-up Voltage[4] | | | $0.7V_{DDP}$ | | $0.7V_{DDP}$ | | V |
| $I_{IL}$ | Input Leakage Current[5] | $0 < V_{IN} < V_{DDP}$ | Std. | –10 | 10 | –50 | 50 | µA |
| | | | –F[3, 6] | –10 | 100 | | | µA |
| $V_{OH}$ | Output High Voltage | $I_{OUT}$ = –500 µA | | $0.9V_{DDP}$ | | $0.9V_{DDP}$ | | V |
| $V_{OL}$ | Output Low Voltage | $I_{OUT}$ = 1500 µA | | | $0.1V_{DDP}$ | | $0.1V_{DDP}$ | V |
| $C_{IN}$ | Input Pin Capacitance (except CLK) | | | | 10 | | 10 | pF |
| $C_{CLK}$ | CLK Pin Capacitance | | | 5 | 12 | 5 | 12 | pF |

***Notes:***

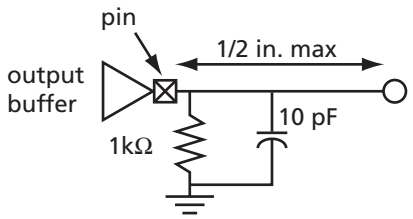
1. *For PCI operation, use OTB33PH, OB33PH, IOB33PH, IB33, or IB33S macro library cell only.*
2. *All process conditions. Junction Temperature: –40 to +110°C for Commercial and Industrial devices and –55 to +125°C for Military.*
3. *All –F parts are available as commercial only.*
4. *This specification is guaranteed by design. It is the minimum voltage to which pull-up resistors are calculated to pull a floated network. Designers with applications sensitive to static power utilization should ensure that the input buffer is conducting minimum current at this input voltage.*
5. *Input leakage currents include hi-Z output leakage for all bidirectional buffers with tristate outputs.*
6. *The sum of the leakage currents for all inputs shall not exceed 2mA per device.*

*Table 1-24* • **AC Specifications (3.3 V PCI Revision 2.2 Operation)**

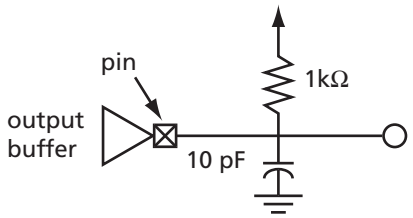
| Symbol | Parameter | Condition | Commercial/Industrial/Military/MIL-STD- 883 | | Units |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| $I_{OH(AC)}$ | Switching Current High | $0 < V_{OUT} \le 0.3V_{DDP}$* | $-12V_{DDP}$ | | mA |
| | | $0.3V_{DDP} \le V_{OUT} < 0.9V_{DDP}$* | $(-17.1 + (V_{DDP} - V_{OUT}))$ | | mA |
| | | $0.7V_{DDP} < V_{OUT} < V_{DDP}$* | | See equation C – page 124 of the PCI Specification document rev. 2.2 | |
| | (Test Point) | $V_{OUT} = 0.7V_{DDP}$* | | $-32V_{DDP}$ | mA |
| $I_{OL(AC)}$ | Switching Current Low | $V_{DDP} > V_{OUT} \ge 0.6V_{DDP}$* | $16V_{DDP}$ | | mA |
| | | $0.6V_{DDP} > V_{OUT} > 0.1V_{DDP}$ [1] | $(26.7V_{OUT})$ | | mA |
| | | $0.18V_{DDP} > V_{OUT} > 0$* | | See equation D – page 124 of the PCI Specification document rev. 2.2 | |
| | (Test Point) | $V_{OUT} = 0.18V_{DDP}$ | | $38V_{DDP}$ | mA |
| $I_{CL}$ | Low Clamp Current | $-3 < V_{IN} \le -1$ | $-25 + (V_{IN} + 1)/0.015$ | | mA |
| $I_{CH}$ | High Clamp Current | $V_{DDP} + 4 > V_{IN} \ge V_{DDP} + 1$ | $25 + (V_{IN} - V_{DDP} - 1)/0.015$ | | mA |
| $slew_R$ | Output Rise Slew Rate | $0.2V_{DDP}$ to $0.6V_{DDP}$ load* | 1 | 4 | V/ns |
| $slew_F$ | Output Fall Slew Rate | $0.6V_{DDP}$ to $0.2V_{DDP}$ load* | 1 | 4 | V/ns |

***Note:*** ** Refer to the PCI Specification document rev. 2.2.*

Pad Loading Applicable to the Rising Edge PCI




Pad Loading Applicable to the Falling Edge PCI



# Tristate Buffer Delays

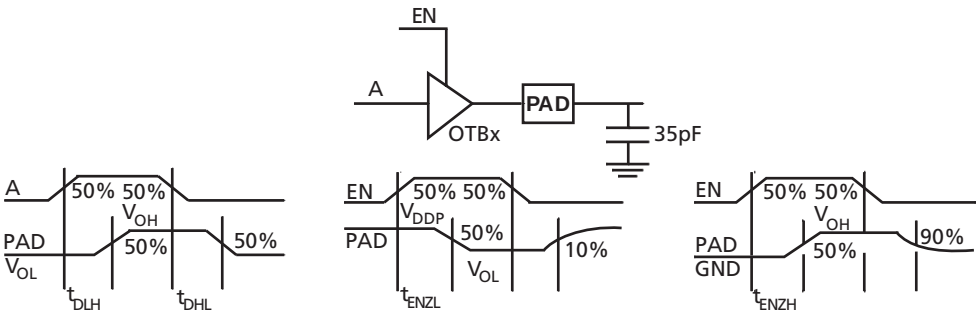



*Figure 1-26* • **Tristate Buffer Delays**

*Table 1-25* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, 35 pF load, $T_J$ = 70°C**

| Macro Type | Description | Max $t_{DLH}$[1] | | Max $t_{DHL}$[2] | | Max $t_{ENZH}$[3] | | Max $t_{ENZL}$[4] | | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Std. | –F | Std. | –F | Std. | –F | Std. | –F | |
| OTB33PH | 3.3 V, PCI Output Current, High Slew Rate | 2.0 | 2.4 | 2.2 | 2.6 | 2.2 | 2.6 | 2.0 | 2.4 | ns |
| OTB33PN | 3.3 V, High Output Current, Nominal Slew Rate | 2.2 | 2.6 | 2.9 | 3.5 | 2.4 | 2.9 | 2.1 | 2.5 | ns |
| OTB33PL | 3.3 V, High Output Current, Low Slew Rate | 2.5 | 3.0 | 3.2 | 3.9 | 2.7 | 3.3 | 2.8 | 3.4 | ns |
| OTB33LH | 3.3 V, Low Output Current, High Slew Rate | 2.6 | 3.1 | 4.0 | 4.8 | 2.8 | 3.4 | 3.0 | 3.6 | ns |
| OTB33LN | 3.3 V, Low Output Current, Nominal Slew Rate | 2.9 | 3.5 | 4.3 | 5.2 | 3.2 | 3.8 | 4.1 | 4.9 | ns |
| OTB33LL | 3.3 V, Low Output Current, Low Slew Rate | 3.0 | 3.6 | 5.6 | 6.7 | 3.3 | 3.9 | 5.5 | 6.6 | ns |

***Notes:***

1. *$t_{DLH}$=Data-to-Pad High*
2. *$t_{DHL}$=Data-to-Pad Low*
3. *$t_{ENZH}$=Enable-to-Pad, Z to High*
4. *$t_{ENZL}$ = Enable-to-Pad, Z to Low*
5. *All –F parts are only available as commercial.*

*Table 1-26* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 2.3 V, $V_{DD}$ = 2.3 V, 35 pF load, $T_J$ = 70°C**

| Macro Type | Description | Max $t_{DLH}$[1] | | Max $t_{DHL}$[2] | | Max $t_{ENZH}$[3] | | Max $t_{ENZL}$[4] | | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Std. | –F | Std. | –F | Std. | –F | Std. | –F | |
| OTB25LPHH | 2.5 V, Low Power, High Output Current, High Slew Rate[5] | 2.0 | 2.4 | 2.1 | 2.5 | 2.3 | 2.7 | 2.0 | 2.4 | ns |
| OTB25LPHN | 2.5 V, Low Power, High Output Current, Nominal Slew Rate[5] | 2.4 | 2.9 | 3.0 | 3.6 | 2.7 | 3.2 | 2.1 | 2.5 | ns |
| OTB25LPHL | 2.5 V, Low Power, High Output Current, Low Slew Rate[5] | 2.9 | 3.5 | 3.2 | 3.8 | 3.1 | 3.8 | 2.7 | 3.2 | ns |
| OTB25LPLH | 2.5 V, Low Power, Low Output Current, High Slew Rate[5] | 2.7 | 3.3 | 4.6 | 5.5 | 3.0 | 3.6 | 2.6 | 3.1 | ns |
| OTB25LPLN | 2.5 V, Low Power, Low Output Current, Nominal Slew Rate[5] | 3.5 | 4.2 | 4.2 | 5.1 | 3.8 | 4.5 | 3.8 | 4.6 | ns |
| OTB25LPLL | 2.5 V, Low Power, Low Output Current, Low Slew Rate[5] | 4.0 | 4.8 | 5.3 | 6.4 | 4.2 | 5.1 | 5.1 | 6.1 | ns |

***Notes:***

1. *$t_{DLH}$=Data-to-Pad High*
2. *$t_{DHL}$=Data-to-Pad Low*
3. *$t_{ENZH}$=Enable-to-Pad, Z to High*
4. *$t_{ENZL}$ = Enable-to-Pad, Z to Low*
5. *Low power I/O work with $V_{DDP}$=2.5 V ±10% only. $V_{DDP}$=2.3 V for delays.*
6. *All –F parts are only available as commercial.*

*Table 1-27* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, 35 pF load, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max $t_{DLH}$[1] Std. | Max $t_{DHL}$[2] Std. | Max $t_{ENZH}$[3] Std. | Max $t_{ENZL}$[4] Std. | Units |
|---|---|---|---|---|---|---|
| OTB33PH | 3.3 V, PCI Output Current, High Slew Rate | 2.2 | 2.4 | 2.3 | 2.1 | ns |
| OTB33PN | 3.3 V, High Output Current, Nominal Slew Rate | 2.4 | 3.2 | 2.7 | 2.3 | ns |
| OTB33PL | 3.3 V, High Output Current, Low Slew Rate | 2.7 | 3.5 | 2.9 | 3.0 | ns |
| OTB33LH | 3.3 V, Low Output Current, High Slew Rate | 2.7 | 4.3 | 3.0 | 3.1 | ns |
| OTB33LN | 3.3 V, Low Output Current, Nominal Slew Rate | 3.3 | 4.7 | 3.4 | 4.4 | ns |
| OTB33LL | 3.3 V, Low Output Current, Low Slew Rate | 3.2 | 6.0 | 3.5 | 5.9 | ns |

***Notes:***

1. *$t_{DLH}$=Data-to-Pad High*
2. *$t_{DHL}$=Data-to-Pad Low*
3. *$t_{ENZH}$=Enable-to-Pad, Z to High*
4. *$t_{ENZL}$ = Enable-to-Pad, Z to Low*

*Table 1-28* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 2.3 V, $V_{DD}$ = 2.3 V, 35 pF load, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max $t_{DLH}$[1] Std. | Max $t_{DHL}$[2] Std. | Max $t_{ENZH}$[3] Std. | Max $t_{ENZL}$[4] Std. | Units |
|---|---|---|---|---|---|---|
| OTB25LPHH | 2.5 V, Low Power, High Output Current, High Slew Rate[5] | 2.3 | 2.3 | 2.4 | 2.1 | ns |
| OTB25LPHN | 2.5 V, Low Power, High Output Current, Nominal Slew Rate[5] | 2.7 | 3.2 | 2.8 | 2.1 | ns |
| OTB25LPHL | 2.5 V, Low Power, High Output Current, Low Slew Rate[5] | 3.2 | 3.5 | 3.3 | 2.8 | ns |
| OTB25LPLH | 2.5 V, Low Power, Low Output Current, High Slew Rate[5] | 3.0 | 5.0 | 3.2 | 2.8 | ns |
| OTB25LPLN | 2.5 V, Low Power, Low Output Current, Nominal Slew Rate[5] | 3.7 | 4.5 | 4.1 | 4.1 | ns |
| OTB25LPLL | 2.5 V, Low Power, Low Output Current, Low Slew Rate[5] | 4.4 | 5.8 | 4.4 | 5.4 | ns |

***Notes:***

1. *$t_{DLH}$=Data-to-Pad High*
2. *$t_{DHL}$=Data-to-Pad Low*
3. *$t_{ENZH}$=Enable-to-Pad, Z to High*
4. *$t_{ENZL}$ = Enable-to-Pad, Z to Low*
5. *Low power I/O work with $V_{DDP}$=2.5V ±10% only. $V_{DDP}$=2.3V for delays.*

# Output Buffer Delays

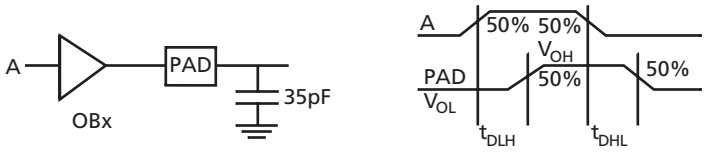



*Figure 1-27* • **Output Buffer Delays**

*Table 1-29* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, 35 pF load, $T_J$ = 70°C**

| Macro Type | Description | Max $t_{DLH}$[1] | | Max $t_{DHL}$[2] | | Units |
|---|---|---|---|---|---|---|
| | | Std. | –F | Std. | –F | |
| OB33PH | 3.3 V, PCI Output Current, High Slew Rate | 2.0 | 2.4 | 2.2 | 2.6 | ns |
| OB33PN | 3.3 V, High Output Current, Nominal Slew Rate | 2.2 | 2.6 | 2.9 | 3.5 | ns |
| OB33PL | 3.3 V, High Output Current, Low Slew Rate | 2.5 | 3.0 | 3.2 | 3.9 | ns |
| OB33LH | 3.3 V, Low Output Current, High Slew Rate | 2.6 | 3.1 | 4.0 | 4.8 | ns |
| OB33LN | 3.3 V, Low Output Current, Nominal Slew Rate | 2.9 | 3.5 | 4.3 | 5.2 | ns |
| OB33LL | 3.3 V, Low Output Current, Low Slew Rate | 3.0 | 3.6 | 5.6 | 6.7 | ns |

***Notes:***

1. *$t_{DLH}$ = Data-to-Pad High*
2. *$t_{DHL}$ = Data-to-Pad Low*
3. *All –F parts are only available as commercial.*

*Table 1-30* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 2.3 V, $V_{DD}$ = 2.3 V, 35 pF load, $T_J$ = 70°C**

| Macro Type | Description | Max $t_{DLH}$[1] | | Max $t_{DHL}$[2] | | Units |
|---|---|---|---|---|---|---|
| | | Std. | –F | Std. | –F | |
| OB25LPHH | 2.5 V, Low Power, High Output Current, High Slew Rate[3] | 2.0 | 2.4 | 2.1 | 2.6 | ns |
| OB25LPHN | 2.5 V, Low Power, High Output Current, Nominal Slew Rate[3] | 2.4 | 2.9 | 3.0 | 3.6 | ns |
| OB25LPHL | 2.5 V, Low Power, High Output Current, Low Slew Rate[3] | 2.9 | 3.5 | 3.2 | 3.8 | ns |
| OB25LPLH | 2.5 V, Low Power, Low Output Current, High Slew Rate[3] | 2.7 | 3.3 | 4.6 | 5.5 | ns |
| OB25LPLN | 2.5 V, Low Power, Low Output Current, Nominal Slew Rate[3] | 3.5 | 4.2 | 4.2 | 5.1 | ns |
| OB25LPLL | 2.5 V, Low Power, Low Output Current, Low Slew Rate[3] | 4.0 | 4.8 | 5.3 | 6.4 | ns |

***Notes:***

1. *$t_{DLH}$ = Data-to-Pad High*
2. *$t_{DHL}$ = Data-to-Pad Low*
3. *Low-power I/Os work with $V_{DDP}$=2.5 V ±10% only. $V_{DDP}$=2.3 V for delays.*
4. *All –F parts are only available as commercial.*

*Table 1-31* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 3.0V, $V_{DD}$ = 2.3V, 35 pF load, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max. $t_{DLH}$[1] Std. | Max. $t_{DHL}$[2] Std. | Units |
|---|---|---|---|---|
| OB33PH | 3.3V, PCI Output Current, High Slew Rate | 2.1 | 2.3 | ns |
| OB33PN | 3.3V, High Output Current, Nominal Slew Rate | 2.5 | 3.2 | ns |
| OB33PL | 3.3V, High Output Current, Low Slew Rate | 2.7 | 3.5 | ns |
| OB33LH | 3.3V, Low Output Current, High Slew Rate | 2.7 | 4.3 | ns |
| OB33LN | 3.3V, Low Output Current, Nominal Slew Rate | 3.3 | 4.7 | ns |
| OB33LL | 3.3V, Low Output Current, Low Slew Rate | 3.3 | 6.1 | ns |

***Notes:***

1. *$t_{DLH}$ = Data-to-Pad High*
2. *$t_{DHL}$ = Data-to-Pad Low*

*Table 1-32* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 2.3 V, $V_{DD}$ = 2.3V, 35 pF load, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max. $t_{DLH}$[1] Std. | Max. $t_{DHL}$[2] Std. | Units |
|---|---|---|---|---|
| OB25LPHH | 2.5V, Low Power, High Output Current, High Slew Rate[3] | 2.3 | 2.4 | ns |
| OB25LPHN | 2.5V, Low Power, High Output Current, Nominal Slew Rate[3] | 2.7 | 3.3 | ns |
| OB25LPHL | 2.5V, Low Power, High Output Current, Low Slew Rate[3] | 3.2 | 3.5 | ns |
| OB25LPLH | 2.5V, Low Power, Low Output Current, High Slew Rate[3] | 3.0 | 5.0 | ns |
| OB25LPLN | 2.5V, Low Power, Low Output Current, Nominal Slew Rate[3] | 3.9 | 4.6 | ns |
| OB25LPLL | 2.5V, Low Power, Low Output Current, Low Slew Rate[3] | 4.3 | 5.7 | ns |

***Notes:***

1. *$t_{DLH}$ = Data-to-Pad High*
2. *$t_{DHL}$ = Data-to-Pad Low*
3. *Low power I/O work with $V_{DDP}$=2.5V ±10% only. $V_{DDP}$=2.3V for delays.*

# Input Buffer Delays

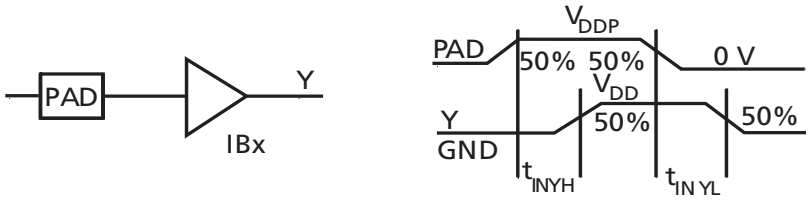



*Figure 1-28* • **Input Buffer Delays**

*Table 1-33* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, $T_J$ = 70°C**

| Macro Type | Description | Max. $t_{INYH}$[1] | | Max. $t_{INYL}$[2] | | Units |
|---|---|---|---|---|---|---|
| | | Std. | –F | Std. | –F | |
| IB33 | 3.3 V, CMOS Input Levels[3], No Pull-up Resistor | 0.4 | 0.5 | 0.6 | 0.7 | ns |
| IB33S | 3.3 V, CMOS Input Levels[3], No Pull-up Resistor, Schmitt Trigger | 0.6 | 0.7 | 0.8 | 0.9 | ns |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *LVTTL delays are the same as CMOS delays.*
4. *For LP Macros, $V_{DDP}$=2.3 V for delays.*
5. *All –F parts are only available as commercial.*

*Table 1-34* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 2.3 V, $V_{DD}$ = 2.3 V, $T_J$ = 70°C**

| Macro Type | Description | Max. $t_{INYH}$[1] | | Max. $t_{INYL}$[2] | | Units |
|---|---|---|---|---|---|---|
| | | Std. | –F | Std. | –F | |
| IB25LP | 2.5 V, CMOS Input Levels[3], Low Power | 0.9 | 1.1 | 0.6 | 0.8 | ns |
| IB25LPS | 2.5 V, CMOS Input Levels[3], Low Power, Schmitt Trigger | 0.7 | 0.9 | 0.9 | 1.1 | ns |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *LVTTL delays are the same as CMOS delays.*
4. *For LP Macros, $V_{DDP}$=2.3 V for delays.*
5. *All –F parts are only available as commercial.*

*Table 1-35* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 3.0V, $V_{DD}$ = 2.3V, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max. $t_{INYH}$[1] | Max. $t_{INYL}$[2] | Units |
|---|---|---|---|---|
| | | Std. | Std. | |
| IB33 | 3.3V, CMOS Input Levels[3], No Pull-up Resistor | 0.5 | 0.6 | ns |
| IB33S | 3.3V, CMOS Input Levels[3], No Pull-up Resistor, Schmitt Trigger | 0.6 | 0.8 | ns |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *LVTTL delays are the same as CMOS delays.*
4. *For LP Macros, $V_{DDP}$=2.3V for delays.*

*Table 1-36* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 2.3V, $V_{DD}$ = 2.3V, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max. $t_{INYH}$[1] | Max. $t_{INYL}$[2] | Units |
|---|---|---|---|---|
| | | Std. | Std. | |
| IB25LP | 2.5V, CMOS Input Levels[3], Low Power | 0.9 | 0.7 | ns |
| IB25LPS | 2.5V, CMOS Input Levels[3], Low Power, Schmitt Trigger | 0.8 | 1.0 | ns |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *LVTTL delays are the same as CMOS delays.*
4. *For LP Macros, $V_{DDP}$=2.3V for delays.*

# Global Input Buffer Delays

*Table 1-37* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, $T_J$ = 70°C**

| Macro Type | Description | Max. $t_{INYH}$[1] | | Max. $t_{INYL}$[2] | | Units |
|---|---|---|---|---|---|---|
| | | Std.[3] | –F | Std.[3] | –F | |
| GL33 | 3.3 V, CMOS Input Levels[4], No Pull-up Resistor | 1.0 | 1.2 | 1.1 | 1.3 | ns |
| GL33S | 3.3 V, CMOS Input Levels[4], No Pull-up Resistor, Schmitt Trigger | 1.0 | 1.2 | 1.1 | 1.3 | ns |
| PECL | PPECL Input Levels | 1.0 | 1.2 | 1.1 | 1.3 | ns |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *Applies to Military ProASIC PLUS devices.*
4. *LVTTL delays are the same as CMOS delays.*
5. *For LP Macros, $V_{DDP}$=2.3 V for delays.*
6. *All –F parts are only available as commercial.*

*Table 1-38* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 2.3 V, $V_{DD}$ = 2.3 V, $T_J$ = 70°C**

| Macro Type | Description | Max. $t_{INYH}$[1] | | Max. $t_{INYL}$[2] | | Units |
|---|---|---|---|---|---|---|
| | | Std.[3] | –F | Std.[3] | –F | |
| GL25LP | 2.5 V, CMOS Input Levels[4], Low Power | 1.1 | 1.2 | 1.0 | 1.3 | ns |
| GL25LPS | 2.5 V, CMOS Input Levels[4], Low Power, Schmitt Trigger | 1.3 | 1.6 | 1.0 | 1.1 | ns |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *Applies to Military ProASIC PLUS devices.*
4. *LVTTL delays are the same as CMOS delays.*
5. *For LP Macros, $V_{DDP}$=2.3 V for delays.*
6. *All –F parts are only available as commercial.*

*Table 1-39* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 3.0V, $V_{DD}$ = 2.3V, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max. $t_{INYH}$[1] | Max. $t_{INYL}$[2] |
|---|---|---|---|
| | | Std. | Std. |
| GL33 | 3.3V, CMOS Input Levels[3], No Pull-up Resistor | 1.1 | 1.1 |
| GL33S | 3.3V, CMOS Input Levels[3], No Pull-up Resistor, Schmitt Trigger | 1.1 | 1.1 |
| PECL | PPECL Input Levels | 1.1 | 1.1 |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *LVTTL delays are the same as CMOS delays.*
4. *For LP Macros, $V_{DDP}$=2.3V for delays.*

*Table 1-40* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 2.3V, $V_{DD}$ = 2.3V, $T_J$ = 125°C for Military/MIL-STD-883**

| Macro Type | Description | Max. $t_{INYH}$[1] | Max. $t_{INYL}$[2] |
|---|---|---|---|
| | | Std. | Std. |
| GL25LP | 2.5V, CMOS Input Levels[3], Low Power | 1.0 | 1.1 |
| GL25LPS | 2.5V, CMOS Input Levels[3], Low Power, Schmitt Trigger | 1.4 | 1.0 |

***Notes:***

1. *$t_{INYH}$ = Input Pad-to-Y High*
2. *$t_{INYL}$ = Input Pad-to-Y Low*
3. *LVTTL delays are the same as CMOS delays.*
4. *For LP Macros, $V_{DDP}$=2.3V for delays.*

# Predicted Global Routing Delay

*Table 1-41* • **Worst-Case Commercial Conditions[1]**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, $T_J$ = 70°C**

| Parameter | Description | Max. | | Units |
|---|---|---|---|---|
| | | Std. | –F[2] | |
| $t_{RCKH}$ | Input Low to High[3] | 1.1 | 1.3 | ns |
| $t_{RCKL}$ | Input High to Low[3] | 1.0 | 1.2 | ns |
| $t_{RCKH}$ | Input Low to High[4] | 0.8 | 1.0 | ns |
| $t_{RCKL}$ | Input High to Low[4] | 0.8 | 1.0 | ns |

***Notes:***

1. *The timing delay difference between tile locations is less than 15ps.*
2. *All –F parts are only available as commercial.*
3. *Highly loaded row 50%.*
4. *Minimally loaded row.*

*Table 1-42* • **Worst-Case Military Conditions**
**$V_{DDP}$ = 3.0V, $V_{DD}$ = 2.3V, $T_J$ = 125°C for Military/MIL-STD-883**

| Parameter | Description | Max. | Units |
|---|---|---|---|
| $t_{RCKH}$ | Input Low to High (high loaded row of 50%) | 1.1 | ns |
| $t_{RCKL}$ | Input High to Low (high loaded row of 50%) | 1.0 | ns |
| $t_{RCKH}$ | Input Low to High (minimally loaded row) | 0.8 | ns |
| $t_{RCKL}$ | Input High to Low (minimally loaded row) | 0.8 | ns |

***Note:*** ** The timing delay difference between tile locations is less than 15 ps.*

# Global Routing Skew

*Table 1-43* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 3.0 V, $V_{DD}$ = 2.3 V, $T_J$ = 70°C**

| Parameter | Description | Max. | | Units |
|---|---|---|---|---|
| | | Std. | –F* | |
| $t_{RCKSWH}$ | Maximum Skew Low to High | 270 | 320 | ps |
| $t_{RCKSHH}$ | Maximum Skew High to Low | 270 | 320 | ps |

***Note:*** **All –F parts are only available as commercial.*

*Table 1-44* • **Worst-Case Commercial Conditions**
**$V_{DDP}$ = 3.0V, $V_{DD}$ = 2.3V, $T_J$ = 125°C for Military/MIL-STD-883**

| Parameter | Description | Max. | Units |
|---|---|---|---|
| $t_{RCKSWH}$ | Maximum Skew Low to High | 270 | ps |
| $t_{RCKSHH}$ | Maximum Skew High to Low | 270 | ps |

# Module Delays

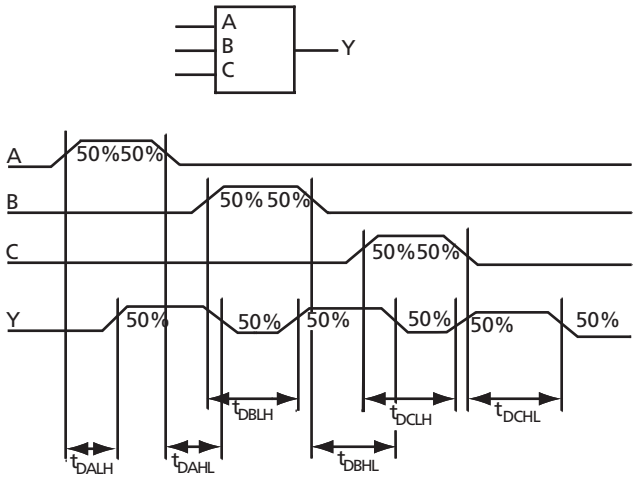



*Figure 1-29* • **Module Delays**

# Sample Macrocell Library Listing

*Table 1-45* • **Worst-Case Military Conditions[1]**
**$V_{DD}$ = 2.3 V, $T_J$ = 70° C, $T_J$ = 70°C, $T_J$ = 125°C for Military/MIL-STD-883**

| Cell Name | Description | | Std. Max | Std. Min | –F[2] Max | –F[2] Min | Units |
|---|---|---|---|---|---|---|---|
| NAND2 | 2-Input NAND | | 0.5 | | 0.6 | | ns |
| AND2 | 2-Input AND | | 0.7 | | 0.8 | | ns |
| NOR3 | 3-Input NOR | | 0.8 | | 1.0 | | ns |
| MUX2L | 2-1 MUX with Active Low Select | | 0.5 | | 0.6 | | ns |
| OA21 | 2-Input OR into a 2-Input AND | | 0.8 | | 1.0 | | ns |
| XOR2 | 2-Input Exclusive OR | | 0.6 | | 0.8 | | ns |
| LDL | Active Low Latch (LH/HL) | | | | | | ns |
| | CLK-Q | LH[3] | 0.9 | | 1.1 | | |
| | | HL[3] | 0.8 | | 0.9 | | ns |
| | $t_{setup}$ | | | 0.7 | | 0.8 | ns |
| | $t_{hold}$ | | | 0.1 | | 0.2 | ns |
| DFFL | Negative Edge-Triggered D-type Flip-Flop (LH/HL) | | | | | | ns |
| | CLK-Q | LH[3] | 0.9 | | 1.1 | | |
| | | HL[3] | 0.8 | | 1.0 | | ns |
| | $t_{setup}$ | | | 0.6 | | 0.7 | ns |
| | $t_{hold}$ | | | 0.0 | | 0.0 | ns |

***Notes:***

1. *Intrinsic delays have a variable component, coupled to the input slope of the signal. These numbers assume an input slope typical of local interconnect.*
2. *All –F parts are only available as commercial.*
3. *LH and HL refer to the Q transitions from Low to High and High to Low, respectively.*

*Table 1-46* • **Recommended Operating Conditions**

| Parameter | Symbol | Limits | |
|---|---|---|---|
| | | Commercial/Industrial | Military/MIL-STD-883 |
| Maximum Clock Frequency* | $f_{CLOCK}$ | 180 MHz | 180 MHz |
| Maximum RAM Frequency* | $f_{RAM}$ | 150 MHz | 150 MHz |
| Maximum Rise/Fall Time on Inputs* | | | |
| • Schmitt Trigger Mode (10% to 90%) | $t_R/t_F$ | N/A | 100 ns |
| • Non-Schmitt Trigger Mode (10% to 90%) | $t_R/t_F$ | 100 ns | 10 ns |
| Maximum LVPECL Frequency* | | 180 MHz | 180 MHz |
| Maximum TCK Frequency (JTAG) | $f_{TCK}$ | 10 MHz | 10 MHz |

***Note:*** **All –F parts will be 20% slower than standard commercial devices.*

*Table 1-47* • **Slew Rates Measured at C = 30pF, Nominal Power Supplies and 25°C**

| Type | Trig. Level | Rising Edge (ns) | Slew Rate (V/ns) | Falling Edge (ns) | Slew Rate (V/ns) | PCI Mode |
|---|---|---|---|---|---|---|
| OB33PH | 10%-90% | 1.60 | 1.65 | 1.65 | 1.60 | Yes |
| OB33PN | 10%-90% | 1.57 | 1.68 | 3.32 | 0.80 | No |
| OB33PL | 10%-90% | 1.57 | 1.68 | 1.99 | 1.32 | No |
| OB33LH | 10%-90% | 3.80 | 0.70 | 4.84 | 0.55 | No |
| OB33LN | 10%-90% | 4.19 | 0.63 | 3.37 | 0.78 | No |
| OB33LL | 10%-90% | 5.49 | 0.48 | 2.98 | 0.89 | No |
| OB25LPHH | 10%-90% | 1.55 | 1.29 | 1.56 | 1.28 | No |
| OB25LPHN | 10%-90% | 1.70 | 1.18 | 2.08 | 0.96 | No |
| OB25LPHL | 10%-90% | 1.97 | 1.02 | 2.09 | 0.96 | No |
| OB25LPLH | 10%-90% | 3.57 | 0.56 | 3.93 | 0.51 | No |
| OB25LPLN | 10%-90% | 4.65 | 0.43 | 3.28 | 0.61 | No |
| OB25LPLL | 10%-90% | 5.52 | 0.36 | 3.44 | 0.58 | No |

***Notes:***

1. *Standard and –F parts.*
2. *All –F only available as commercial.*

*Table 1-48* • **JTAG Switching Characteristics**

| Description | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Output delay from TCK falling to TDI, TMS | $t_{TCKTDI}$ | –4 | 4 | ns |
| TDO Setup time before TCK rising | $t_{TDOTCK}$ | 10 | | ns |
| TDO Hold time after TCK rising | $t_{TCKTDO}$ | 0 | | ns |
| TCK period | $t_{TCK}$ | 100 [2] | 1,000 | ns |
| RCK period | $t_{RCK}$ | 100 | 1,000 | ns |

***Notes:***

1. *For DC electrical specifications of the JTAG pins (TCK, TDI, TMS, TDO, TRST), refer to Table 1-21 on page 1-36 when $V_{DDP}$ = 2.5 V and Table 1-22 on page 1-38 when $V_{DDP}$ = 3.3 V.*
2. *If RCK is being used, there is no minimum on the TCK period.*

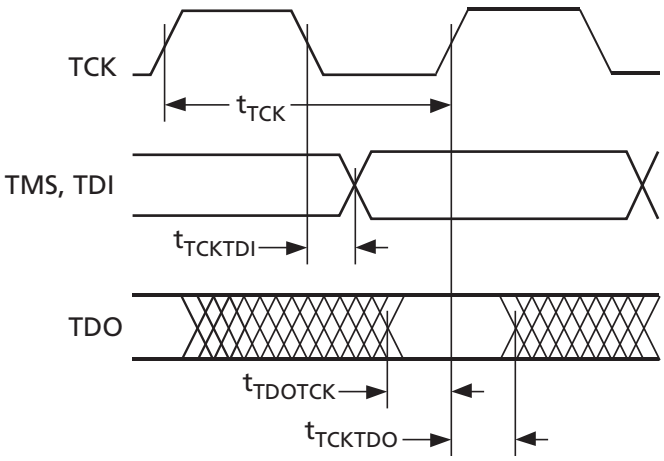



*Figure 1-30* • **JTAG Operation Timing**

# Embedded Memory Specifications

This section discusses ProASIC^PLUS SRAM/FIFO embedded memory and its interface signals, including timing diagrams that show the relationships of signals as they pertain to single embedded memory blocks (Table 1-49). Table 1-12 on page 1-23 shows basic SRAM and FIFO configurations. Simultaneous read and write to the same location must be done with care. On such accesses the DI bus is output to the DO bus. Refer to the *ProASIC^PLUS RAM and FIFO Blocks* application note for more information.

## Enclosed Timing Diagrams—SRAM Mode:

- "Synchronous SRAM Read, Access Timed Output Strobe (Synchronous Transparent)" section on page 1-55
- "Synchronous SRAM Read, Pipeline Mode Outputs (Synchronous Pipelined)" section on page 1-56
- "Asynchronous SRAM Write" section on page 1-57
- "Asynchronous SRAM Read, Address Controlled, RDB=0" section on page 1-58
- "Asynchronous SRAM Read, RDB Controlled" section on page 1-59
- "Synchronous SRAM Write"
- Embedded Memory Specifications

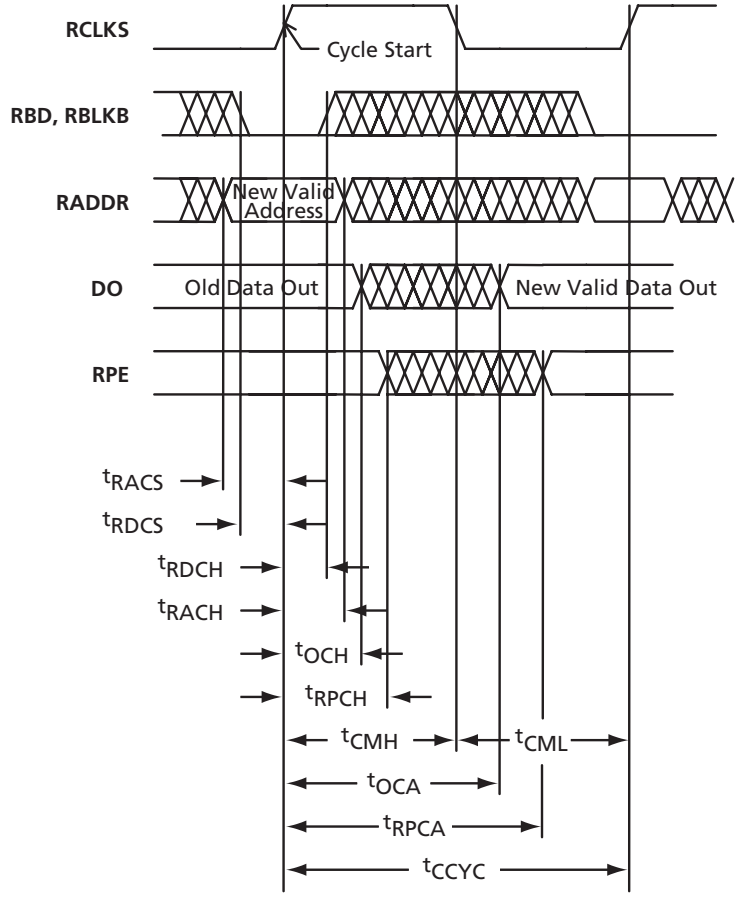
The difference between synchronous transparent and pipeline modes is the timing of all the output signals from the memory. In transparent mode, the outputs will change within the same clock cycle to reflect the data requested by the currently valid access to the memory. If clock cycles are short (high clock speed), the data requires most of the clock cycle to change to valid values (stable signals). Processing of this data in the same clock cycle is nearly impossible. Most designers add registers at all outputs of the memory to push the data processing into the next clock cycle. An entire clock cycle can then be used to process the data. To simplify use of this memory setup, suitable registers have been implemented as part of the memory primitive and are available to the user in the synchronous pipeline mode. In this mode, the output signals will change shortly after the second rising edge, following the initiation of the read access.

*Table 1-49* • **Memory Block SRAM Interface Signals**

| SRAM Signal | Bits | In/Out | Description |
|---|---|---|---|
| WCLKS | 1 | In | Write clock used on synchronization on write side |
| RCLKS | 1 | In | Read clock used on synchronization on read side |
| RADDR<0:7> | 8 | In | Read address |
| RBLKB | 1 | In | True read block select (active Low) |
| RDB | 1 | In | True read pulse (active Low) |
| WADDR<0:7> | 8 | In | Write address |
| WBLKB | 1 | In | Write block select (active Low) |
| DI<0:8> | 9 | In | Input data bits <0:8>, <8> can be used for parity In |
| WRB | 1 | In | Negative true write pulse |
| DO<0:8> | 9 | Out | Output data bits <0:8>, <8> can be used for parity Out |
| RPE | 1 | Out | Read parity error (active High) |
| WPE | 1 | Out | Write parity error (active High) |
| PARODD | 1 | In | Selects Odd parity generation/detect when high, Even when low |

***Note:*** *Not all signals shown are used in all modes.*

## Synchronous SRAM Read, Access Timed Output Strobe (Synchronous Transparent)




***Note:*** *The plot shows the normal operation status.*

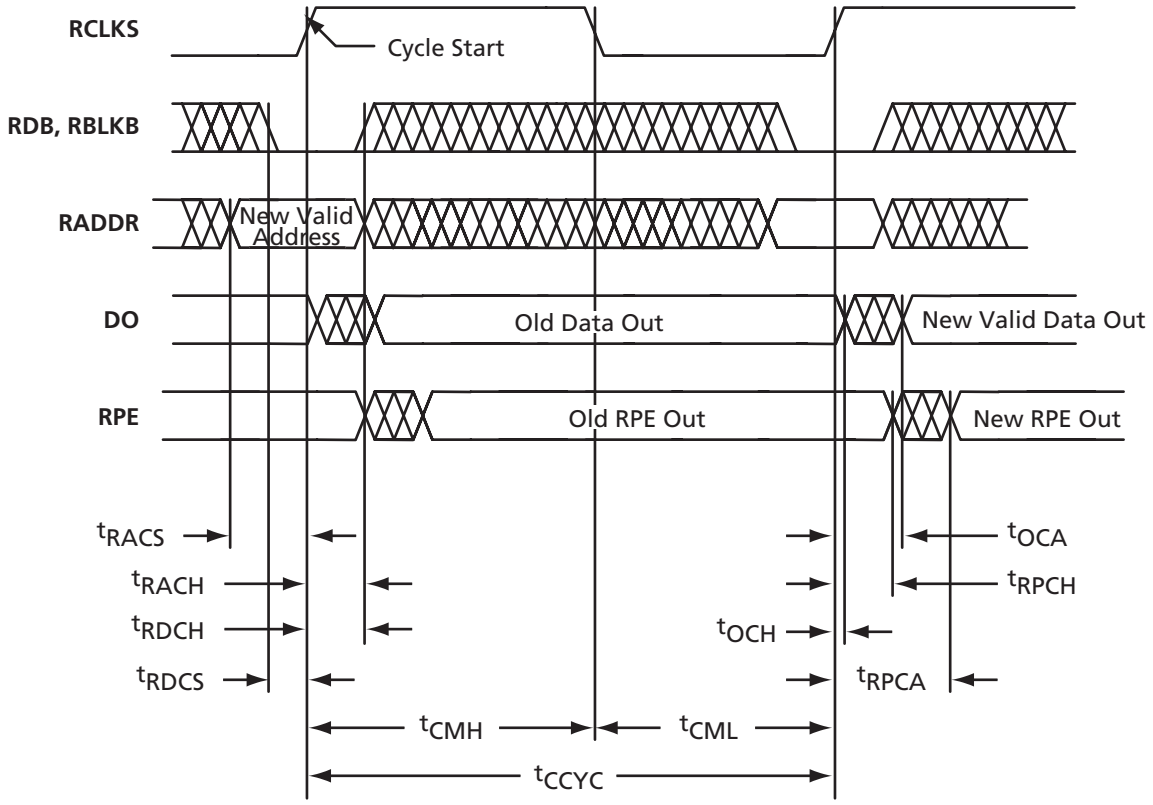
*Figure 1-31* • **Synchronous SRAM Read, Access Timed Output Strobe (Synchronous Transparent)**

*Table 1-50* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| OCA | New DO access from RCLKS ↑ | 7.5 | | ns | |
| OCH | Old DO valid from RCLKS ↑ | | 3.0 | ns | |
| RACH | RADDR hold from RCLKS ↑ | 0.5 | | ns | |
| RACS | RADDR setup to RCLKS ↑ | 1.0 | | ns | |
| RDCH | RDB hold from RCLKS ↑ | 0.5 | | ns | |
| RDCS | RDB setup to RCLKS ↑ | 1.0 | | ns | |
| RPCA | New RPE access from RCLKS ↑ | 9.5 | | ns | |
| RPCH | Old RPE valid from RCLKS ↑ | | 3.0 | ns | |

***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

## Synchronous SRAM Read, Pipeline Mode Outputs (Synchronous Pipelined)




***Note:*** *The plot shows the normal operation status.*

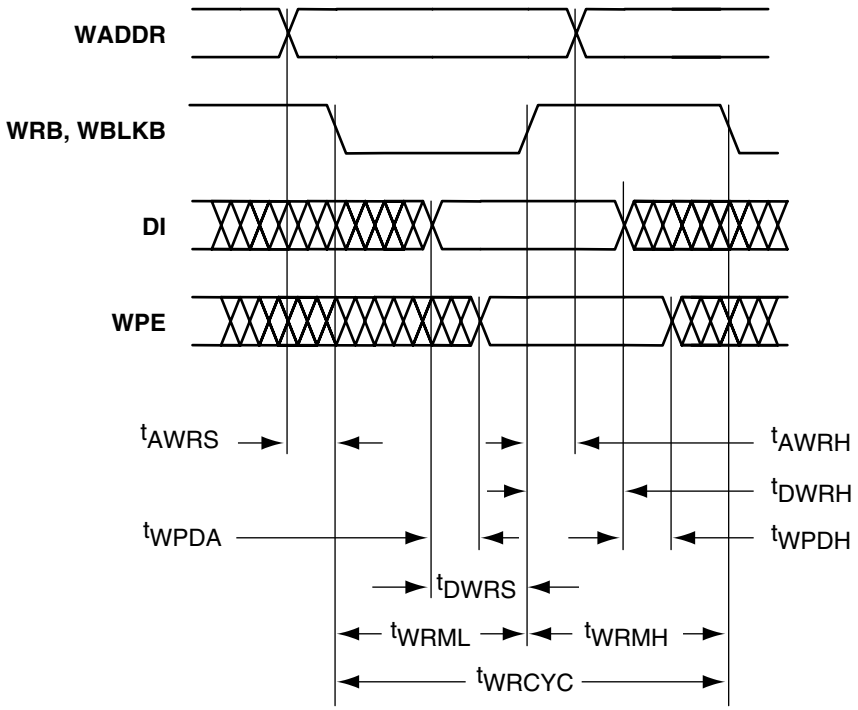
*Figure 1-32* • **Synchronous SRAM Read, Pipeline Mode Outputs (Synchronous Pipelined)**

*Table 1-51* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = 0°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| OCA | New DO access from RCLKS ↑ | 2.0 | | ns | |
| OCH | Old DO valid from RCLKS ↑ | | 0.75 | ns | |
| RACH | RADDR hold from RCLKS ↑ | 0.5 | | ns | |
| RACS | RADDR setup to RCLKS ↑ | 1.0 | | ns | |
| RDCH | RDB hold from RCLKS ↑ | 0.5 | | ns | |
| RDCS | RDB setup to RCLKS ↑ | 1.0 | | ns | |
| RPCA | New RPE access from RCLKS ↑ | 4.0 | | ns | |
| RPCH | Old RPE valid from RCLKS ↑ | | 1.0 | ns | |

***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous SRAM Write




***Note:*** *The plot shows the normal operation status.*

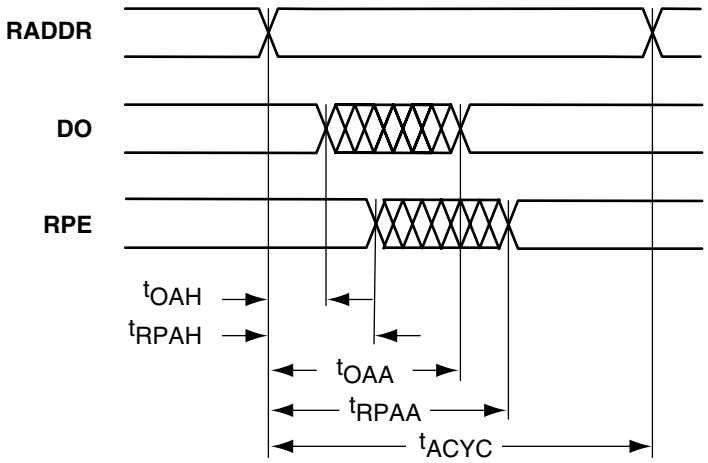
*Figure 1-33* • **Asynchronous SRAM Write**

*Table 1-52* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883B**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| AWRH | WADDR hold from WB ↑ | 1.0 | | ns | |
| AWRS | WADDR setup to WB ↓ | 0.5 | | ns | |
| DWRH | DI hold from WB ↑ | 1.5 | | ns | |
| DWRS | DI setup to WB ↑ | 0.5 | | ns | PARGEN is inactive. |
| DWRS | DI setup to WB ↑ | 2.5 | | ns | PARGEN is active. |
| WPDA | WPE access from DI | 3.0 | | ns | WPE is invalid, while PARGEN is active. |
| WPDH | WPE hold from DI | | 1.0 | ns | |
| WRCYC | Cycle time | 7.5 | | ns | |
| WRMH | WB high phase | 3.0 | | ns | Inactive |
| WRML | WB low phase | 3.0 | | ns | Active |

***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous SRAM Read, Address Controlled, RDB=0




***Note:*** *The plot shows the normal operation status.*

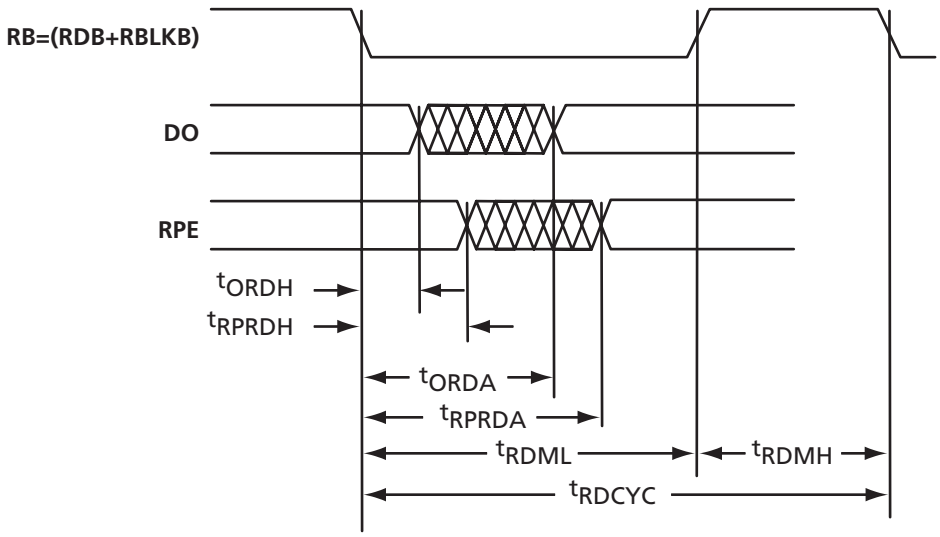
*Figure 1-34* • **Asynchronous SRAM Read, Address Controlled, RDB=0**

*Table 1-53* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883B**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| ACYC | Read cycle time | 7.5 | | ns | |
| OAA | New DO access from RADDR stable | 7.5 | | ns | |
| OAH | Old DO hold from RADDR stable | | 3.0 | ns | |
| RPAA | New RPE access from RADDR stable | 10.0 | | ns | |
| RPAH | Old RPE hold from RADDR stable | | 3.0 | ns | |

***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous SRAM Read, RDB Controlled




***Note:*** *The plot shows the normal operation status.*

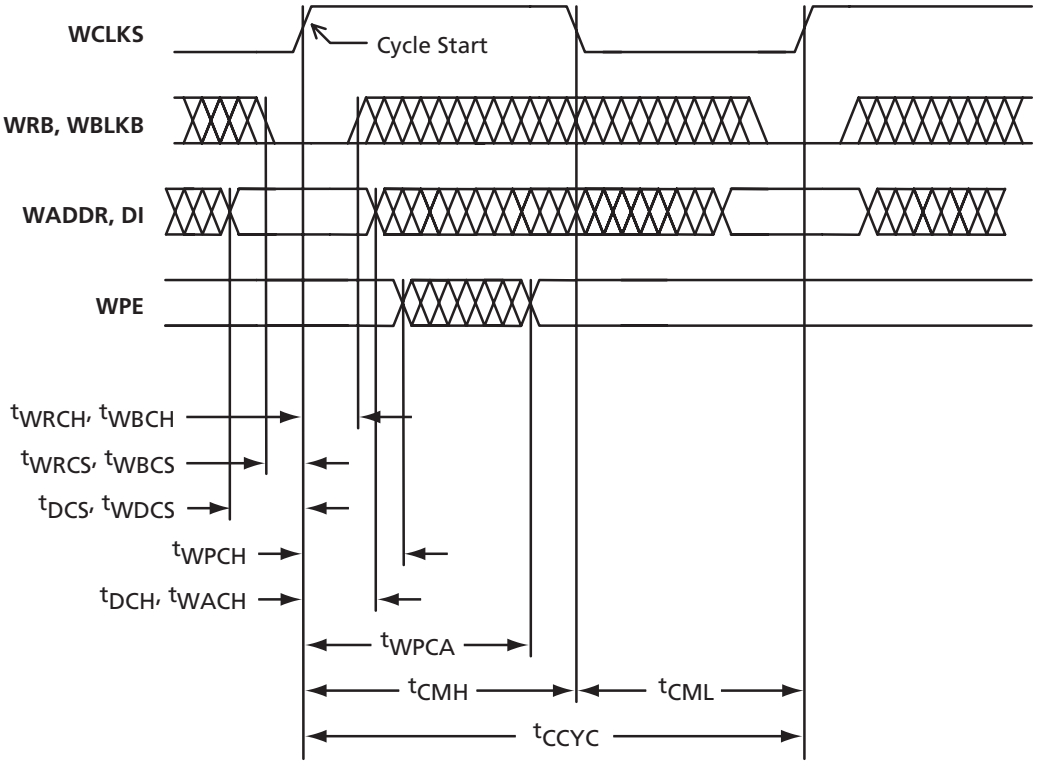
*Figure 1-35* • **Asynchronous SRAM Read, RDB Controlled**

*Table 1-54* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| ORDA | New DO access from RB ↓ | 7.5 | | ns | |
| ORDH | Old DO valid from RB ↓ | | 3.0 | ns | |
| RDCYC | Read cycle time | 7.5 | | ns | |
| RDMH | RB high phase | 3.0 | | ns | Inactive setup to new cycle |
| RDML | RB low phase | 3.0 | | ns | Active |
| RPRDA | New RPE access from RB ↓ | 9.5 | | ns | |
| RPRDH | Old RPE valid from RB ↓ | | 3.0 | ns | |

***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

## Synchronous SRAM Write




***Note:*** *The plot shows the normal operation status.*

*Figure 1-36* • **Synchronous SRAM Write**

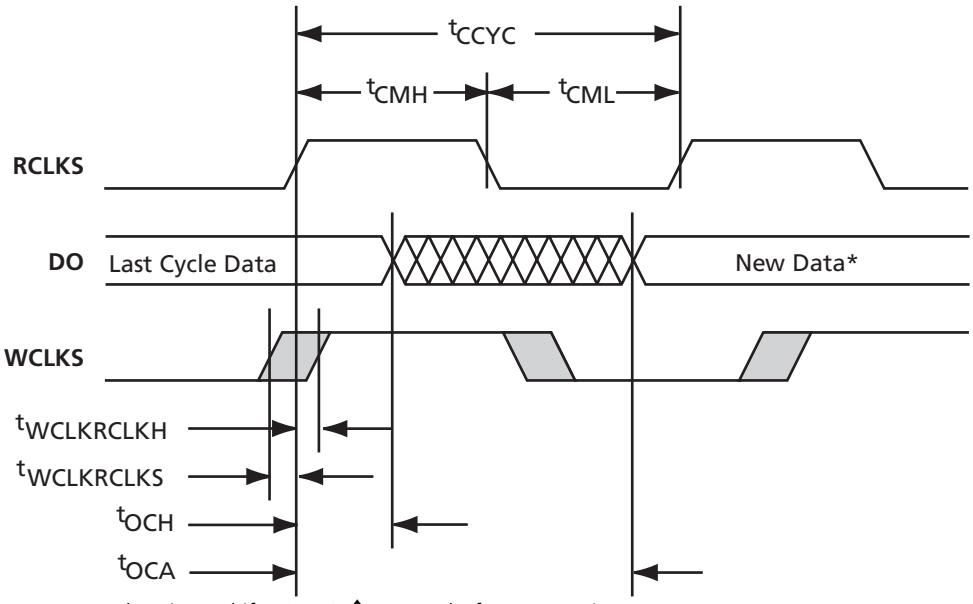
*Table 1-55* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| DCH | DI hold from WCLKS ↑ | 0.5 | | ns | |
| DCS | DI setup to WCLKS ↑ | 1.0 | | ns | |
| WACH | WADDR hold from WCLKS ↑ | 0.5 | | ns | |
| WDCS | WADDR setup to WCLKS ↑ | 1.0 | | ns | |
| WPCA | New WPE access from WCLKS ↑ | 3.0 | | ns | WPE is invalid while PARGEN is active |
| WPCH | Old WPE valid from WCLKS ↑ | | 0.5 | ns | |
| WRCH, WBCH | WRB & WBLKB hold from WCLKS ↑ | 0.5 | | ns | |
| WRCS, WBCS | WRB & WBLKB setup to WCLKS ↑ | 1.0 | | ns | |

***Notes:***

1. *On simultaneous read and write accesses to the same location, DI is output to DO.*
2. *All –F speed grade devices are 20% slower than the standard numbers.*

## Synchronous Write and Read to the Same Location




***Note:*** *The plot shows the normal operation status.*

*Figure 1-37* • **Synchronous Write and Read to the Same Location**

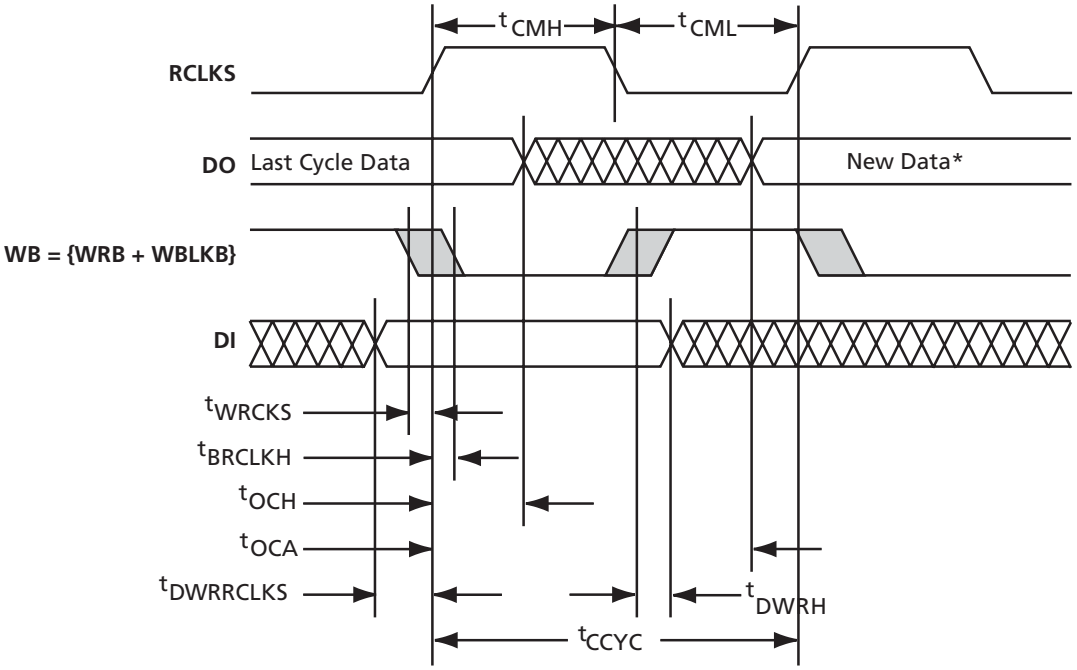
*Table 1-56* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| WCLKRCLKS | WCLKS ↑ to RCLKS ↑ setup time | – 0.1 | | ns | |
| WCLKRCLKH | WCLKS ↑ to RCLKS ↑ hold time | | 7.0 | ns | |
| OCH | Old DO valid from RCLKS ↑ | | 3.0 | ns | OCA/OCH displayed for Access Timed Output |
| OCA | New DO valid from RCLKS ↑ | 7.5 | | ns | |

***Notes:***

1. *This behavior is valid for Access Timed Output and Pipelined Mode Output. The table shows the timings of an Access Timed Output.*
2. *During synchronous write and synchronous read access to the same location, the new write data will be read out if the active write clock edge occurs before or at the same time as the active read clock edge. The negative setup time insures this behavior for WCLKS and RCLKS driven by the same design signal.*
3. *If WCLKS changes after the hold time, the data will be read.*
4. *A setup or hold time violation will result in unknown output data.*
5. *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous Write and Synchronous Read to the Same Location




* New data is read if WB ↓ occurs before setup time.
The stored data is read if WB ↓ occurs after hold time.

***Note:*** *The plot shows the normal operation status.*

*Figure 1-38* • **Asynchronous Write and Synchronous Read to the Same Location**

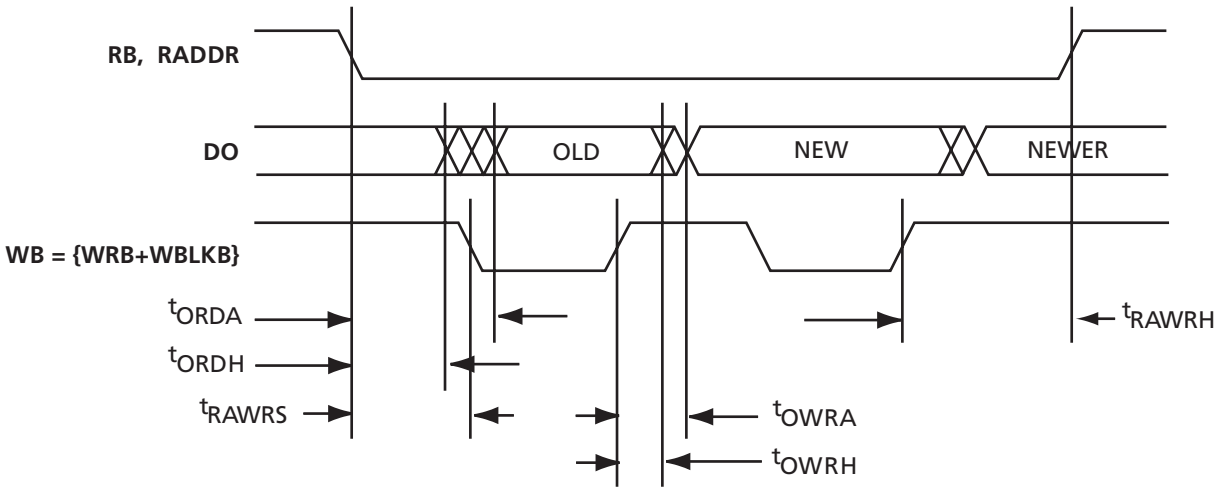
*Table 1-57* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| WBRCLKS | WB ↓ to RCLKS ↑ setup time | –0.1 | | ns | |
| WBRCLKH | WB ↓ to RCLKS ↑ hold time | | 7.0 | ns | |
| OCH | Old DO valid from RCLKS ↑ | | 3.0 | ns | OCA/OCH displayed for Access Timed Output |
| OCA | New DO valid from RCLKS ↑ | 7.5 | | ns | |
| DWRRCLKS | DI to RCLKS ↑ setup time | 0 | | ns | |
| DWRH | DI to WB ↑ hold time | | 1.5 | ns | |

***Notes:***

1. *This behavior is valid for Access Timed Output and Pipelined Mode Output. The table shows the timings of an Access Timed Output.*
2. *In asynchronous write and synchronous read access to the same location, the new write data will be read out if the active write signal edge occurs before or at the same time as the active read clock edge. If WB changes to low after hold time, the data will be read.*
3. *A setup or hold time violation will result in unknown output data.*
4. *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous Write and Read to the Same Location




***Note:*** *The plot shows the normal operation status.*

*Figure 1-39* • **Asynchronous Write and Read to the Same Location**

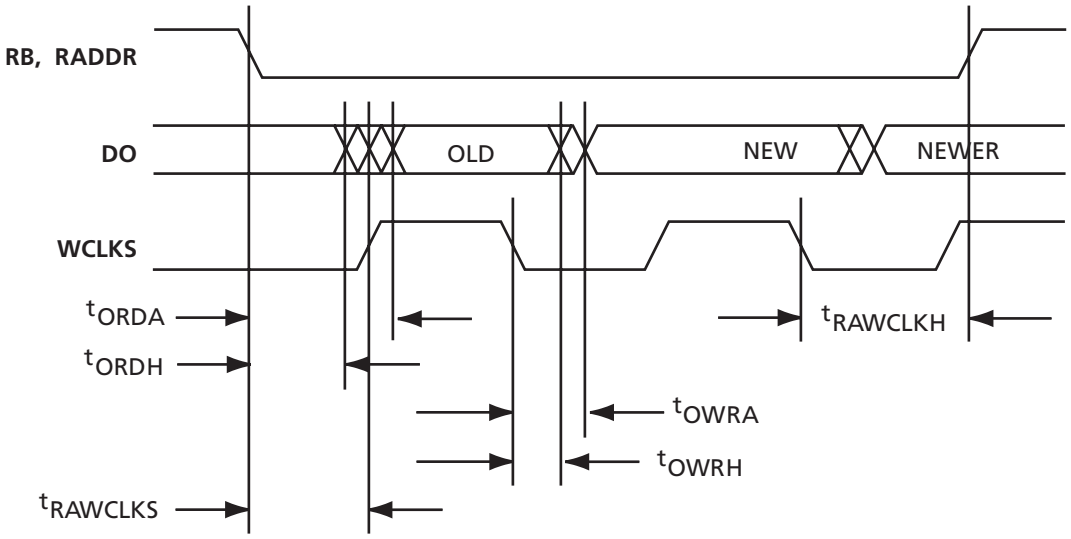
*Table 1-58* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| ORDA | New DO access from RB ↓ | 7.5 | | ns | |
| ORDH | Old DO valid from RB ↓ | | 3.0 | ns | |
| OWRA | New DO access from WB ↑ | 3.0 | | ns | |
| OWRH | Old DO valid from WB ↑ | | 0.5 | ns | |
| RAWRS | RB ↓ or RADDR from WB ↓ | 5.0 | | ns | |
| RAWRH | RB ↑ or RADDR from WB ↑ | 5.0 | | ns | |

***Notes:***

1. *During an asynchronous read cycle, each write operation (synchronous or asynchronous) to the same location will automatically trigger a read operation which updates the read data. Refer to the ProASIC^PLUS RAM and FIFO Blocks application note for more information.*
2. *Violation or RAWRS will disturb access to the OLD data.*
3. *Violation of RAWRH will disturb access to the NEWER data.*
4. *All –F speed grade devices are 20% slower than the standard numbers.*

## Synchronous Write and Asynchronous Read to the Same Location




***Note:*** *The plot shows the normal operation status.*

*Figure 1-40* • **Synchronous Write and Asynchronous Read to the Same Location**

*Table 1-59* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| ORDA | New DO access from RB ↓ | 7.5 | | ns | |
| ORDH | Old DO valid from RB ↓ | | 3.0 | ns | |
| OWRA | New DO access from WCLKS ↓ | 3.0 | | ns | |
| OWRH | Old DO valid from WCLKS ↓ | | 0.5 | ns | |
| RAWCLKS | RB ↓ or RADDR from WCLKS ↑ | 5.0 | | ns | |
| RAWCLKH | RB ↑ or RADDR from WCLKS ↓ | 5.0 | | ns | |

***Notes:***

1. *During an asynchronous read cycle, each write operation (synchronous or asynchronous) to the same location will automatically trigger a read operation which updates the read data.*
2. *Violation of RAWCLKS will disturb access to OLD data.*
3. *Violation of RAWCLKH will disturb access to NEWER data.*
4. *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous FIFO Full and Empty Transitions

The asynchronous FIFO accepts writes and reads while not full or not empty. When the FIFO is full, all writes are inhibited. Conversely, when the FIFO is empty, all reads are inhibited. A problem is created if the FIFO is written to during the transition from full to not full, or read during the transition from empty to not empty. The exact time at which the write or read operation changes from inhibited to accepted after the read (write) signal which causes the transition from full or empty to not full or not empty is indeterminate. For slow cycles, this indeterminate period starts 1 ns after the RB (WB) transition, which deactivates full or not empty and ends 3 ns after the RB (WB) transition. For fast cycles, the indeterminate period ends 3 ns (7.5 ns – RDL (WRL)) after the RB (WB) transition, whichever is later (Table 1-1 on page 1-7).

The timing diagram for write is shown in Figure 1-38 on page 1-62. The timing diagram for read is shown in Figure 1-39 on page 1-63. For basic SRAM configurations, see Table 1-13 on page 1-24. When reset is asserted, the empty flag will be asserted, the counters will reset, the outputs go to zero, but the internal RAM is not erased.

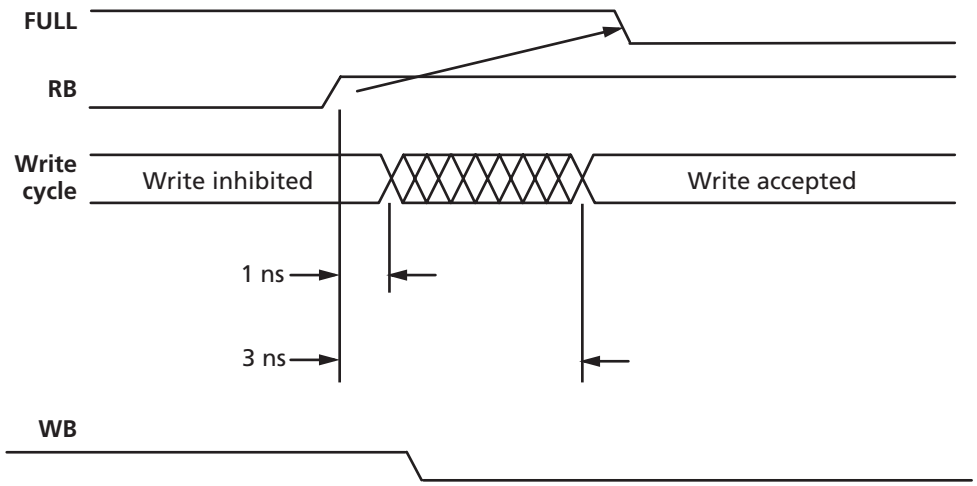
### Enclosed Timing Diagrams – FIFO Mode:

- "Asynchronous FIFO Read" section on page 1-67
- "Asynchronous FIFO Write" section on page 1-68
- "Synchronous FIFO Read, Access Timed Output Strobe (Synchronous Transparent)" section on page 1-69
- "Synchronous FIFO Read, Pipeline Mode Outputs (Synchronous Pipelined)" section on page 1-70
- "Synchronous FIFO Write" section on page 1-71
- "FIFO Reset" section on page 1-72

*Table 1-60* • **Memory Block FIFO Interface Signals**

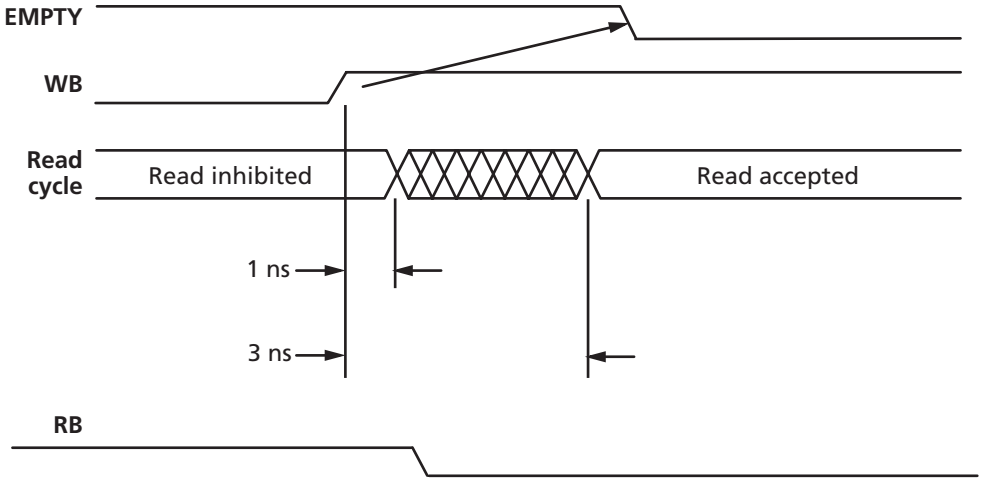
| FIFO Signal | Bits | In/Out | Description |
|---|---|---|---|
| WCLKS | 1 | In | Write clock used for synchronization on write side |
| RCLKS | 1 | In | Read clock used for synchronization on read side |
| LEVEL <0:7>* | 8 | In | Direct configuration implements static flag logic |
| RBLKB | 1 | In | Read block select (active Low) |
| RDB | 1 | In | Read pulse (active Low) |
| RESET | 1 | In | Reset for FIFO pointers (active Low) |
| WBLKB | 1 | In | Write block select (active Low) |
| DI<0:8> | 9 | In | Input data bits <0:8>, <8> will be generated if PARGEN is true |
| WRB | 1 | In | Write pulse (active Low) |
| FULL, EMPTY | 2 | Out | FIFO flags. FULL prevents write and EMPTY prevents read |
| EQTH, GEQTH* | 2 | Out | EQTH is true when the FIFO holds the number of words specified by the LEVEL signal. GEQTH is true when the FIFO holds (LEVEL) words or more |
| DO<0:8> | 9 | Out | Output data bits <0:8> |
| RPE | 1 | Out | Read parity error (active High) |
| WPE | 1 | Out | Write parity error (active High) |
| LGDEP <0:2> | 3 | In | Configures DEPTH of the FIFO to $2^{(LGDEP+1)}$ |
| PARODD | 1 | In | Selects Odd parity generation/detect when high, Even when low |

***Note:*** **LEVEL is always eight bits (0000.0000, 0000.0001). That means for values of DEPTH greater than 256, not all values will be possible, e.g. for DEPTH=512, the LEVEL can only have the values 2, 4, . . ., 512. The LEVEL signal circuit will generate signals that indicate whether the FIFO is exactly filled to the value of LEVEL (EQTH) or filled equal or higher (GEQTH) than the specified LEVEL. Since counting starts at 0, EQTH will become true when the FIFO holds (LEVEL+1) words for 512-bit FIFOs.*




***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

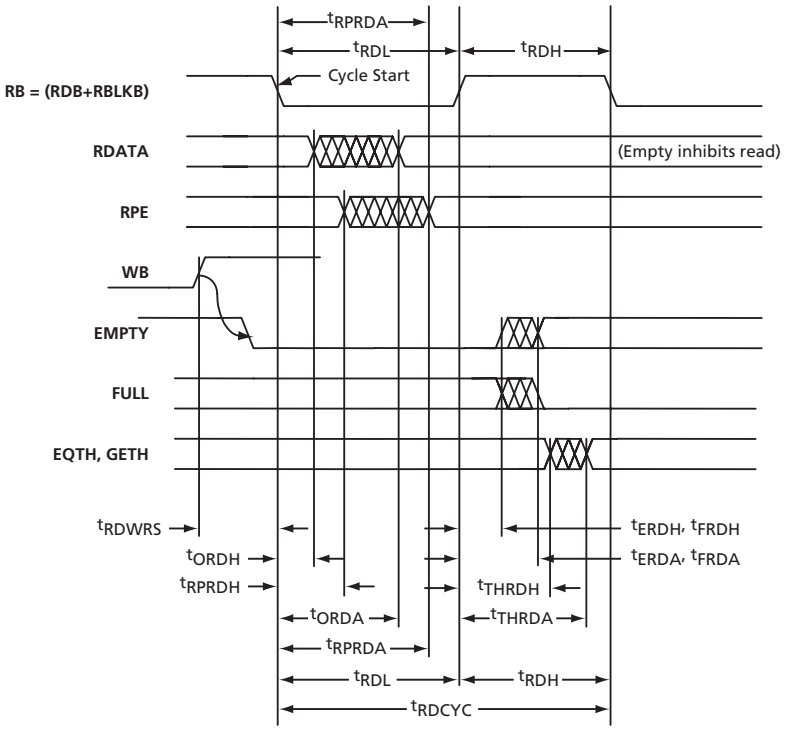
*Figure 1-41* • **Write Timing Diagram**




***Note:*** *All –F speed grade devices are 20% slower than the standard numbers.*

*Figure 1-42* • **Read Timing Diagram**

## Asynchronous FIFO Read




***Note:*** *The plot shows the normal operation status.*

*Figure 1-43* • **Asynchronous FIFO Read**

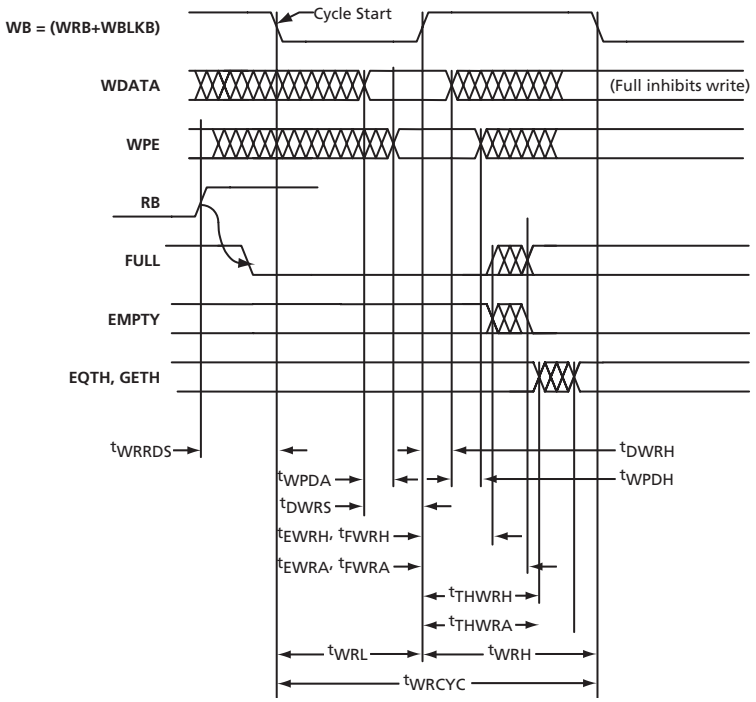
*Table 1-61* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| ERDH, FRDH, THRDH | Old EMPTY, FULL, EQTH, & GETH valid hold time from RB ↑ | | 0.5 | ns | Empty/full/thresh are invalid from the end of hold until the new access is complete |
| ERDA | New EMPTY access from RB ↑ | 3.0[1] | | ns | |
| FRDA | FULL↓ access from RB ↑ | 3.0[1] | | ns | |
| ORDA | New DO access from RB ↓ | 7.5 | | ns | |
| ORDH | Old DO valid from RB ↓ | | 3.0 | ns | |
| RDCYC | Read cycle time | 7.5 | | ns | |
| RDWRS | WB ↑, clearing EMPTY, setup to RB ↓ | 3.0[2] | | ns | Enabling the read operation |
| | | | 1.0 | ns | Inhibiting the read operation |
| RDH | RB high phase | 3.0 | | ns | Inactive |
| RDL | RB low phase | 3.0 | | ns | Active |
| RPRDA | New RPE access from RB ↓ | 9.5 | | ns | |
| RPRDH | Old RPE valid from RB ↓ | | 4.0 | ns | |
| THRDA | EQTH or GETH access from RB↑ | 4.5 | | ns | |

***Notes:***

1. *At fast cycles, ERDA and FRDA = MAX (7.5 ns – RDL), 3.0 ns.*
2. *At fast cycles, RDWRS (for enabling read) = MAX (7.5 ns – WRL), 3.0 ns.*
3. *All –F speed grade devices are 20% slower than the standard numbers.*

## Asynchronous FIFO Write




***Note:*** *The plot shows the normal operation status.*

*Figure 1-44* • **Asynchronous FIFO Write**

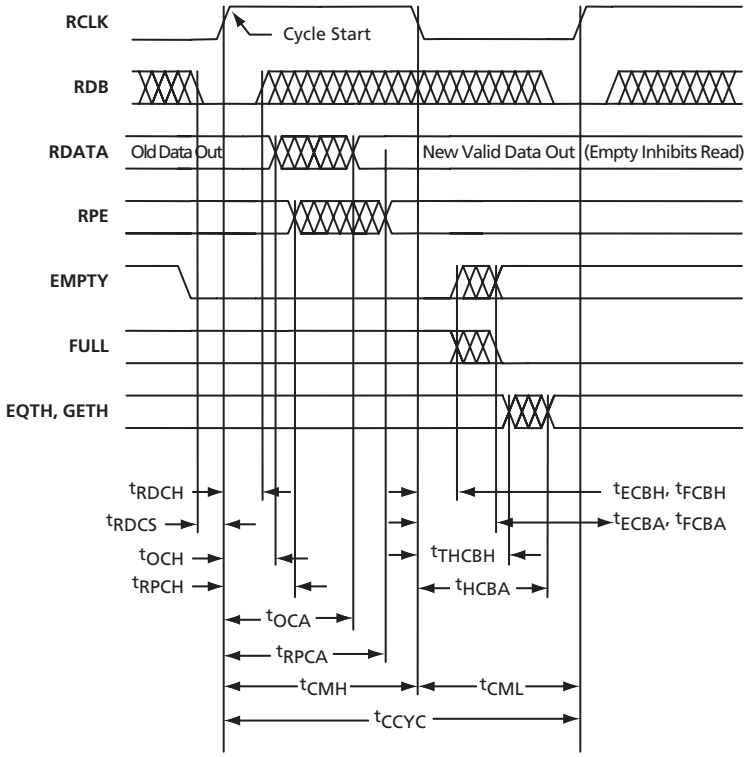
*Table 1-62* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| DWRH | DI hold from WB ↑ | 1.5 | | ns | |
| DWRS | DI setup to WB ↑ | 0.5 | | ns | PARGEN is inactive |
| DWRS | DI setup to WB ↑ | 2.5 | | ns | PARGEN is active |
| EWRH, FWRH, THWRH | Old EMPTY, FULL, EQTH, & GETH valid hold time after WB ↑ | | 0.5 | ns | Empty/full/thresh are invalid from the end of hold until the new access is complete |
| EWRA | EMPTY ↓ access from WB ↑ | 3.0[1] | | ns | |
| FWRA | New FULL access from WB ↑ | 3.0[1] | | ns | |
| THWRA | EQTH or GETH access from WB ↑ | 4.5 | | ns | |
| WPDA | WPE access from DI | 3.0 | | ns | WPE is invalid while PARGEN is active |
| WPDH | WPE hold from DI | | 1.0 | ns | |
| WRCYC | Cycle time | 7.5 | | ns | |
| WRRDS | RB ↑, clearing FULL, setup to WB ↓ | 3.0[2] | | ns | Enabling the write operation |
| | | | 1.0 | | Inhibiting the write operation |
| WRH | WB high phase | 3.0 | | ns | Inactive |
| WRL | WB low phase | 3.0 | | ns | Active |

***Notes:***

1. *At fast cycles, EWRA, FWRA = MAX (7.5 ns – WRL), 3.0 ns.*
2. *At fast cycles, WRRDS (for enabling write) = MAX (7.5 ns – RDL), 3.0 ns.*
3. *All –F speed grade devices are 20% slower than the standard numbers.*
4. *After FIFO reset, WRB needs an initial falling edge prior to any write actions.*

## Synchronous FIFO Read, Access Timed Output Strobe (Synchronous Transparent)




***Note:*** *The plot shows the normal operation status.*

*Figure 1-45* • **Synchronous FIFO Read, Access Timed Output Strobe (Synchronous Transparent)**

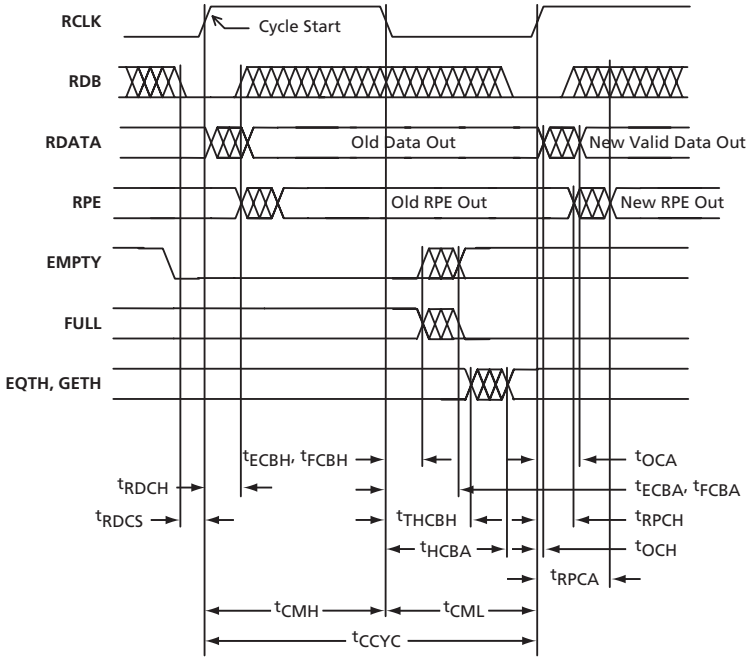
*Table 1-63* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| ECBA | New EMPTY access from RCLKS ↓ | 3.0[1] | | ns | |
| FCBA | FULL ↓ access from RCLKS ↓ | 3.0[1] | | ns | |
| ECBH, FCBH, THCBH | Old EMPTY, FULL, EQTH, & GETH valid hold time from RCLKS ↓ | | 1.0 | ns | Empty/full/thresh are invalid from the end of hold until the new access is complete |
| OCA | New DO access from RCLKS ↑ | 7.5 | | ns | |
| OCH | Old DO valid from RCLKS ↑ | | 3.0 | ns | |
| RDCH | RDB hold from RCLKS ↑ | 0.5 | | ns | |
| RDCS | RDB setup to RCLKS ↑ | 1.0 | | ns | |
| RPCA | New RPE access from RCLKS ↑ | 9.5 | | ns | |
| RPCH | Old RPE valid from RCLKS ↑ | | 3.0 | ns | |
| HCBA | EQTH or GETH access from RCLKS ↓ | 4.5 | | ns | |

***Notes:***

1. *At fast cycles, ECBA and FCBA = MAX (7.5 ns – CMH), 3.0 ns.*
2. *All –F speed grade devices are 20% slower than the standard numbers.*

## Synchronous FIFO Read, Pipeline Mode Outputs (Synchronous Pipelined)




***Note:*** *The plot shows the normal operation status.*

*Figure 1-46* • **Synchronous FIFO Read, Pipeline Mode Outputs (Synchronous Pipelined)**

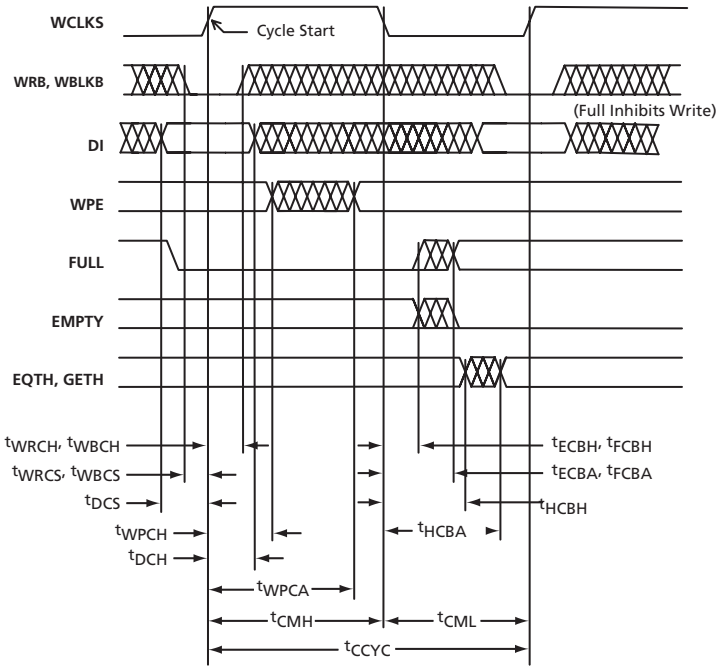
*Table 1-64* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| ECBA | New EMPTY access from RCLKS ↓ | 3.0[1] | | ns | |
| FCBA | FULL ↓ access from RCLKS ↓ | 3.0[1] | | ns | |
| ECBH, FCBH, THCBH | Old EMPTY, FULL, EQTH, & GETH valid hold time from RCLKS ↓ | | 1.0 | ns | Empty/full/thresh are invalid from the end of hold until the new access is complete |
| OCA | New DO access from RCLKS ↑ | 2.0 | | ns | |
| OCH | Old DO valid from RCLKS ↑ | | 0.75 | ns | |
| RDCH | RDB hold from RCLKS ↑ | 0.5 | | ns | |
| RDCS | RDB setup to RCLKS ↑ | 1.0 | | ns | |
| RPCA | New RPE access from RCLKS ↑ | 4.0 | | ns | |
| RPCH | Old RPE valid from RCLKS ↑ | | 1.0 | ns | |
| HCBA | EQTH or GETH access from RCLKS ↓ | 4.5 | | ns | |

***Notes:***

1. *At fast cycles, ECBA and FCBA = MAX (7.5 ns – CMS), 3.0 ns.*
2. *All –F speed grade devices are 20% slower than the standard numbers.*

## Synchronous FIFO Write




***Note:*** *The plot shows the normal operation status.*

*Figure 1-47* • **Synchronous FIFO Write**

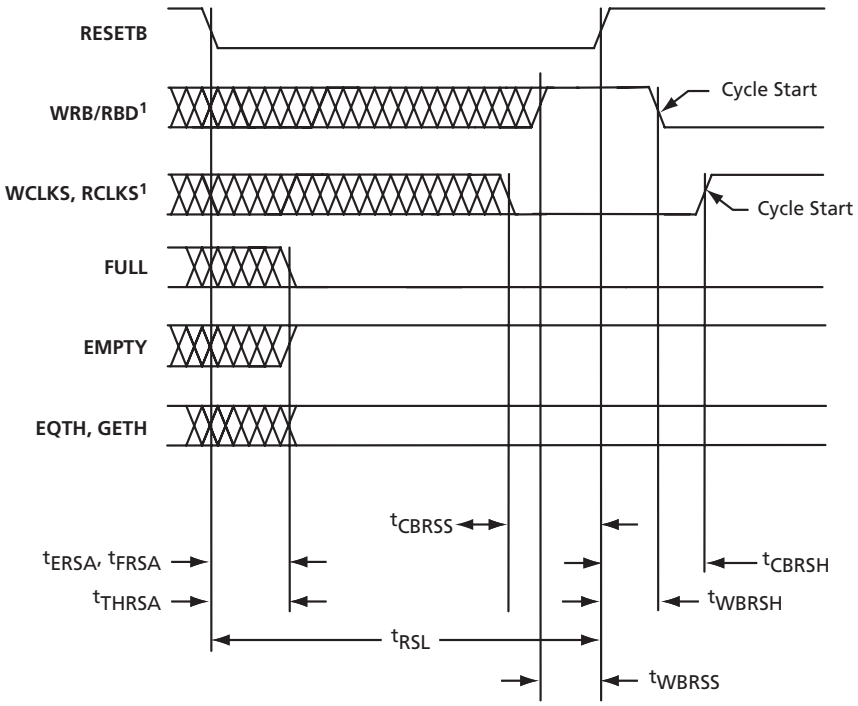
*Table 1-65* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CCYC | Cycle time | 7.5 | | ns | |
| CMH | Clock high phase | 3.0 | | ns | |
| CML | Clock low phase | 3.0 | | ns | |
| DCH | DI hold from WCLKS ↑ | 0.5 | | ns | |
| DCS | DI setup to WCLKS ↑ | 1.0 | | ns | |
| FCBA | New FULL access from WCLKS ↓ | 3.0[1] | | ns | |
| ECBA | EMPTY↓ access from WCLKS ↓ | 3.0[1] | | ns | |
| ECBH, FCBH, HCBH | Old EMPTY, FULL, EQTH, & GETH valid hold time from WCLKS ↓ | | 1.0 | ns | Empty/full/thresh are invalid from the end of hold until the new access is complete |
| HCBA | EQTH or GETH access from WCLKS ↓ | 4.5 | | ns | |
| WPCA | New WPE access from WCLKS ↑ | 3.0 | | ns | WPE is invalid, while PARGEN is active |
| WPCH | Old WPE valid from WCLKS ↑ | | 0.5 | ns | |
| WRCH, WBCH | WRB & WBLKB hold from WCLKS ↑ | 0.5 | | ns | |
| WRCS, WBCS | WRB & WBLKB setup to WCLKS ↑ | 1.0 | | ns | |

***Notes:***

1. *At fast cycles, ECBA and FCBA = MAX (7.5 ns – CMH), 3.0 ns.*
2. *All –F speed grade devices are 20% slower than the standard numbers.*

## FIFO Reset




***Notes:***

1. *During rest, the enables (WRB and RBD) must be high OR the clocks (WCLKS and RCKLS) must be low.*
2. *The plot shows the normal operation status.*

*Figure 1-48* • **FIFO Reset**

*Table 1-66* • **$T_J$ = 0°C to 110°C; $V_{DD}$ = 2.3 V to 2.7 V for Commercial/industrial**
**$T_J$ = –55°C to 150°C, $V_{DD}$ = 2.3 V to 2.7 V for Military/MIL-STD-883**

| Symbol $t_{xxx}$ | Description | Min. | Max. | Units | Notes |
|---|---|---|---|---|---|
| CBRSH[1] | WCLKS or RCLKS ↑ hold from RESETB ↑ | 1.5 | | ns | Synchronous mode only |
| CBRSS[1] | WCLKS or RCLKS ↓ setup to RESETB ↑ | 1.5 | | ns | Synchronous mode only |
| ERSA | New EMPTY ↑ access from RESETB ↓ | 3.0 | | ns | |
| FRSA | FULL ↓ access from RESETB ↓ | 3.0 | | ns | |
| RSL | RESETB low phase | 7.5 | | ns | |
| THRSA | EQTH or GETH access from RESETB ↓ | 4.5 | | ns | |
| WBRSH[1] | WB ↓ hold from RESETB ↑ | 1.5 | | ns | Asynchronous mode only |
| WBRSS[1] | WB ↑ setup to RESETB ↑ | 1.5 | | ns | Asynchronous mode only |

***Notes:***

1. *During rest, the enables (WRB and RBD) must be high OR the clocks (WCLKS and RCKLS) must be low.*
2. *All –F speed grade devices are 20% slower than the standard numbers.*

# Pin Description

## 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 standard LVTTL and LVCMOS specifications. Unused I/O pins are configured as inputs with pull-up resistors.

**NC** **No Connect**

To maintain compatibility with other Actel ProASIC^PLUS products, it is recommended that this pin not be connected to the circuitry on the board.

**GL** **Global Pin**

Low skew input pin for clock or other global signals. This pin can be configured with an internal pull-up resistor. When it is not connected to the global network or the clock conditioning circuit, it can be configured and used as a normal I/O.

**GLMX** **Global Multiplexing Pin**

Low skew input pin for clock or other global signals. This pin can be used in one of two special ways (refer to Actel's *Using ProASIC^PLUS Clock Conditioning Circuits*).

When the external feedback option is selected for the PLL block, this pin is routed as the external feedback source to the clock conditioning circuit.

In applications where two different signals access the same global net at different times through the use of GLMXx and GLMXLx macros, this pin will be fixed as one of the source pins.

This pin can be configured with an internal pull-up resistor. When it is not connected to the global network or the clock conditioning circuit, it can be configured and used as any normal I/O. If not used, the GLMXx pin will be configured as an input with pull-up.

## Dedicated Pins

**GND** **Ground**

Common ground supply voltage.

**$V_{DD}$** **Logic Array Power Supply Pin**

2.5 V supply voltage.

**$V_{DDP}$** **I/O Pad Power Supply Pin**

2.5 V or 3.3 V supply voltage.

**TMS** **Test Mode Select**

The TMS pin controls the use of boundary-scan circuitry. This pin has an internal pull-up resistor.

**TCK** **Test Clock**

Clock input pin for boundary scan (maximum 10 MHz). Actel recommends adding a nominal 20 kΩ pull-up resistor to this pin.

**TDI** **Test Data In**

Serial input for boundary scan. A dedicated pull-up resistor is included to pull this pin high when not being driven.

**TDO** **Test Data Out**

Serial output for boundary scan. Actel recommends adding a nominal 20kΩ pull-up resistor to this pin.

**TRST** **Test Reset Input**

Asynchronous, active-low input pin for resetting boundary-scan circuitry. This pin has an internal pull-up resistor. For more information, please refer to *Power-up Behavior of ProASIC^PLUS Devices* application note.

## Special Function Pins

**RCK** **Running Clock**

A free running clock is needed during programming if the programmer cannot guarantee that TCK will be uninterrupted. If not used, this pin has an internal pull-up and can be left floating.

**NPECL** **User Negative Input**

Provides high speed clock or data signals to the PLL block. If unused, leave the pin unconnected.

**PPECL** **User Positive Input**

Provides high speed clock or data signals to the PLL block. If unused, leave the pin unconnected.

**AVDD** **PLL Power Supply**

Analog $V_{DD}$ should be $V_{DD}$ (core voltage) 2.5 V (nominal) and be decoupled from GND with suitable decoupling capacitors to reduce noise. For more information, refer to Actel's *Using ProASIC^PLUS Clock Conditioning Circuits* application note. If the clock conditioning circuitry is not used in a design, AVDD can either be left floating or tied to 2.5 V.

**AGND** **PLL Power Ground**

The analog ground can be connected to the system ground. For more information, refer to Actel's *Using ProASIC^PLUS Clock Conditioning Circuits* application note. If the PLLs or clock conditioning circuitry are not used in a design, AGND should be tied to GND.

**$V_{PP}$ Programming Supply Pin**

This pin may be connected to any voltage between GND and 16.5 V during normal operation, or it can be left unconnected.[2] For information on using this pin during programming, see the *In-System Programming ProASIC^PLUS Devices* application note. Actel recommends floating the pin or connecting it to $V_{DDP}$.

**$V_{PN}$ Programming Supply Pin**

This pin may be connected to any voltage between 0.5V and –13.8 V during normal operation, or it can be left unconnected.[3] For information on using this pin during programming, see the *In-System Programming ProASIC^PLUS Devices* application note. Actel recommends floating the pin or connecting it to GND.

# Recommended Design Practice for $V_{PN}/V_{PP}$

## ProASIC^PLUS Devices – APA450, APA600, APA750, APA1000

Bypass capacitors are required from $V_{PP}$ to GND and $V_{PN}$ to GND for all ProASIC^PLUS devices during programming. During the erase cycle, ProASIC^PLUS devices may have current surges on the $V_{PP}$ and $V_{PN}$ power supplies. The only way to maintain the integrity of the power distribution to the ProASIC^PLUS device during these current surges is to counteract the inductance of the finite length conductors that distribute the power to the device. This can be accomplished by providing sufficient bypass capacitance between the $V_{PP}$ and $V_{PN}$ pins and GND (using the shortest paths possible). Without sufficient bypass capacitance to counteract the inductance, the $V_{PP}$ and $V_{PN}$ pins may incur a voltage spike beyond the voltage that the device can withstand. This issue applies to all programming configurations.

The solution prevents spikes from damaging the ProASIC^PLUS devices. Bypass capacitors are required for the $V_{PP}$ and $V_{PN}$ pads. Use a 0.01 µF to 0.1 µF ceramic capacitor with a 25 V or greater rating. To filter low-frequency noise (decoupling), use a 4.7 µF (low ESR, <1 <Ω, tantalum, 25 V or greater rating) capacitor. The capacitors should be located as close to the device pins as possible (within 2.5 cm is desirable). The smaller, high-frequency capacitor should be placed closer to the device pins than the larger low-frequency capacitor. The same dual-capacitor circuit should be used on both the $V_{PP}$ and $V_{PN}$ pins (Figure 1-49).

## ProASIC^PLUS Devices – APA075, APA150, APA300

These devices do not require bypass capacitors on the $V_{PP}$ and $V_{PN}$ pins as long as the total combined distance of the programming cable and the trace length on the board is less than or equal to 30 inches. Note: For trace lengths greater than 30 inches, use the bypass capacitor recommendations in the previous section.

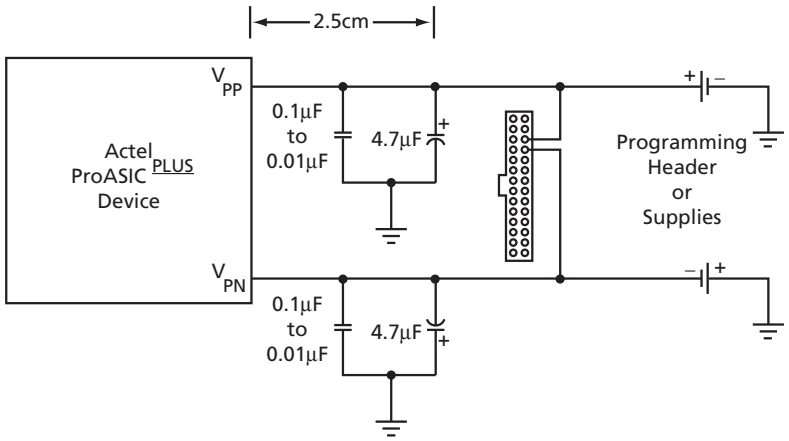
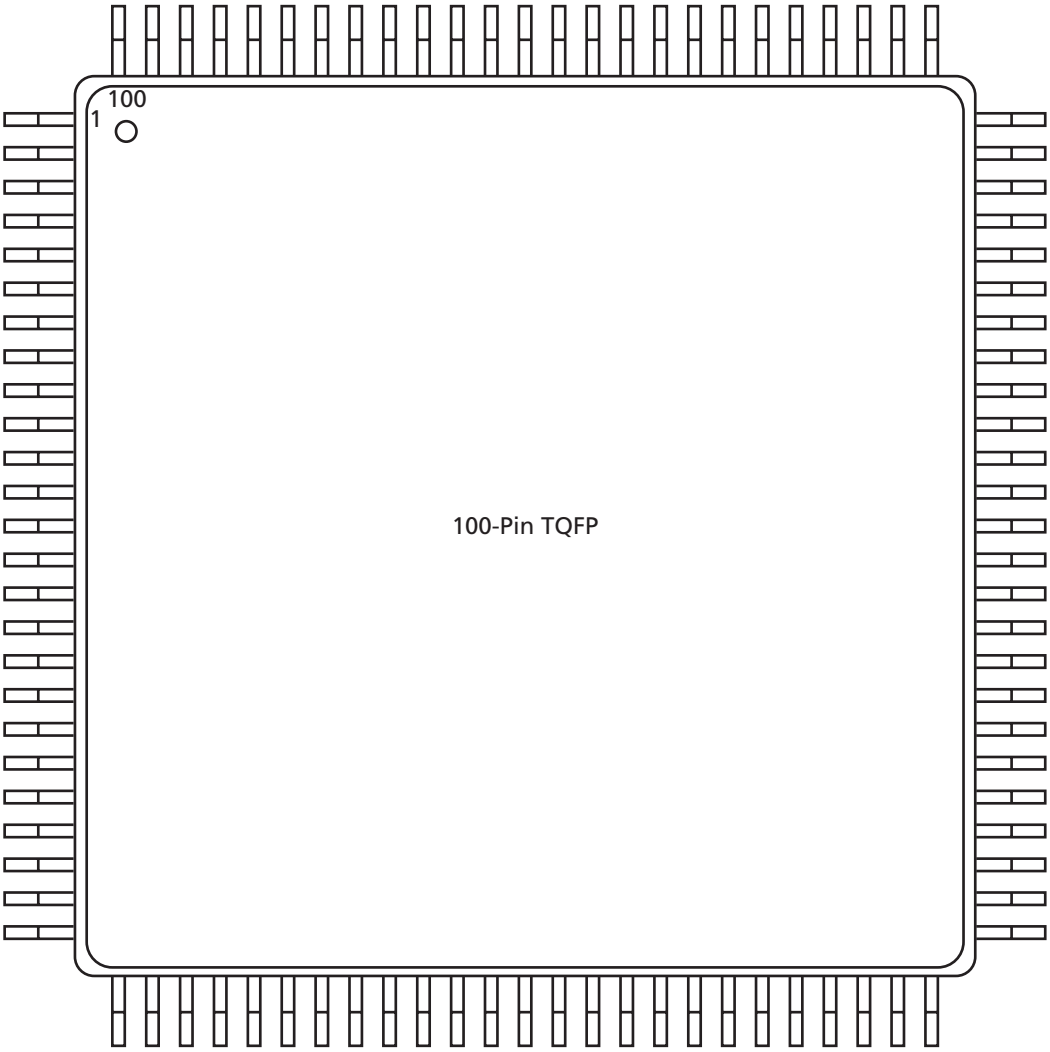



*Figure 1-49* • **ProASIC^PLUS $V_{PP}$ and $V_{PN}$ Capacitor Requirements**

2. *There is a nominal 40 kΩ pull-up resistor on $V_{PP}$*
3. *There is a nominal 40 kΩ pull-down resistor on $V_{PN}$.*

# Package Pin Assignments

## 100-Pin TQFP




### Note

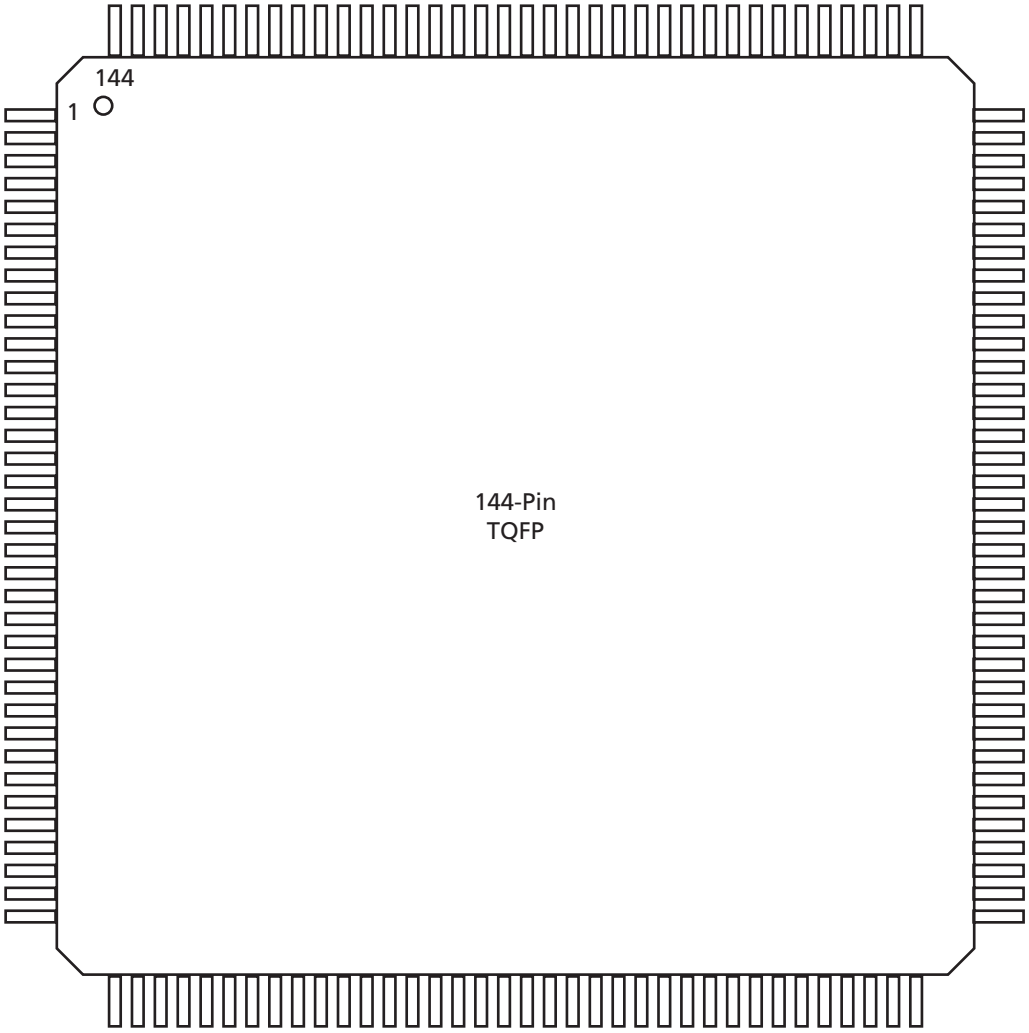
For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 100-Pin TQFP | | |
|---|---|---|
| Pin Number | APA075 Function | APA150 Function |
| 1 | GND | GND |
| 2 | I/O | I/O |
| 3 | I/O | I/O |
| 4 | I/O | I/O |
| 5 | I/O | I/O |
| 6 | I/O | I/O |
| 7 | I/O | I/O |
| 8 | I/O | I/O |
| 9 | GND | GND |
| 10 | I/O / GLMX1 | I/O / GLMX1 |
| 11 | I/O / GL1 | I/O / GL1 |
| 12 | AGND | AGND |
| 13 | NPECL1 | NPECL1 |
| 14 | AVDD | AVDD |
| 15 | PPECL1 / Input | PPECL1 / Input |
| 16 | I/O / GL2 | I/O / GL2 |
| 17 | $V_{DD}$ | $V_{DD}$ |
| 18 | I/O | I/O |
| 19 | I/O | I/O |
| 20 | I/O | I/O |
| 21 | I/O | I/O |
| 22 | I/O | I/O |
| 23 | I/O | I/O |
| 24 | I/O | I/O |
| 25 | GND | GND |
| 26 | $V_{DDP}$ | $V_{DDP}$ |
| 27 | I/O | I/O |
| 28 | I/O | I/O |
| 29 | I/O | I/O |
| 30 | I/O | I/O |
| 31 | I/O | I/O |
| 32 | I/O | I/O |
| 33 | I/O | I/O |
| 34 | I/O | I/O |
| 35 | I/O | I/O |

| 100-Pin TQFP | | |
|---|---|---|
| Pin Number | APA075 Function | APA150 Function |
| 36 | I/O | I/O |
| 37 | $V_{DD}$ | $V_{DD}$ |
| 38 | GND | GND |
| 39 | $V_{DDP}$ | $V_{DDP}$ |
| 40 | GND | GND |
| 41 | I/O | I/O |
| 42 | I/O | I/O |
| 43 | I/O | I/O |
| 44 | I/O | I/O |
| 45 | I/O | I/O |
| 46 | I/O | I/O |
| 47 | TCK | TCK |
| 48 | TDI | TDI |
| 49 | TMS | TMS |
| 50 | $V_{DDP}$ | $V_{DDP}$ |
| 51 | GND | GND |
| 52 | $V_{PP}$ | $V_{PP}$ |
| 53 | $V_{PN}$ | $V_{PN}$ |
| 54 | TDO | TDO |
| 55 | TRST | TRST |
| 56 | RCK | RCK |
| 57 | I/O | I/O |
| 58 | I/O | I/O |
| 59 | I/O | I/O |
| 60 | I/O / GL3 | I/O / GL3 |
| 61 | PPECL2 / Input | PPECL2 / Input |
| 62 | AVDD | AVDD |
| 63 | NPECL2 | NPECL2 |
| 64 | AGND | AGND |
| 65 | I/O / GL4 | I/O / GL4 |
| 66 | I/O / GLMX2 | I/O / GLMX2 |
| 67 | GND | GND |
| 68 | $V_{DD}$ | $V_{DD}$ |
| 69 | I/O | I/O |
| 70 | I/O | I/O |

| 100-Pin TQFP | | |
|---|---|---|
| Pin Number | APA075 Function | APA150 Function |
| 71 | I/O | I/O |
| 72 | I/O | I/O |
| 73 | I/O | I/O |
| 74 | I/O | I/O |
| 75 | GND | GND |
| 76 | $V_{DDP}$ | $V_{DDP}$ |
| 77 | I/O | I/O |
| 78 | I/O | I/O |
| 79 | I/O | I/O |
| 80 | I/O | I/O |
| 81 | I/O | I/O |
| 82 | I/O | I/O |
| 83 | I/O | I/O |
| 84 | I/O | I/O |
| 85 | I/O | I/O |
| 86 | GND | GND |
| 87 | $V_{DDP}$ | $V_{DDP}$ |
| 88 | GND | GND |
| 89 | $V_{DD}$ | $V_{DD}$ |
| 90 | I/O | I/O |
| 91 | I/O | I/O |
| 92 | I/O | I/O |
| 93 | I/O | I/O |
| 94 | I/O | I/O |
| 95 | I/O | I/O |
| 96 | I/O | I/O |
| 97 | I/O | I/O |
| 98 | I/O | I/O |
| 99 | I/O | I/O |
| 100 | $V_{DDP}$ | $V_{DDP}$ |

# 144-Pin TQFP




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

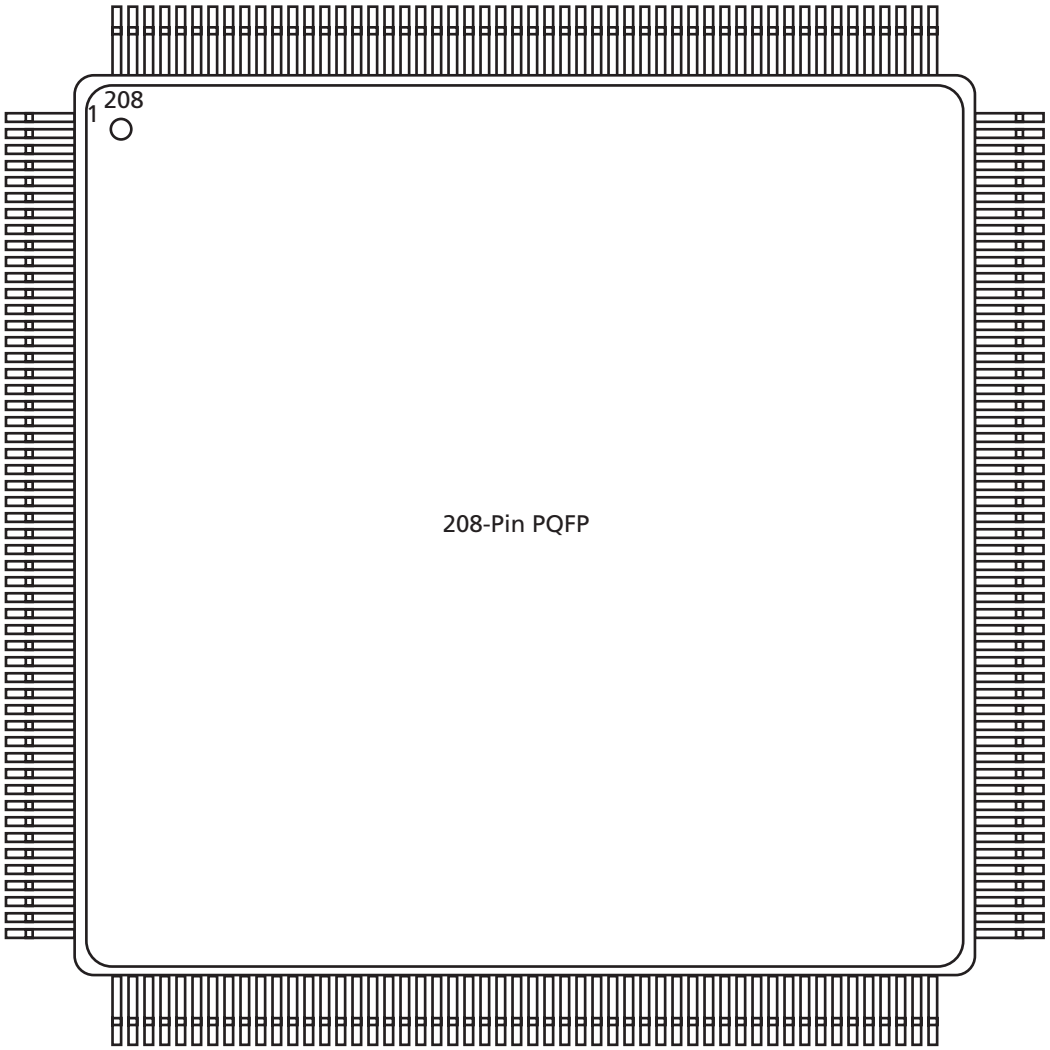
| 144-Pin TQFP | |
|---|---|
| **Pin Number** | **APA075 Function** |
| 1 | I/O |
| 2 | I/O |
| 3 | I/O |
| 4 | I/O |
| 5 | I/O |
| 6 | I/O |
| 7 | I/O |
| 8 | I/O |
| 9 | $V_{DD}$ |
| 10 | GND |
| 11 | $V_{DDP}$ |
| 12 | I/O |
| 13 | I/O |
| 14 | I/O |
| 15 | I/O / GLMX1 |
| 16 | I/O / GL1 |
| 17 | AGND |
| 18 | NPECL |
| 19 | AVDD |
| 20 | PPECL1 / Input |
| 21 | I/O / GL2 |
| 22 | I/O |
| 23 | I/O |
| 24 | I/O |
| 25 | I/O |
| 26 | I/O |
| 27 | GND |
| 28 | $V_{DDP}$ |
| 29 | I/O |
| 30 | I/O |
| 31 | I/O |
| 32 | I/O |
| 33 | I/O |
| 34 | I/O |
| 35 | I/O |
| 36 | I/O |

| 144-Pin TQFP | |
|---|---|
| **Pin Number** | **APA075 Function** |
| 37 | I/O |
| 38 | I/O |
| 39 | I/O |
| 40 | I/O |
| 41 | I/O |
| 42 | I/O |
| 43 | I/O |
| 44 | I/O |
| 45 | $V_{DD}$ |
| 46 | GND |
| 47 | $V_{DDP}$ |
| 48 | I/O |
| 49 | I/O |
| 50 | I/O |
| 51 | I/O |
| 52 | I/O |
| 53 | I/O |
| 54 | I/O |
| 55 | I/O |
| 56 | I/O |
| 57 | I/O |
| 58 | I/O |
| 59 | I/O |
| 60 | I/O |
| 61 | I/O |
| 62 | $V_{DD}$ |
| 63 | GND |
| 64 | $V_{DDP}$ |
| 65 | I/O |
| 66 | I/O |
| 67 | I/O |
| 68 | I/O |
| 69 | TCK |
| 70 | TDI |
| 71 | TMS |
| 72 | NC |
| 73 | $V_{PP}$ |

| 144-Pin TQFP | |
|---|---|
| **Pin Number** | **APA075 Function** |
| 74 | $V_{PN}$ |
| 75 | TDO |
| 76 | TRST |
| 77 | RCK |
| 78 | I/O |
| 79 | I/O |
| 80 | I/O |
| 81 | $V_{DDP}$ |
| 82 | GND |
| 83 | I/O |
| 84 | I/O |
| 85 | I/O |
| 86 | I/O |
| 87 | I/O |
| 88 | I/O / GL3 |
| 89 | PPECL2 / Input |
| 90 | AVDD |
| 91 | NPECL |
| 92 | AGND |
| 93 | I/O / GL4 |
| 94 | I/O / GLMX2 |
| 95 | I/O |
| 96 | I/O |
| 97 | I/O |
| 98 | $V_{DDP}$ |
| 99 | GND |
| 100 | $V_{DD}$ |
| 101 | I/O |
| 102 | I/O |
| 103 | I/O |
| 104 | I/O |
| 105 | I/O |
| 106 | I/O |
| 107 | I/O |
| 108 | I/O |
| 109 | I/O |

| 144-Pin TQFP | |
|---|---|
| **Pin Number** | **APA075 Function** |
| 110 | I/O |
| 111 | I/O |
| 112 | I/O |
| 113 | I/O |
| 114 | I/O |
| 115 | I/O |
| 116 | I/O |
| 117 | $V_{DDP}$ |
| 118 | GND |
| 119 | $V_{DD}$ |
| 120 | I/O |
| 121 | I/O |
| 122 | I/O |
| 123 | I/O |
| 124 | I/O |
| 125 | I/O |
| 126 | I/O |
| 127 | I/O |
| 128 | I/O |
| 129 | I/O |
| 130 | I/O |
| 131 | I/O |
| 132 | I/O |
| 133 | I/O |
| 134 | $V_{DDP}$ |
| 135 | GND |
| 136 | $V_{DD}$ |
| 137 | I/O |
| 138 | I/O |
| 139 | I/O |
| 140 | I/O |
| 141 | I/O |
| 142 | I/O |
| 143 | I/O |
| 144 | I/O |

# 208-Pin PQFP




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 208-Pin PQFP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| 1 | GND | GND | GND | GND | GND | GND | GND |
| 2 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 3 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 4 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 5 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 6 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 7 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 8 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 9 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 10 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 11 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 12 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 13 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 14 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 15 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 16 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 17 | GND | GND | GND | GND | GND | GND | GND |
| 18 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 19 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 20 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 21 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 22 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 23 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 |
| 24 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 |
| 25 | AGND | AGND | AGND | AGND | AGND | AGND | AGND |
| 26 | NPECL1 | NPECL1 | NPECL1 | NPECL1 | NPECL1 | NPECL1 | NPECL1 |
| 27 | AVDD | AVDD | AVDD | AVDD | AVDD | AVDD | AVDD |
| 28 | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input |
| 29 | GND | GND | GND | GND | GND | GND | GND |
| 30 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 |
| 31 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 32 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 33 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 34 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 35 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |

| 208-Pin PQFP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| 36 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 37 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 38 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 39 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 40 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 41 | GND | GND | GND | GND | GND | GND | GND |
| 42 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 43 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 44 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 45 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 46 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 47 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 48 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 49 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 50 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 51 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 52 | GND | GND | GND | GND | GND | GND | GND |
| 53 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 54 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 55 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 56 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 57 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 58 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 59 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 60 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 61 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 62 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 63 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 64 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 65 | GND | GND | GND | GND | GND | GND | GND |
| 66 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 67 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 68 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 69 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 70 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |

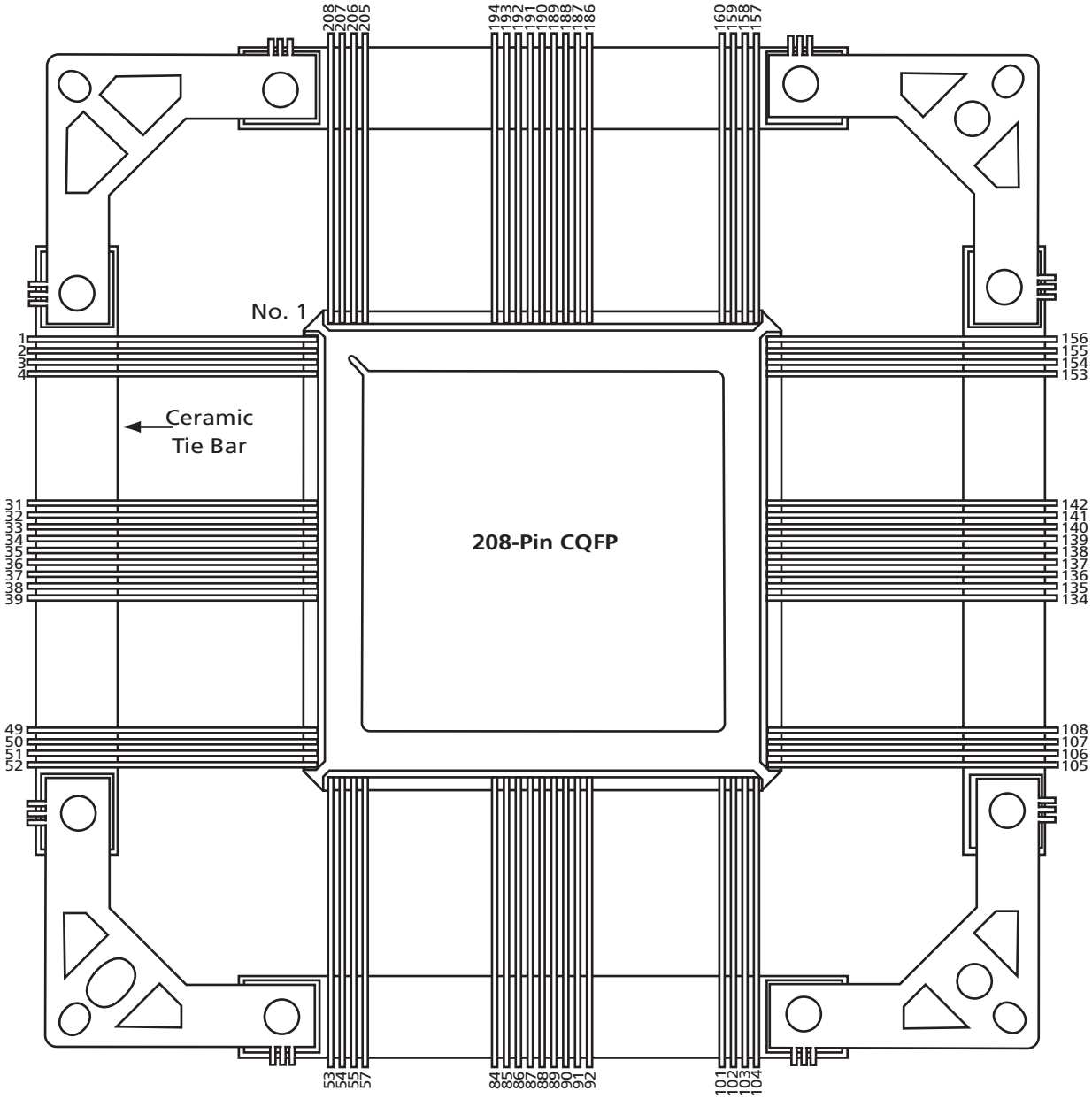
| 208-Pin PQFP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| 71 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 72 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 73 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 74 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 75 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 76 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 77 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 78 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 79 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 80 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 81 | GND | GND | GND | GND | GND | GND | GND |
| 82 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 83 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 84 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 85 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 86 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 87 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 88 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 89 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 90 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 91 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 92 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 93 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 94 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 95 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 96 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 97 | GND | GND | GND | GND | GND | GND | GND |
| 98 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 99 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 100 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 101 | TCK | TCK | TCK | TCK | TCK | TCK | TCK |
| 102 | TDI | TDI | TDI | TDI | TDI | TDI | TDI |
| 103 | TMS | TMS | TMS | TMS | TMS | TMS | TMS |
| 104 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 105 | GND | GND | GND | GND | GND | GND | GND |

| 208-Pin PQFP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| 106 | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ |
| 107 | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ |
| 108 | TDO | TDO | TDO | TDO | TDO | TDO | TDO |
| 109 | TRST | TRST | TRST | TRST | TRST | TRST | TRST |
| 110 | RCK | RCK | RCK | RCK | RCK | RCK | RCK |
| 111 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 112 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 113 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 114 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 115 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 116 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 117 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 118 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 119 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 120 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 121 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 122 | GND | GND | GND | GND | GND | GND | GND |
| 123 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 124 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 125 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 126 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 127 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 128 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 |
| 129 | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input |
| 130 | GND | GND | GND | GND | GND | GND | GND |
| 131 | AVDD | AVDD | AVDD | AVDD | AVDD | AVDD | AVDD |
| 132 | NPECL2 | NPECL2 | NPECL2 | NPECL2 | NPECL2 | NPECL2 | NPECL2 |
| 133 | AGND | AGND | AGND | AGND | AGND | AGND | AGND |
| 134 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 |
| 135 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 |
| 136 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 137 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 138 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 139 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 140 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |

| 208-Pin PQFP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| 141 | GND | GND | GND | GND | GND | GND | GND |
| 142 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 143 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 144 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 145 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 146 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 147 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 148 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 149 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 150 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 151 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 152 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 153 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 154 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 155 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 156 | GND | GND | GND | GND | GND | GND | GND |
| 157 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 158 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 159 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 160 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 161 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 162 | GND | GND | GND | GND | GND | GND | GND |
| 163 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 164 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 165 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 166 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 167 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 168 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 169 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 170 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 171 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 172 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 173 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 174 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 175 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |

| 208-Pin PQFP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| 176 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 177 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 178 | GND | GND | GND | GND | GND | GND | GND |
| 179 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 180 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 181 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 182 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 183 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 184 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 185 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 186 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 187 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 188 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 189 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 190 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 191 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 192 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 193 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 194 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 195 | GND | GND | GND | GND | GND | GND | GND |
| 196 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 197 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 198 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 199 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 200 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 201 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 202 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 203 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 204 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 205 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 206 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 207 | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
| 208 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |

# 208-Pin CQFP




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 208-Pin CQFP | | | |
|---|---|---|---|
| **Pin Number** | **APA300 Function** | **APA600 Function** | **APA1000 Function** |
| 1 | GND | GND | GND |
| 2 | I/O | I/O | I/O |
| 3 | I/O | I/O | I/O |
| 4 | I/O | I/O | I/O |
| 5 | I/O | I/O | I/O |
| 6 | I/O | I/O | I/O |
| 7 | I/O | I/O | I/O |
| 8 | I/O | I/O | I/O |
| 9 | I/O | I/O | I/O |
| 10 | I/O | I/O | I/O |
| 11 | I/O | I/O | I/O |
| 12 | I/O | I/O | I/O |
| 13 | I/O | I/O | I/O |
| 14 | I/O | I/O | I/O |
| 15 | I/O | I/O | I/O |
| 16 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 17 | GND | GND | GND |
| 18 | I/O | I/O | I/O |
| 19 | I/O | I/O | I/O |
| 20 | I/O | I/O | I/O |
| 21 | I/O | I/O | I/O |
| 22 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 23 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 |
| 24 | I/O / GL2 | I/O / GL2 | I/O / GL2 |
| 25 | AGND | AGND | AGND |
| 26 | NPECL1 | NPECL1 | NPECL1 |
| 27 | AVDD | AVDD | AVDD |
| 28 | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input |
| 29 | GND | GND | GND |
| 30 | I/O / GL1 | I/O / GL1 | I/O / GL1 |
| 31 | I/O | I/O | I/O |
| 32 | I/O | I/O | I/O |
| 33 | I/O | I/O | I/O |
| 34 | I/O | I/O | I/O |
| 35 | I/O | I/O | I/O |

| 208-Pin CQFP | | | |
|---|---|---|---|
| **Pin Number** | **APA300 Function** | **APA600 Function** | **APA1000 Function** |
| 36 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 37 | I/O | I/O | I/O |
| 38 | I/O | I/O | I/O |
| 39 | I/O | I/O | I/O |
| 40 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 41 | GND | GND | GND |
| 42 | I/O | I/O | I/O |
| 43 | I/O | I/O | I/O |
| 44 | I/O | I/O | I/O |
| 45 | I/O | I/O | I/O |
| 46 | I/O | I/O | I/O |
| 47 | I/O | I/O | I/O |
| 48 | I/O | I/O | I/O |
| 49 | I/O | I/O | I/O |
| 50 | I/O | I/O | I/O |
| 51 | I/O | I/O | I/O |
| 52 | GND | GND | GND |
| 53 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 54 | I/O | I/O | I/O |
| 55 | I/O | I/O | I/O |
| 56 | I/O | I/O | I/O |
| 57 | I/O | I/O | I/O |
| 58 | I/O | I/O | I/O |
| 59 | I/O | I/O | I/O |
| 60 | I/O | I/O | I/O |
| 61 | I/O | I/O | I/O |
| 62 | I/O | I/O | I/O |
| 63 | I/O | I/O | I/O |
| 64 | I/O | I/O | I/O |
| 65 | GND | GND | GND |
| 66 | I/O | I/O | I/O |
| 67 | I/O | I/O | I/O |
| 68 | I/O | I/O | I/O |
| 69 | I/O | I/O | I/O |
| 70 | I/O | I/O | I/O |

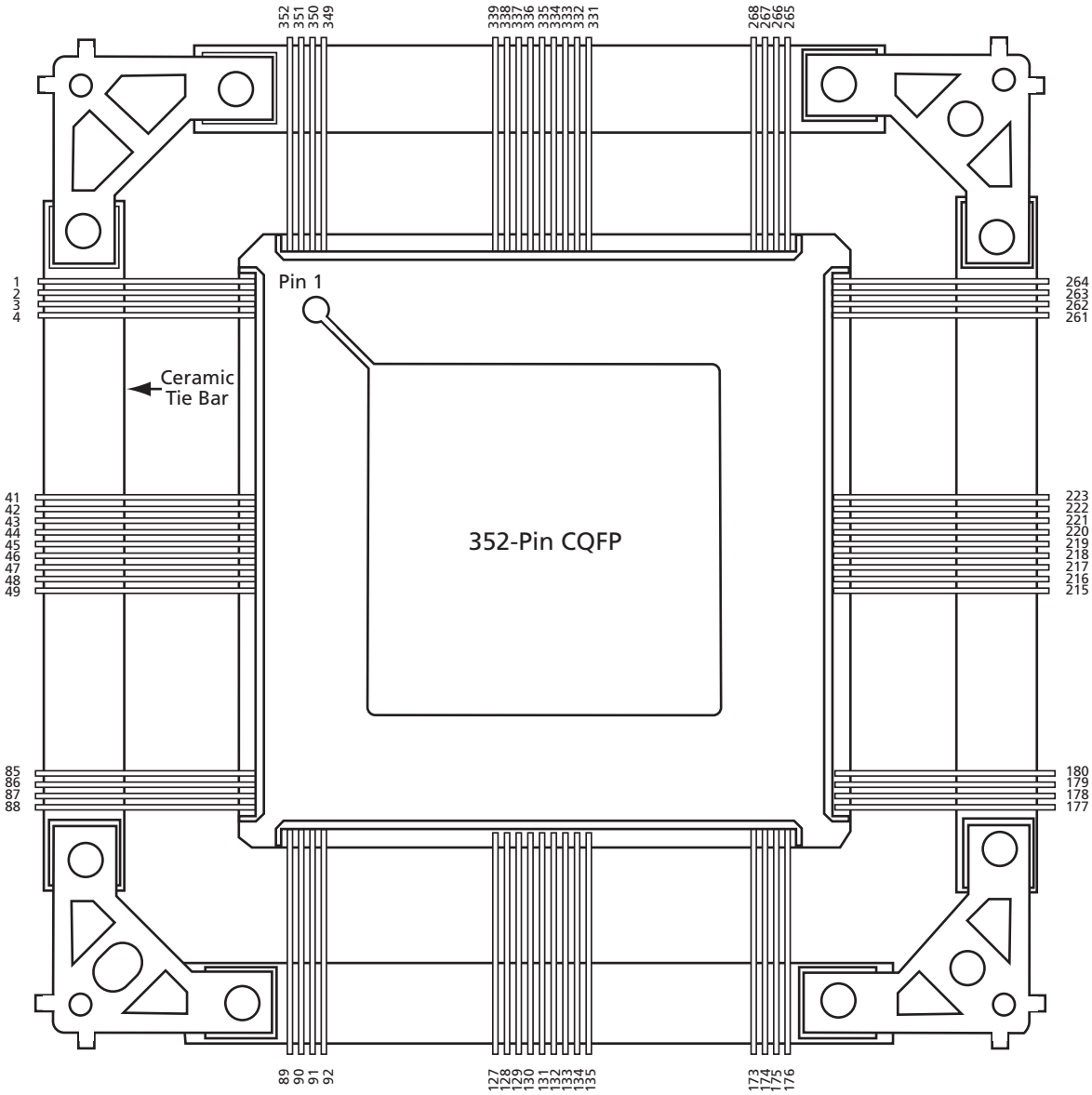
| 208-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 71 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 72 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 73 | I/O | I/O | I/O |
| 74 | I/O | I/O | I/O |
| 75 | I/O | I/O | I/O |
| 76 | I/O | I/O | I/O |
| 77 | I/O | I/O | I/O |
| 78 | I/O | I/O | I/O |
| 79 | I/O | I/O | I/O |
| 80 | I/O | I/O | I/O |
| 81 | GND | GND | GND |
| 82 | I/O | I/O | I/O |
| 83 | I/O | I/O | I/O |
| 84 | I/O | I/O | I/O |
| 85 | I/O | I/O | I/O |
| 86 | I/O | I/O | I/O |
| 87 | I/O | I/O | I/O |
| 88 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 89 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 90 | I/O | I/O | I/O |
| 91 | I/O | I/O | I/O |
| 92 | I/O | I/O | I/O |
| 93 | I/O | I/O | I/O |
| 94 | I/O | I/O | I/O |
| 95 | I/O | I/O | I/O |
| 96 | I/O | I/O | I/O |
| 97 | GND | GND | GND |
| 98 | I/O | I/O | I/O |
| 99 | I/O | I/O | I/O |
| 100 | I/O | I/O | I/O |
| 101 | TCK | TCK | TCK |
| 102 | TDI | TDI | TDI |
| 103 | TMS | TMS | TMS |
| 104 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 105 | GND | GND | GND |

| 208-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 106 | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ |
| 107 | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ |
| 108 | TDO | TDO | TDO |
| 109 | TRST | TRST | TRST |
| 110 | RCK | RCK | RCK |
| 111 | I/O | I/O | I/O |
| 112 | I/O | I/O | I/O |
| 113 | I/O | I/O | I/O |
| 114 | I/O | I/O | I/O |
| 115 | I/O | I/O | I/O |
| 116 | I/O | I/O | I/O |
| 117 | I/O | I/O | I/O |
| 118 | I/O | I/O | I/O |
| 119 | I/O | I/O | I/O |
| 120 | I/O | I/O | I/O |
| 121 | I/O | I/O | I/O |
| 122 | GND | GND | GND |
| 123 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 124 | I/O | I/O | I/O |
| 125 | I/O | I/O | I/O |
| 126 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 127 | I/O | I/O | I/O |
| 128 | I/O / GL3 | I/O / GL3 | I/O / GL3 |
| 129 | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input |
| 130 | GND | GND | GND |
| 131 | AVDD | AVDD | AVDD |
| 132 | NPECL2 | NPECL2 | NPECL2 |
| 133 | AGND | AGND | AGND |
| 134 | I/O / GL4 | I/O / GL4 | I/O / GL4 |
| 135 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 |
| 136 | I/O | I/O | I/O |
| 137 | I/O | I/O | I/O |
| 138 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 139 | I/O | I/O | I/O |
| 140 | I/O | I/O | I/O |

| 208-Pin CQFP | | | |
|---|---|---|---|
| **Pin Number** | **APA300 Function** | **APA600 Function** | **APA1000 Function** |
| 141 | GND | GND | GND |
| 142 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 143 | I/O | I/O | I/O |
| 144 | I/O | I/O | I/O |
| 145 | I/O | I/O | I/O |
| 146 | I/O | I/O | I/O |
| 147 | I/O | I/O | I/O |
| 148 | I/O | I/O | I/O |
| 149 | I/O | I/O | I/O |
| 150 | I/O | I/O | I/O |
| 151 | I/O | I/O | I/O |
| 152 | I/O | I/O | I/O |
| 153 | I/O | I/O | I/O |
| 154 | I/O | I/O | I/O |
| 155 | I/O | I/O | I/O |
| 156 | GND | GND | GND |
| 157 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 158 | I/O | I/O | I/O |
| 159 | I/O | I/O | I/O |
| 160 | I/O | I/O | I/O |
| 161 | I/O | I/O | I/O |
| 162 | GND | GND | GND |
| 163 | I/O | I/O | I/O |
| 164 | I/O | I/O | I/O |
| 165 | I/O | I/O | I/O |
| 166 | I/O | I/O | I/O |
| 167 | I/O | I/O | I/O |
| 168 | I/O | I/O | I/O |
| 169 | I/O | I/O | I/O |
| 170 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 171 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 172 | I/O | I/O | I/O |
| 173 | I/O | I/O | I/O |
| 174 | I/O | I/O | I/O |
| 175 | I/O | I/O | I/O |

| 208-Pin CQFP | | | |
|---|---|---|---|
| **Pin Number** | **APA300 Function** | **APA600 Function** | **APA1000 Function** |
| 176 | I/O | I/O | I/O |
| 177 | I/O | I/O | I/O |
| 178 | GND | GND | GND |
| 179 | I/O | I/O | I/O |
| 180 | I/O | I/O | I/O |
| 181 | I/O | I/O | I/O |
| 182 | I/O | I/O | I/O |
| 183 | I/O | I/O | I/O |
| 184 | I/O | I/O | I/O |
| 185 | I/O | I/O | I/O |
| 186 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 187 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 188 | I/O | I/O | I/O |
| 189 | I/O | I/O | I/O |
| 190 | I/O | I/O | I/O |
| 191 | I/O | I/O | I/O |
| 192 | I/O | I/O | I/O |
| 193 | I/O | I/O | I/O |
| 194 | I/O | I/O | I/O |
| 195 | GND | GND | GND |
| 196 | I/O | I/O | I/O |
| 197 | I/O | I/O | I/O |
| 198 | I/O | I/O | I/O |
| 199 | I/O | I/O | I/O |
| 200 | I/O | I/O | I/O |
| 201 | I/O | I/O | I/O |
| 202 | I/O | I/O | I/O |
| 203 | I/O | I/O | I/O |
| 204 | I/O | I/O | I/O |
| 205 | I/O | I/O | I/O |
| 206 | I/O | I/O | I/O |
| 207 | I/O | I/O | I/O |
| 208 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |

# 352-Pin CQFP




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 1 | I/O | I/O | I/O |
| 2 | I/O | I/O | I/O |
| 3 | I/O | I/O | I/O |
| 4 | I/O | I/O | I/O |
| 5 | I/O | I/O | I/O |
| 6 | I/O | I/O | I/O |
| 7 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 8 | GND | GND | GND |
| 9 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 10 | I/O | I/O | I/O |
| 11 | I/O | I/O | I/O |
| 12 | I/O | I/O | I/O |
| 13 | I/O | I/O | I/O |
| 14 | I/O | I/O | I/O |
| 15 | I/O | I/O | I/O |
| 16 | I/O | I/O | I/O |
| 17 | I/O | I/O | I/O |
| 18 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 19 | GND | GND | GND |
| 20 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 21 | I/O | I/O | I/O |
| 22 | I/O | I/O | I/O |
| 23 | I/O | I/O | I/O |
| 24 | I/O | I/O | I/O |
| 25 | I/O | I/O | I/O |
| 26 | I/O | I/O | I/O |
| 27 | I/O | I/O | I/O |
| 28 | I/O | I/O | I/O |
| 29 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 30 | GND | GND | GND |
| 31 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 32 | I/O | I/O | I/O |
| 33 | I/O | I/O | I/O |
| 34 | I/O | I/O | I/O |
| 35 | I/O | I/O | I/O |
| 36 | I/O | I/O | I/O |
| 37 | I/O | I/O | I/O |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 38 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 |
| 39 | I/O / GL2 | I/O / GL2 | I/O / GL2 |
| 40 | AGND | AGND | AGND |
| 41 | AVDD | AVDD | AVDD |
| 42 | NPECL1 | NPECL1 | NPECL1 |
| 43 | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input |
| 44 | I/O / GL1 | I/O / GL1 | I/O / GL1 |
| 45 | I/O | I/O | I/O |
| 46 | I/O | I/O | I/O |
| 47 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 48 | GND | GND | GND |
| 49 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 50 | I/O | I/O | I/O |
| 51 | I/O | I/O | I/O |
| 52 | I/O | I/O | I/O |
| 53 | I/O | I/O | I/O |
| 54 | I/O | I/O | I/O |
| 55 | I/O | I/O | I/O |
| 56 | I/O | I/O | I/O |
| 57 | I/O | I/O | I/O |
| 58 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 59 | GND | GND | GND |
| 60 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 61 | I/O | I/O | I/O |
| 62 | I/O | I/O | I/O |
| 63 | I/O | I/O | I/O |
| 64 | I/O | I/O | I/O |
| 65 | I/O | I/O | I/O |
| 66 | I/O | I/O | I/O |
| 67 | I/O | I/O | I/O |
| 68 | I/O | I/O | I/O |
| 69 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 70 | GND | GND | GND |
| 71 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 72 | I/O | I/O | I/O |
| 73 | I/O | I/O | I/O |
| 74 | I/O | I/O | I/O |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 75 | I/O | I/O | I/O |
| 76 | I/O | I/O | I/O |
| 77 | I/O | I/O | I/O |
| 78 | I/O | I/O | I/O |
| 79 | I/O | I/O | I/O |
| 80 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 81 | GND | GND | GND |
| 82 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 83 | I/O | I/O | I/O |
| 84 | I/O | I/O | I/O |
| 85 | I/O | I/O | I/O |
| 86 | I/O | I/O | I/O |
| 87 | I/O | I/O | I/O |
| 88 | I/O | I/O | I/O |
| 89 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 90 | GND | GND | GND |
| 91 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 92 | I/O | I/O | I/O |
| 93 | I/O | I/O | I/O |
| 94 | I/O | I/O | I/O |
| 95 | I/O | I/O | I/O |
| 96 | I/O | I/O | I/O |
| 97 | I/O | I/O | I/O |
| 98 | I/O | I/O | I/O |
| 99 | I/O | I/O | I/O |
| 100 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 101 | GND | GND | GND |
| 102 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 103 | I/O | I/O | I/O |
| 104 | I/O | I/O | I/O |
| 105 | I/O | I/O | I/O |
| 106 | I/O | I/O | I/O |
| 107 | I/O | I/O | I/O |
| 108 | I/O | I/O | I/O |
| 109 | I/O | I/O | I/O |
| 110 | I/O | I/O | I/O |
| 111 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 112 | GND | GND | GND |
| 113 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 114 | I/O | I/O | I/O |
| 115 | I/O | I/O | I/O |
| 116 | I/O | I/O | I/O |
| 117 | I/O | I/O | I/O |
| 118 | I/O | I/O | I/O |
| 119 | I/O | I/O | I/O |
| 120 | I/O | I/O | I/O |
| 121 | I/O | I/O | I/O |
| 122 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 123 | GND | GND | GND |
| 124 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 125 | I/O | I/O | I/O |
| 126 | I/O | I/O | I/O |
| 127 | I/O | I/O | I/O |
| 128 | I/O | I/O | I/O |
| 129 | I/O | I/O | I/O |
| 130 | I/O | I/O | I/O |
| 131 | I/O | I/O | I/O |
| 132 | I/O | I/O | I/O |
| 133 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 134 | GND | GND | GND |
| 135 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 136 | I/O | I/O | I/O |
| 137 | I/O | I/O | I/O |
| 138 | I/O | I/O | I/O |
| 139 | I/O | I/O | I/O |
| 140 | I/O | I/O | I/O |
| 141 | I/O | I/O | I/O |
| 142 | I/O | I/O | I/O |
| 143 | I/O | I/O | I/O |
| 144 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 145 | GND | GND | GND |
| 146 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 147 | I/O | I/O | I/O |
| 148 | I/O | I/O | I/O |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 149 | I/O | I/O | I/O |
| 150 | I/O | I/O | I/O |
| 151 | I/O | I/O | I/O |
| 152 | I/O | I/O | I/O |
| 153 | I/O | I/O | I/O |
| 154 | I/O | I/O | I/O |
| 155 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 156 | GND | GND | GND |
| 157 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 158 | I/O | I/O | I/O |
| 159 | I/O | I/O | I/O |
| 160 | I/O | I/O | I/O |
| 161 | I/O | I/O | I/O |
| 162 | I/O | I/O | I/O |
| 163 | I/O | I/O | I/O |
| 164 | I/O | I/O | I/O |
| 165 | I/O | I/O | I/O |
| 166 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 167 | GND | GND | GND |
| 168 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 169 | I/O | I/O | I/O |
| 170 | I/O | I/O | I/O |
| 171 | I/O | I/O | I/O |
| 172 | I/O | I/O | I/O |
| 173 | TCK | TCK | TCK |
| 174 | TDI | TDI | TDI |
| 175 | TMS | TMS | TMS |
| 176 | I/O | I/O | I/O |
| 177 | VPP | VPP | VPP |
| 178 | VPN | VPN | VPN |
| 179 | TDO | TDO | TDO |
| 180 | TRST | TRST | TRST |
| 181 | RCK | RCK | RCK |
| 182 | I/O | I/O | I/O |
| 183 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 184 | GND | GND | GND |
| 185 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 186 | I/O | I/O | I/O |
| 187 | I/O | I/O | I/O |
| 188 | I/O | I/O | I/O |
| 189 | I/O | I/O | I/O |
| 190 | I/O | I/O | I/O |
| 191 | I/O | I/O | I/O |
| 192 | I/O | I/O | I/O |
| 193 | I/O | I/O | I/O |
| 194 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 195 | GND | GND | GND |
| 196 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 197 | I/O | I/O | I/O |
| 198 | I/O | I/O | I/O |
| 199 | I/O | I/O | I/O |
| 200 | I/O | I/O | I/O |
| 201 | I/O | I/O | I/O |
| 202 | I/O | I/O | I/O |
| 203 | I/O | I/O | I/O |
| 204 | I/O | I/O | I/O |
| 205 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 206 | GND | GND | GND |
| 207 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 208 | I/O | I/O | I/O |
| 209 | I/O | I/O | I/O |
| 210 | I/O | I/O | I/O |
| 211 | I/O | I/O | I/O |
| 212 | I/O | I/O | I/O |
| 213 | I/O | I/O | I/O |
| 214 | I/O | I/O | I/O |
| 215 | I/O | I/O | I/O |
| 216 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 217 | GND | GND | GND |
| 218 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 219 | I/O | I/O | I/O |
| 220 | I/O | I/O | I/O |
| 221 | I/O / GL3 | I/O / GL3 | I/O / GL3 |
| 222 | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input |

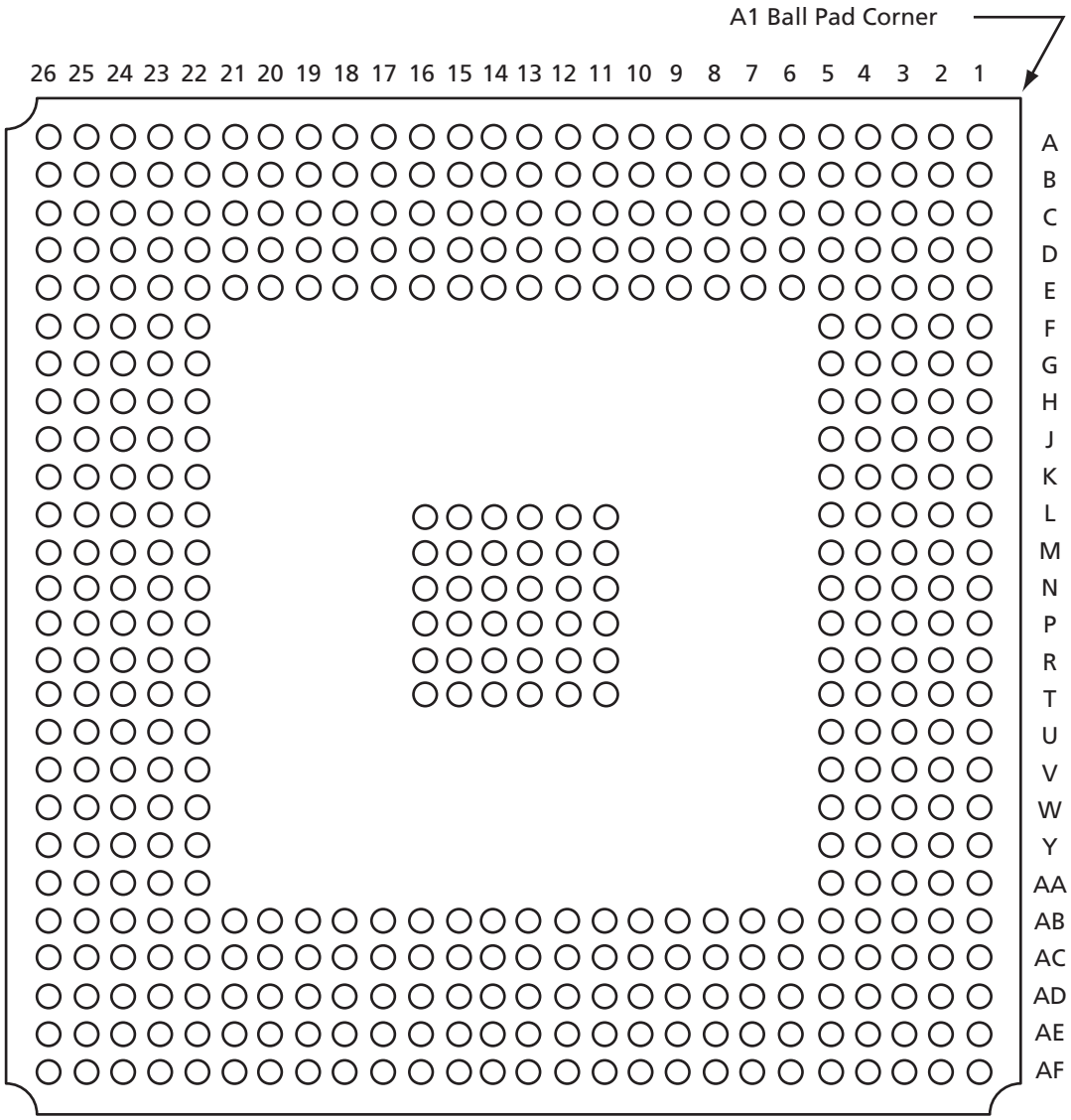
| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 223 | NPECL2 | NPECL2 | NPECL2 |
| 224 | AVDD | AVDD | AVDD |
| 225 | AGND | AGND | AGND |
| 226 | I/O / GL4 | I/O / GL4 | I/O / GL4 |
| 227 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 |
| 228 | I/O | I/O | I/O |
| 229 | I/O | I/O | I/O |
| 230 | I/O | I/O | I/O |
| 231 | I/O | I/O | I/O |
| 232 | I/O | I/O | I/O |
| 233 | I/O | I/O | I/O |
| 234 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 235 | GND | GND | GND |
| 236 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 237 | I/O | I/O | I/O |
| 238 | I/O | I/O | I/O |
| 239 | I/O | I/O | I/O |
| 240 | I/O | I/O | I/O |
| 241 | I/O | I/O | I/O |
| 242 | I/O | I/O | I/O |
| 243 | I/O | I/O | I/O |
| 244 | I/O | I/O | I/O |
| 245 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 246 | GND | GND | GND |
| 247 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 248 | I/O | I/O | I/O |
| 249 | I/O | I/O | I/O |
| 250 | I/O | I/O | I/O |
| 251 | I/O | I/O | I/O |
| 252 | I/O | I/O | I/O |
| 253 | I/O | I/O | I/O |
| 254 | I/O | I/O | I/O |
| 255 | I/O | I/O | I/O |
| 256 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 257 | GND | GND | GND |
| 258 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 259 | I/O | I/O | I/O |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 260 | I/O | I/O | I/O |
| 261 | I/O | I/O | I/O |
| 262 | I/O | I/O | I/O |
| 263 | I/O | I/O | I/O |
| 264 | I/O | I/O | I/O |
| 265 | I/O | I/O | I/O |
| 266 | I/O | I/O | I/O |
| 267 | I/O | I/O | I/O |
| 268 | I/O | I/O | I/O |
| 269 | I/O | I/O | I/O |
| 270 | I/O | I/O | I/O |
| 271 | I/O | I/O | I/O |
| 272 | I/O | I/O | I/O |
| 273 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 274 | GND | GND | GND |
| 275 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 276 | I/O | I/O | I/O |
| 277 | I/O | I/O | I/O |
| 278 | I/O | I/O | I/O |
| 279 | I/O | I/O | I/O |
| 280 | I/O | I/O | I/O |
| 281 | I/O | I/O | I/O |
| 282 | I/O | I/O | I/O |
| 283 | I/O | I/O | I/O |
| 284 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 285 | GND | GND | GND |
| 286 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 287 | I/O | I/O | I/O |
| 288 | I/O | I/O | I/O |
| 289 | I/O | I/O | I/O |
| 290 | I/O | I/O | I/O |
| 291 | I/O | I/O | I/O |
| 292 | I/O | I/O | I/O |
| 293 | I/O | I/O | I/O |
| 294 | I/O | I/O | I/O |
| 295 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 296 | GND | GND | GND |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 297 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 298 | I/O | I/O | I/O |
| 299 | I/O | I/O | I/O |
| 300 | I/O | I/O | I/O |
| 301 | I/O | I/O | I/O |
| 302 | I/O | I/O | I/O |
| 303 | I/O | I/O | I/O |
| 304 | I/O | I/O | I/O |
| 305 | I/O | I/O | I/O |
| 306 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 307 | GND | GND | GND |
| 308 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 309 | I/O | I/O | I/O |
| 310 | I/O | I/O | I/O |
| 311 | I/O | I/O | I/O |
| 312 | I/O | I/O | I/O |
| 313 | I/O | I/O | I/O |
| 314 | I/O | I/O | I/O |
| 315 | I/O | I/O | I/O |
| 316 | I/O | I/O | I/O |
| 317 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 318 | GND | GND | GND |
| 319 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 320 | I/O | I/O | I/O |
| 321 | I/O | I/O | I/O |
| 322 | I/O | I/O | I/O |
| 323 | I/O | I/O | I/O |
| 324 | I/O | I/O | I/O |
| 325 | I/O | I/O | I/O |
| 326 | I/O | I/O | I/O |
| 327 | I/O | I/O | I/O |
| 328 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 329 | GND | GND | GND |
| 330 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 331 | I/O | I/O | I/O |
| 332 | I/O | I/O | I/O |
| 333 | I/O | I/O | I/O |

| 352-Pin CQFP | | | |
|---|---|---|---|
| Pin Number | APA300 Function | APA600 Function | APA1000 Function |
| 334 | I/O | I/O | I/O |
| 335 | I/O | I/O | I/O |
| 336 | I/O | I/O | I/O |
| 337 | I/O | I/O | I/O |
| 338 | I/O | I/O | I/O |
| 339 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 340 | GND | GND | GND |
| 341 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| 342 | I/O | I/O | I/O |
| 343 | I/O | I/O | I/O |
| 344 | I/O | I/O | I/O |
| 345 | I/O | I/O | I/O |
| 346 | I/O | I/O | I/O |
| 347 | I/O | I/O | I/O |
| 348 | I/O | I/O | I/O |
| 349 | I/O | I/O | I/O |
| 350 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| 351 | GND | GND | GND |
| 352 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |

# 456-Pin PBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| A1 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| A2 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| A3 | NC | NC | I/O | I/O | I/O | I/O |
| A4 | NC | NC | I/O | I/O | I/O | I/O |
| A5 | NC | NC | I/O | I/O | I/O | I/O |
| A6 | NC | NC | I/O | I/O | I/O | I/O |
| A7 | NC | NC | I/O | I/O | I/O | I/O |
| A8 | I/O | I/O | I/O | I/O | I/O | I/O |
| A9 | I/O | I/O | I/O | I/O | I/O | I/O |
| A10 | I/O | I/O | I/O | I/O | I/O | I/O |
| A11 | I/O | I/O | I/O | I/O | I/O | I/O |
| A12 | I/O | I/O | I/O | I/O | I/O | I/O |
| A13 | I/O | I/O | I/O | I/O | I/O | I/O |
| A14 | I/O | I/O | I/O | I/O | I/O | I/O |
| A15 | I/O | I/O | I/O | I/O | I/O | I/O |
| A16 | I/O | I/O | I/O | I/O | I/O | I/O |
| A17 | I/O | I/O | I/O | I/O | I/O | I/O |
| A18 | I/O | I/O | I/O | I/O | I/O | I/O |
| A19 | I/O | I/O | I/O | I/O | I/O | I/O |
| A20 | NC | NC | I/O | I/O | I/O | I/O |
| A21 | NC | NC | I/O | I/O | I/O | I/O |
| A22 | NC | NC | I/O | I/O | I/O | I/O |
| A23 | NC | NC | I/O | I/O | I/O | I/O |
| A24 | NC | NC | I/O | I/O | I/O | I/O |
| A25 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| A26 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| B1 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| B2 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| B3 | NC | NC | NC | I/O | I/O | I/O |
| B4 | NC | NC | I/O | I/O | I/O | I/O |
| B5 | NC | NC | I/O | I/O | I/O | I/O |
| B6 | NC | NC | I/O | I/O | I/O | I/O |
| B7 | NC | NC | I/O | I/O | I/O | I/O |
| B8 | I/O | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| B9 | I/O | I/O | I/O | I/O | I/O | I/O |
| B10 | I/O | I/O | I/O | I/O | I/O | I/O |
| B11 | I/O | I/O | I/O | I/O | I/O | I/O |
| B12 | I/O | I/O | I/O | I/O | I/O | I/O |
| B13 | I/O | I/O | I/O | I/O | I/O | I/O |
| B14 | I/O | I/O | I/O | I/O | I/O | I/O |
| B15 | I/O | I/O | I/O | I/O | I/O | I/O |
| B16 | I/O | I/O | I/O | I/O | I/O | I/O |
| B17 | I/O | I/O | I/O | I/O | I/O | I/O |
| B18 | I/O | I/O | I/O | I/O | I/O | I/O |
| B19 | I/O | I/O | I/O | I/O | I/O | I/O |
| B20 | NC | NC | I/O | I/O | I/O | I/O |
| B21 | NC | NC | I/O | I/O | I/O | I/O |
| B22 | NC | NC | I/O | I/O | I/O | I/O |
| B23 | NC | NC | I/O | I/O | I/O | I/O |
| B24 | NC | NC | I/O | I/O | I/O | I/O |
| B25 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| B26 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| C1 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| C2 | NC | I/O | I/O | I/O | I/O | I/O |
| C3 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| C4 | NC | NC | NC | I/O | I/O | I/O |
| C5 | NC | NC | I/O | I/O | I/O | I/O |
| C6 | NC | NC | I/O | I/O | I/O | I/O |
| C7 | I/O | I/O | I/O | I/O | I/O | I/O |
| C8 | I/O | I/O | I/O | I/O | I/O | I/O |
| C9 | I/O | I/O | I/O | I/O | I/O | I/O |
| C10 | I/O | I/O | I/O | I/O | I/O | I/O |
| C11 | I/O | I/O | I/O | I/O | I/O | I/O |
| C12 | I/O | I/O | I/O | I/O | I/O | I/O |
| C13 | I/O | I/O | I/O | I/O | I/O | I/O |
| C14 | I/O | I/O | I/O | I/O | I/O | I/O |
| C15 | I/O | I/O | I/O | I/O | I/O | I/O |
| C16 | I/O | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| C17 | I/O | I/O | I/O | I/O | I/O | I/O |
| C18 | I/O | I/O | I/O | I/O | I/O | I/O |
| C19 | I/O | I/O | I/O | I/O | I/O | I/O |
| C20 | I/O | I/O | I/O | I/O | I/O | I/O |
| C21 | NC | NC | I/O | I/O | I/O | I/O |
| C22 | NC | NC | I/O | I/O | I/O | I/O |
| C23 | NC | NC | I/O | I/O | I/O | I/O |
| C24 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| C25 | NC | NC | NC | I/O | I/O | I/O |
| C26 | NC | NC | NC | I/O | I/O | I/O |
| D1 | NC | NC | NC | I/O | I/O | I/O |
| D2 | NC | NC | NC | I/O | I/O | I/O |
| D3 | NC | I/O | I/O | I/O | I/O | I/O |
| D4 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| D5 | NC | NC | I/O | I/O | I/O | I/O |
| D6 | NC | NC | I/O | I/O | I/O | I/O |
| D7 | I/O | I/O | I/O | I/O | I/O | I/O |
| D8 | I/O | I/O | I/O | I/O | I/O | I/O |
| D9 | I/O | I/O | I/O | I/O | I/O | I/O |
| D10 | I/O | I/O | I/O | I/O | I/O | I/O |
| D11 | I/O | I/O | I/O | I/O | I/O | I/O |
| D12 | I/O | I/O | I/O | I/O | I/O | I/O |
| D13 | I/O | I/O | I/O | I/O | I/O | I/O |
| D14 | I/O | I/O | I/O | I/O | I/O | I/O |
| D15 | I/O | I/O | I/O | I/O | I/O | I/O |
| D16 | I/O | I/O | I/O | I/O | I/O | I/O |
| D17 | I/O | I/O | I/O | I/O | I/O | I/O |
| D18 | I/O | I/O | I/O | I/O | I/O | I/O |
| D19 | I/O | I/O | I/O | I/O | I/O | I/O |
| D20 | I/O | I/O | I/O | I/O | I/O | I/O |
| D21 | I/O | I/O | I/O | I/O | I/O | I/O |
| D22 | NC | NC | I/O | I/O | I/O | I/O |
| D23 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| D24 | NC | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| D25 | NC | NC | NC | I/O | I/O | I/O |
| D26 | NC | NC | NC | I/O | I/O | I/O |
| E1 | NC | I/O | I/O | I/O | I/O | I/O |
| E2 | NC | I/O | I/O | I/O | I/O | I/O |
| E3 | NC | I/O | I/O | I/O | I/O | I/O |
| E4 | NC | I/O | I/O | I/O | I/O | I/O |
| E5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E6 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E7 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E8 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E9 | I/O | I/O | I/O | I/O | I/O | I/O |
| E10 | I/O | I/O | I/O | I/O | I/O | I/O |
| E11 | I/O | I/O | I/O | I/O | I/O | I/O |
| E12 | I/O | I/O | I/O | I/O | I/O | I/O |
| E13 | I/O | I/O | I/O | I/O | I/O | I/O |
| E14 | I/O | I/O | I/O | I/O | I/O | I/O |
| E15 | I/O | I/O | I/O | I/O | I/O | I/O |
| E16 | I/O | I/O | I/O | I/O | I/O | I/O |
| E17 | I/O | I/O | I/O | I/O | I/O | I/O |
| E18 | I/O | I/O | I/O | I/O | I/O | I/O |
| E19 | I/O | I/O | I/O | I/O | I/O | I/O |
| E20 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E21 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E23 | NC | I/O | I/O | I/O | I/O | I/O |
| E24 | NC | I/O | I/O | I/O | I/O | I/O |
| E25 | NC | I/O | I/O | I/O | I/O | I/O |
| E26 | NC | I/O | I/O | I/O | I/O | I/O |
| F1 | NC | I/O | I/O | I/O | I/O | I/O |
| F2 | NC | I/O | I/O | I/O | I/O | I/O |
| F3 | NC | I/O | I/O | I/O | I/O | I/O |
| F4 | NC | I/O | I/O | I/O | I/O | I/O |
| F5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| F22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| F23 | NC | I/O | I/O | I/O | I/O | I/O |
| F24 | NC | I/O | I/O | I/O | I/O | I/O |
| F25 | NC | I/O | I/O | I/O | I/O | I/O |
| F26 | NC | I/O | I/O | I/O | I/O | I/O |
| G1 | I/O | I/O | I/O | I/O | I/O | I/O |
| G2 | I/O | I/O | I/O | I/O | I/O | I/O |
| G3 | NC | I/O | I/O | I/O | I/O | I/O |
| G4 | NC | I/O | I/O | I/O | I/O | I/O |
| G5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| G22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| G23 | NC | I/O | I/O | I/O | I/O | I/O |
| G24 | NC | I/O | I/O | I/O | I/O | I/O |
| G25 | NC | I/O | I/O | I/O | I/O | I/O |
| G26 | I/O | I/O | I/O | I/O | I/O | I/O |
| H1 | I/O | I/O | I/O | I/O | I/O | I/O |
| H2 | I/O | I/O | I/O | I/O | I/O | I/O |
| H3 | I/O | I/O | I/O | I/O | I/O | I/O |
| H4 | I/O | I/O | I/O | I/O | I/O | I/O |
| H5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| H22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| H23 | I/O | I/O | I/O | I/O | I/O | I/O |
| H24 | I/O | I/O | I/O | I/O | I/O | I/O |
| H25 | I/O | I/O | I/O | I/O | I/O | I/O |
| H26 | I/O | I/O | I/O | I/O | I/O | I/O |
| J1 | I/O | I/O | I/O | I/O | I/O | I/O |
| J2 | I/O | I/O | I/O | I/O | I/O | I/O |
| J3 | I/O | I/O | I/O | I/O | I/O | I/O |
| J4 | I/O | I/O | I/O | I/O | I/O | I/O |
| J5 | I/O | I/O | I/O | I/O | I/O | I/O |
| J22 | I/O | I/O | I/O | I/O | I/O | I/O |
| J23 | I/O | I/O | I/O | I/O | I/O | I/O |
| J24 | I/O | I/O | I/O | I/O | I/O | I/O |
| J25 | I/O | I/O | I/O | I/O | I/O | I/O |
| J26 | I/O | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| K1 | I/O | I/O | I/O | I/O | I/O | I/O |
| K2 | I/O | I/O | I/O | I/O | I/O | I/O |
| K3 | I/O | I/O | I/O | I/O | I/O | I/O |
| K4 | I/O | I/O | I/O | I/O | I/O | I/O |
| K5 | I/O | I/O | I/O | I/O | I/O | I/O |
| K22 | I/O | I/O | I/O | I/O | I/O | I/O |
| K23 | I/O | I/O | I/O | I/O | I/O | I/O |
| K24 | I/O | I/O | I/O | I/O | I/O | I/O |
| K25 | I/O | I/O | I/O | I/O | I/O | I/O |
| K26 | I/O | I/O | I/O | I/O | I/O | I/O |
| L1 | I/O | I/O | I/O | I/O | I/O | I/O |
| L2 | I/O | I/O | I/O | I/O | I/O | I/O |
| L3 | I/O | I/O | I/O | I/O | I/O | I/O |
| L4 | I/O | I/O | I/O | I/O | I/O | I/O |
| L5 | I/O | I/O | I/O | I/O | I/O | I/O |
| L11 | GND | GND | GND | GND | GND | GND |
| L12 | GND | GND | GND | GND | GND | GND |
| L13 | GND | GND | GND | GND | GND | GND |
| L14 | GND | GND | GND | GND | GND | GND |
| L15 | GND | GND | GND | GND | GND | GND |
| L16 | GND | GND | GND | GND | GND | GND |
| L22 | I/O | I/O | I/O | I/O | I/O | I/O |
| L23 | I/O | I/O | I/O | I/O | I/O | I/O |
| L24 | I/O | I/O | I/O | I/O | I/O | I/O |
| L25 | I/O | I/O | I/O | I/O | I/O | I/O |
| L26 | I/O | I/O | I/O | I/O | I/O | I/O |
| M1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 |
| M2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 |
| M3 | I/O | I/O | I/O | I/O | I/O | I/O |
| M4 | I/O | I/O | I/O | I/O | I/O | I/O |
| M5 | I/O | I/O | I/O | I/O | I/O | I/O |
| M11 | GND | GND | GND | GND | GND | GND |
| M12 | GND | GND | GND | GND | GND | GND |
| M13 | GND | GND | GND | GND | GND | GND |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| M14 | GND | GND | GND | GND | GND | GND |
| M15 | GND | GND | GND | GND | GND | GND |
| M16 | GND | GND | GND | GND | GND | GND |
| M22 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 |
| M23 | I/O | I/O | I/O | I/O | I/O | I/O |
| M24 | I/O | I/O | I/O | I/O | I/O | I/O |
| M25 | I/O | I/O | I/O | I/O | I/O | I/O |
| M26 | I/O | I/O | I/O | I/O | I/O | I/O |
| N1 | I/O | I/O | I/O | I/O | I/O | I/O |
| N2 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 |
| N3 | AGND | AGND | AGND | AGND | AGND | AGND |
| N4 | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input |
| N5 | AVDD | AVDD | AVDD | AVDD | AVDD | AVDD |
| N11 | GND | GND | GND | GND | GND | GND |
| N12 | GND | GND | GND | GND | GND | GND |
| N13 | GND | GND | GND | GND | GND | GND |
| N14 | GND | GND | GND | GND | GND | GND |
| N15 | GND | GND | GND | GND | GND | GND |
| N16 | GND | GND | GND | GND | GND | GND |
| N22 | NPECL2 | NPECL2 | NPECL2 | NPECL2 | NPECL2 | NPECL2 |
| N23 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 |
| N24 | AVDD | AVDD | AVDD | AVDD | AVDD | AVDD |
| N25 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 |
| N26 | AGND | AGND | AGND | AGND | AGND | AGND |
| P1 | I/O | I/O | I/O | I/O | I/O | I/O |
| P2 | I/O | I/O | I/O | I/O | I/O | I/O |
| P3 | I/O | I/O | I/O | I/O | I/O | I/O |
| P4 | I/O | I/O | I/O | I/O | I/O | I/O |
| P5 | NPECL1 | NPECL1 | NPECL1 | NPECL1 | NPECL1 | NPECL1 |
| P11 | GND | GND | GND | GND | GND | GND |
| P12 | GND | GND | GND | GND | GND | GND |
| P13 | GND | GND | GND | GND | GND | GND |
| P14 | GND | GND | GND | GND | GND | GND |
| P15 | GND | GND | GND | GND | GND | GND |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| P16 | GND | GND | GND | GND | GND | GND |
| P22 | I/O | I/O | I/O | I/O | I/O | I/O |
| P23 | I/O | I/O | I/O | I/O | I/O | I/O |
| P24 | I/O | I/O | I/O | I/O | I/O | I/O |
| P25 | I/O | I/O | I/O | I/O | I/O | I/O |
| P26 | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input |
| R1 | I/O | I/O | I/O | I/O | I/O | I/O |
| R2 | I/O | I/O | I/O | I/O | I/O | I/O |
| R3 | I/O | I/O | I/O | I/O | I/O | I/O |
| R4 | I/O | I/O | I/O | I/O | I/O | I/O |
| R5 | I/O | I/O | I/O | I/O | I/O | I/O |
| R11 | GND | GND | GND | GND | GND | GND |
| R12 | GND | GND | GND | GND | GND | GND |
| R13 | GND | GND | GND | GND | GND | GND |
| R14 | GND | GND | GND | GND | GND | GND |
| R15 | GND | GND | GND | GND | GND | GND |
| R16 | GND | GND | GND | GND | GND | GND |
| R22 | I/O | I/O | I/O | I/O | I/O | I/O |
| R23 | I/O | I/O | I/O | I/O | I/O | I/O |
| R24 | I/O | I/O | I/O | I/O | I/O | I/O |
| R25 | I/O | I/O | I/O | I/O | I/O | I/O |
| R26 | I/O | I/O | I/O | I/O | I/O | I/O |
| T1 | I/O | I/O | I/O | I/O | I/O | I/O |
| T2 | I/O | I/O | I/O | I/O | I/O | I/O |
| T3 | I/O | I/O | I/O | I/O | I/O | I/O |
| T4 | I/O | I/O | I/O | I/O | I/O | I/O |
| T5 | I/O | I/O | I/O | I/O | I/O | I/O |
| T11 | GND | GND | GND | GND | GND | GND |
| T12 | GND | GND | GND | GND | GND | GND |
| T13 | GND | GND | GND | GND | GND | GND |
| T14 | GND | GND | GND | GND | GND | GND |
| T15 | GND | GND | GND | GND | GND | GND |
| T16 | GND | GND | GND | GND | GND | GND |
| T22 | I/O | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| T23 | I/O | I/O | I/O | I/O | I/O | I/O |
| T24 | I/O | I/O | I/O | I/O | I/O | I/O |
| T25 | I/O | I/O | I/O | I/O | I/O | I/O |
| T26 | I/O | I/O | I/O | I/O | I/O | I/O |
| U1 | I/O | I/O | I/O | I/O | I/O | I/O |
| U2 | I/O | I/O | I/O | I/O | I/O | I/O |
| U3 | I/O | I/O | I/O | I/O | I/O | I/O |
| U4 | I/O | I/O | I/O | I/O | I/O | I/O |
| U5 | I/O | I/O | I/O | I/O | I/O | I/O |
| U22 | I/O | I/O | I/O | I/O | I/O | I/O |
| U23 | I/O | I/O | I/O | I/O | I/O | I/O |
| U24 | I/O | I/O | I/O | I/O | I/O | I/O |
| U25 | I/O | I/O | I/O | I/O | I/O | I/O |
| U26 | I/O | I/O | I/O | I/O | I/O | I/O |
| V1 | I/O | I/O | I/O | I/O | I/O | I/O |
| V2 | I/O | I/O | I/O | I/O | I/O | I/O |
| V3 | I/O | I/O | I/O | I/O | I/O | I/O |
| V4 | I/O | I/O | I/O | I/O | I/O | I/O |
| V5 | I/O | I/O | I/O | I/O | I/O | I/O |
| V22 | I/O | I/O | I/O | I/O | I/O | I/O |
| V23 | I/O | I/O | I/O | I/O | I/O | I/O |
| V24 | I/O | I/O | I/O | I/O | I/O | I/O |
| V25 | I/O | I/O | I/O | I/O | I/O | I/O |
| V26 | I/O | I/O | I/O | I/O | I/O | I/O |
| W1 | I/O | I/O | I/O | I/O | I/O | I/O |
| W2 | I/O | I/O | I/O | I/O | I/O | I/O |
| W3 | I/O | I/O | I/O | I/O | I/O | I/O |
| W4 | I/O | I/O | I/O | I/O | I/O | I/O |
| W5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| W22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| W23 | I/O | I/O | I/O | I/O | I/O | I/O |
| W24 | I/O | I/O | I/O | I/O | I/O | I/O |
| W25 | I/O | I/O | I/O | I/O | I/O | I/O |
| W26 | I/O | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| Y1 | I/O | I/O | I/O | I/O | I/O | I/O |
| Y2 | I/O | I/O | I/O | I/O | I/O | I/O |
| Y3 | I/O | I/O | I/O | I/O | I/O | I/O |
| Y4 | NC | I/O | I/O | I/O | I/O | I/O |
| Y5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| Y22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| Y23 | NC | I/O | I/O | I/O | I/O | I/O |
| Y24 | NC | I/O | I/O | I/O | I/O | I/O |
| Y25 | NC | I/O | I/O | I/O | I/O | I/O |
| Y26 | NC | I/O | I/O | I/O | I/O | I/O |
| AA1 | I/O | I/O | I/O | I/O | I/O | I/O |
| AA2 | NC | I/O | I/O | I/O | I/O | I/O |
| AA3 | NC | I/O | I/O | I/O | I/O | I/O |
| AA4 | NC | I/O | I/O | I/O | I/O | I/O |
| AA5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AA22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AA23 | NC | I/O | I/O | I/O | I/O | I/O |
| AA24 | NC | I/O | I/O | I/O | I/O | I/O |
| AA25 | NC | I/O | I/O | I/O | I/O | I/O |
| AA26 | NC | I/O | I/O | I/O | I/O | I/O |
| AB1 | NC | I/O | I/O | I/O | I/O | I/O |
| AB2 | NC | I/O | I/O | I/O | I/O | I/O |
| AB3 | NC | I/O | I/O | I/O | I/O | I/O |
| AB4 | NC | I/O | I/O | I/O | I/O | I/O |
| AB5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AB6 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AB7 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AB8 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB9 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB10 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB11 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB12 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB13 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB14 | I/O | I/O | I/O | I/O | I/O | I/O |

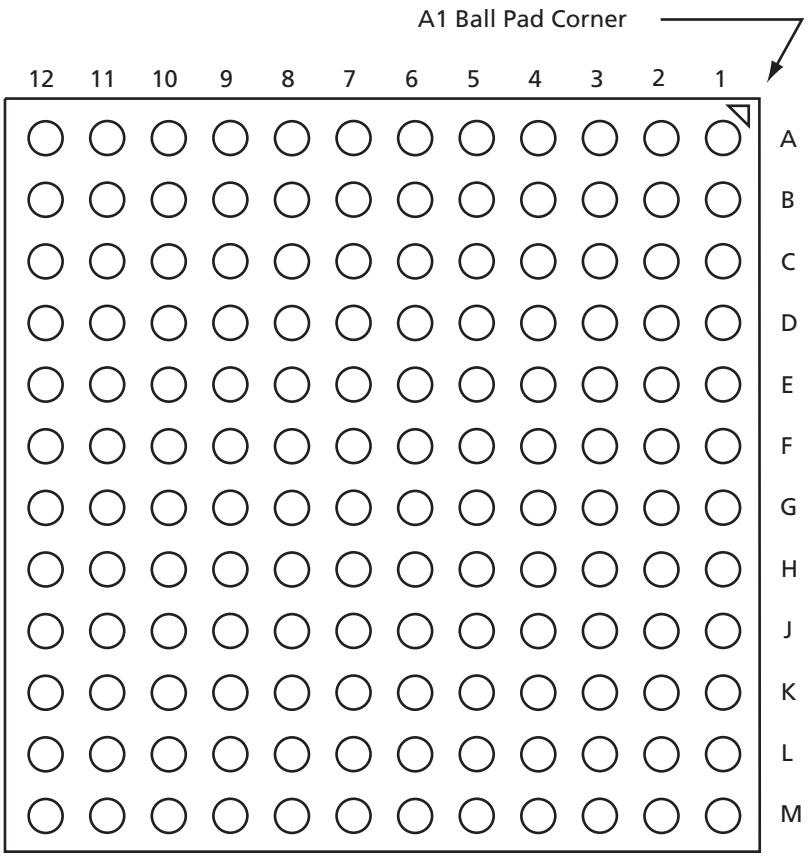
| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| AB15 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB16 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB17 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB18 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB19 | I/O | I/O | I/O | I/O | I/O | I/O |
| AB20 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AB21 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AB22 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| AB23 | NC | I/O | I/O | I/O | I/O | I/O |
| AB24 | NC | I/O | I/O | I/O | I/O | I/O |
| AB25 | NC | I/O | I/O | I/O | I/O | I/O |
| AB26 | NC | NC | NC | I/O | I/O | I/O |
| AC1 | NC | I/O | I/O | I/O | I/O | I/O |
| AC2 | NC | I/O | I/O | I/O | I/O | I/O |
| AC3 | NC | I/O | I/O | I/O | I/O | I/O |
| AC4 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AC5 | NC | NC | I/O | I/O | I/O | I/O |
| AC6 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC7 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC8 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC9 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC10 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC11 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC12 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC13 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC14 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC15 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC16 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC17 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC18 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC19 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC20 | I/O | I/O | I/O | I/O | I/O | I/O |
| AC21 | TMS | TMS | TMS | TMS | TMS | TMS |
| AC22 | TDO | TDO | TDO | TDO | TDO | TDO |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| AC23 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AC24 | RCK | RCK | RCK | RCK | RCK | RCK |
| AC25 | NC | NC | I/O | I/O | I/O | I/O |
| AC26 | NC | I/O | I/O | I/O | I/O | I/O |
| AD1 | NC | NC | NC | I/O | I/O | I/O |
| AD2 | NC | I/O | I/O | I/O | I/O | I/O |
| AD3 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AD4 | NC | NC | I/O | I/O | I/O | I/O |
| AD5 | NC | NC | I/O | I/O | I/O | I/O |
| AD6 | NC | NC | I/O | I/O | I/O | I/O |
| AD7 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD8 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD9 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD10 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD11 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD12 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD13 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD14 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD15 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD16 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD17 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD18 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD19 | I/O | I/O | I/O | I/O | I/O | I/O |
| AD20 | NC | NC | I/O | I/O | I/O | I/O |
| AD21 | TCK | TCK | TCK | TCK | TCK | TCK |
| AD22 | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ |
| AD23 | NC | NC | NC | I/O | I/O | I/O |
| AD24 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AD25 | NC | NC | I/O | I/O | I/O | I/O |
| AD26 | NC | NC | I/O | I/O | I/O | I/O |
| AE1 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AE2 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AE3 | NC | NC | I/O | I/O | I/O | I/O |
| AE4 | NC | NC | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| AE5 | NC | NC | I/O | I/O | I/O | I/O |
| AE6 | NC | NC | I/O | I/O | I/O | I/O |
| AE7 | NC | NC | I/O | I/O | I/O | I/O |
| AE8 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE9 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE10 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE11 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE12 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE13 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE14 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE15 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE16 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE17 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE18 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE19 | I/O | I/O | I/O | I/O | I/O | I/O |
| AE20 | NC | NC | I/O | I/O | I/O | I/O |
| AE21 | NC | NC | I/O | I/O | I/O | I/O |
| AE22 | NC | NC | I/O | I/O | I/O | I/O |
| AE23 | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ |
| AE24 | TRST | TRST | TRST | TRST | TRST | TRST |
| AE25 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AE26 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AF1 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AF2 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AF3 | NC | NC | I/O | I/O | I/O | I/O |
| AF4 | NC | NC | I/O | I/O | I/O | I/O |
| AF5 | NC | NC | I/O | I/O | I/O | I/O |
| AF6 | NC | NC | I/O | I/O | I/O | I/O |
| AF7 | NC | NC | I/O | I/O | I/O | I/O |
| AF8 | NC | NC | NC | I/O | I/O | I/O |
| AF9 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF10 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF11 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF12 | I/O | I/O | I/O | I/O | I/O | I/O |

| 456-Pin PBGA | | | | | | |
|---|---|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** | **APA750 Function** | **APA1000 Function** |
| AF13 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF14 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF15 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF16 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF17 | I/O | I/O | I/O | I/O | I/O | I/O |
| AF18 | NC | NC | I/O | I/O | I/O | I/O |
| AF19 | NC | NC | I/O | I/O | I/O | I/O |
| AF20 | NC | NC | I/O | I/O | I/O | I/O |
| AF21 | NC | NC | I/O | I/O | I/O | I/O |
| AF22 | NC | NC | I/O | I/O | I/O | I/O |
| AF23 | TDI | TDI | TDI | TDI | TDI | TDI |
| AF24 | NC | NC | I/O | I/O | I/O | I/O |
| AF25 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| AF26 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |

# 144-Pin FBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

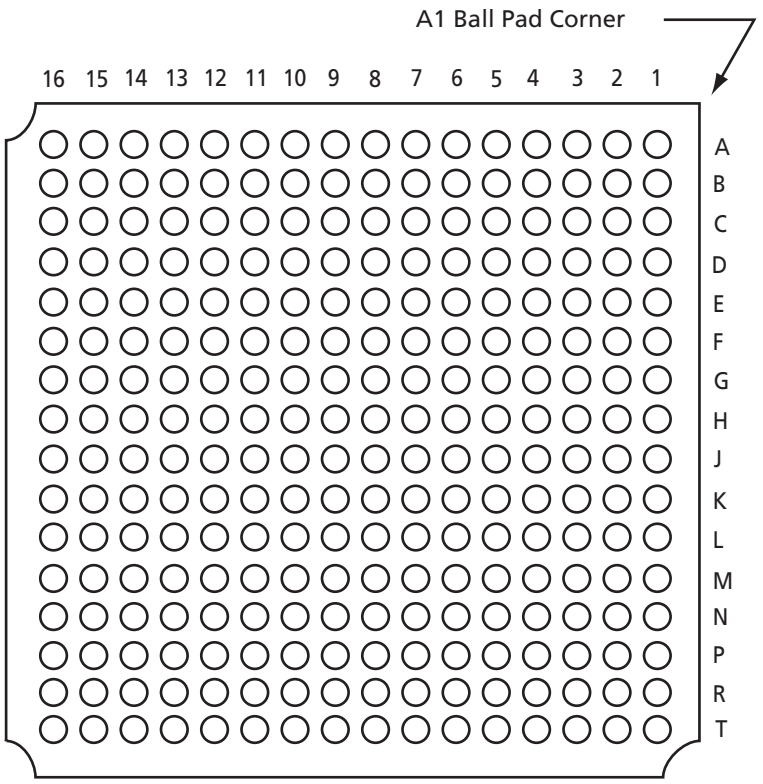
| 144-FBGA Pin | | | | |
|---|---|---|---|---|
| Pin Number | APA075 Function | APA150 Function | APA300 Function | APA450 Function |
| A1 | I/O | I/O | I/O | I/O |
| A2 | I/O | I/O | I/O | I/O |
| A3 | I/O | I/O | I/O | I/O |
| A4 | I/O | I/O | I/O | I/O |
| A5 | I/O | I/O | I/O | I/O |
| A6 | GND | GND | GND | GND |
| A7 | I/O | I/O | I/O | I/O |
| A8 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| A9 | I/O | I/O | I/O | I/O |
| A10 | I/O | I/O | I/O | I/O |
| A11 | I/O | I/O | I/O | I/O |
| A12 | I/O | I/O | I/O | I/O |
| B1 | I/O | I/O | I/O | I/O |
| B2 | GND | GND | GND | GND |
| B3 | I/O | I/O | I/O | I/O |
| B4 | I/O | I/O | I/O | I/O |
| B5 | I/O | I/O | I/O | I/O |
| B6 | I/O | I/O | I/O | I/O |
| B7 | I/O | I/O | I/O | I/O |
| B8 | I/O | I/O | I/O | I/O |
| B9 | I/O | I/O | I/O | I/O |
| B10 | I/O | I/O | I/O | I/O |
| B11 | GND | GND | GND | GND |
| B12 | I/O | I/O | I/O | I/O |
| C1 | I/O | I/O | I/O | I/O |
| C2 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 |
| C3 | I/O | I/O | I/O | I/O |
| C4 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| C5 | I/O | I/O | I/O | I/O |
| C6 | I/O | I/O | I/O | I/O |
| C7 | I/O | I/O | I/O | I/O |
| C8 | I/O | I/O | I/O | I/O |
| C9 | I/O | I/O | I/O | I/O |
| C10 | I/O | I/O | I/O | I/O |
| C11 | I/O | I/O | I/O | I/O |
| C12 | I/O | I/O | I/O | I/O |
| D1 | I/O | I/O | I/O | I/O |

| 144-FBGA Pin | | | | |
|---|---|---|---|---|
| Pin Number | APA075 Function | APA150 Function | APA300 Function | APA450 Function |
| D2 | I/O | I/O | I/O | I/O |
| D3 | I/O | I/O | I/O | I/O |
| D4 | I/O | I/O | I/O | I/O |
| D5 | I/O | I/O | I/O | I/O |
| D6 | I/O | I/O | I/O | I/O |
| D7 | I/O | I/O | I/O | I/O |
| D8 | I/O | I/O | I/O | I/O |
| D9 | I/O | I/O | I/O | I/O |
| D10 | I/O | I/O | I/O | I/O |
| D11 | I/O | I/O | I/O | I/O |
| D12 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 |
| E1 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E2 | I/O | I/O | I/O | I/O |
| E3 | I/O | I/O | I/O | I/O |
| E4 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E5 | I/O | I/O | I/O | I/O |
| E6 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E7 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E8 | AVDD | AVDD | AVDD | AVDD |
| E9 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E10 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| E11 | NPECL2 | NPECL2 | NPECL2 | NPECL2 |
| E12 | AGND | AGND | AGND | AGND |
| F1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 |
| F2 | AGND | AGND | AGND | AGND |
| F3 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 |
| F4 | I/O | I/O | I/O | I/O |
| F5 | GND | GND | GND | GND |
| F6 | GND | GND | GND | GND |
| F7 | GND | GND | GND | GND |
| F8 | I/O | I/O | I/O | I/O |
| F9 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 |
| F10 | GND | GND | GND | GND |
| F11 | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input |
| F12 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 |

| 144-FBGA Pin | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** |
| G1 | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input |
| G2 | GND | GND | GND | GND |
| G3 | AVDD | AVDD | AVDD | AVDD |
| G4 | NPECL1 | NPECL1 | NPECL1 | NPECL1 |
| G5 | GND | GND | GND | GND |
| G6 | GND | GND | GND | GND |
| G7 | GND | GND | GND | GND |
| G8 | I/O | I/O | I/O | I/O |
| G9 | I/O | I/O | I/O | I/O |
| G10 | I/O | I/O | I/O | I/O |
| G11 | I/O | I/O | I/O | I/O |
| G12 | I/O | I/O | I/O | I/O |
| H1 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| H2 | I/O | I/O | I/O | I/O |
| H3 | I/O | I/O | I/O | I/O |
| H4 | I/O | I/O | I/O | I/O |
| H5 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| H6 | I/O | I/O | I/O | I/O |
| H7 | I/O | I/O | I/O | I/O |
| H8 | I/O | I/O | I/O | I/O |
| H9 | I/O | I/O | I/O | I/O |
| H10 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| H11 | I/O | I/O | I/O | I/O |
| H12 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| J1 | I/O | I/O | I/O | I/O |
| J2 | I/O | I/O | I/O | I/O |
| J3 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| J4 | I/O | I/O | I/O | I/O |
| J5 | I/O | I/O | I/O | I/O |
| J6 | I/O | I/O | I/O | I/O |
| J7 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| J8 | TCK | TCK | TCK | TCK |
| J9 | I/O | I/O | I/O | I/O |
| J10 | TDO | TDO | TDO | TDO |
| J11 | I/O | I/O | I/O | I/O |
| J12 | I/O | I/O | I/O | I/O |

| 144-FBGA Pin | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA075 Function** | **APA150 Function** | **APA300 Function** | **APA450 Function** |
| K1 | I/O | I/O | I/O | I/O |
| K2 | I/O | I/O | I/O | I/O |
| K3 | I/O | I/O | I/O | I/O |
| K4 | I/O | I/O | I/O | I/O |
| K5 | I/O | I/O | I/O | I/O |
| K6 | I/O | I/O | I/O | I/O |
| K7 | GND | GND | GND | GND |
| K8 | I/O | I/O | I/O | I/O |
| K9 | I/O | I/O | I/O | I/O |
| K10 | GND | GND | GND | GND |
| K11 | I/O | I/O | I/O | I/O |
| K12 | I/O | I/O | I/O | I/O |
| L1 | GND | GND | GND | GND |
| L2 | I/O | I/O | I/O | I/O |
| L3 | I/O | I/O | I/O | I/O |
| L4 | I/O | I/O | I/O | I/O |
| L5 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| L6 | I/O | I/O | I/O | I/O |
| L7 | I/O | I/O | I/O | I/O |
| L8 | I/O | I/O | I/O | I/O |
| L9 | TMS | TMS | TMS | TMS |
| L10 | RCK | RCK | RCK | RCK |
| L11 | I/O | I/O | I/O | I/O |
| L12 | TRST | TRST | TRST | TRST |
| M1 | I/O | I/O | I/O | I/O |
| M2 | I/O | I/O | I/O | I/O |
| M3 | I/O | I/O | I/O | I/O |
| M4 | I/O | I/O | I/O | I/O |
| M5 | I/O | I/O | I/O | I/O |
| M6 | I/O | I/O | I/O | I/O |
| M7 | I/O | I/O | I/O | I/O |
| M8 | I/O | I/O | I/O | I/O |
| M9 | TDI | TDI | TDI | TDI |
| M10 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| M11 | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ |
| M12 | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ |

# 256-Pin FBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| Pin Number | APA150 Function | APA300 Function | APA450 Function | APA600 Function |
| A1 | GND | GND | GND | GND |
| A2 | I/O | I/O | I/O | I/O |
| A3 | I/O | I/O | I/O | I/O |
| A4 | I/O | I/O | I/O | I/O |
| A5 | I/O | I/O | I/O | I/O |
| A6 | I/O | I/O | I/O | I/O |
| A7 | I/O | I/O | I/O | I/O |
| A8 | I/O | I/O | I/O | I/O |
| A9 | I/O | I/O | I/O | I/O |
| A10 | I/O | I/O | I/O | I/O |
| A11 | I/O | I/O | I/O | I/O |
| A12 | I/O | I/O | I/O | I/O |
| A13 | I/O | I/O | I/O | I/O |
| A14 | I/O | I/O | I/O | I/O |
| A15 | I/O | I/O | I/O | I/O |
| A16 | GND | GND | GND | GND |
| B1 | I/O | I/O | I/O | I/O |
| B2 | I/O | I/O | I/O | I/O |
| B3 | I/O | I/O | I/O | I/O |
| B4 | I/O | I/O | I/O | I/O |
| B5 | I/O | I/O | I/O | I/O |
| B6 | I/O | I/O | I/O | I/O |
| B7 | I/O | I/O | I/O | I/O |
| B8 | I/O | I/O | I/O | I/O |
| B9 | I/O | I/O | I/O | I/O |
| B10 | I/O | I/O | I/O | I/O |
| B11 | I/O | I/O | I/O | I/O |
| B12 | I/O | I/O | I/O | I/O |
| B13 | I/O | I/O | I/O | I/O |
| B14 | I/O | I/O | I/O | I/O |
| B15 | I/O | I/O | I/O | I/O |
| B16 | I/O | I/O | I/O | I/O |
| C1 | I/O | I/O | I/O | I/O |
| C2 | I/O | I/O | I/O | I/O |
| C3 | I/O | I/O | I/O | I/O |

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| Pin Number | APA150 Function | APA300 Function | APA450 Function | APA600 Function |
| C4 | I/O | I/O | I/O | I/O |
| C5 | I/O | I/O | I/O | I/O |
| C6 | I/O | I/O | I/O | I/O |
| C7 | I/O | I/O | I/O | I/O |
| C8 | I/O | I/O | I/O | I/O |
| C9 | I/O | I/O | I/O | I/O |
| C10 | I/O | I/O | I/O | I/O |
| C11 | I/O | I/O | I/O | I/O |
| C12 | I/O | I/O | I/O | I/O |
| C13 | I/O | I/O | I/O | I/O |
| C14 | I/O | I/O | I/O | I/O |
| C15 | I/O | I/O | I/O | I/O |
| C16 | I/O | I/O | I/O | I/O |
| D1 | I/O | I/O | I/O | I/O |
| D2 | I/O | I/O | I/O | I/O |
| D3 | I/O | I/O | I/O | I/O |
| D4 | I/O | I/O | I/O | I/O |
| D5 | I/O | I/O | I/O | I/O |
| D6 | I/O | I/O | I/O | I/O |
| D7 | I/O | I/O | I/O | I/O |
| D8 | I/O | I/O | I/O | I/O |
| D9 | I/O | I/O | I/O | I/O |
| D10 | I/O | I/O | I/O | I/O |
| D11 | I/O | I/O | I/O | I/O |
| D12 | I/O | I/O | I/O | I/O |
| D13 | I/O | I/O | I/O | I/O |
| D14 | I/O | I/O | I/O | I/O |
| D15 | I/O | I/O | I/O | I/O |
| D16 | I/O | I/O | I/O | I/O |
| E1 | I/O | I/O | I/O | I/O |
| E2 | I/O | I/O | I/O | I/O |
| E3 | I/O | I/O | I/O | I/O |
| E4 | I/O | I/O | I/O | I/O |
| E5 | I/O | I/O | I/O | I/O |
| E6 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** |
| E7 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E8 | I/O | I/O | I/O | I/O |
| E9 | I/O | I/O | I/O | I/O |
| E10 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E11 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| E12 | I/O | I/O | I/O | I/O |
| E13 | I/O | I/O | I/O | I/O |
| E14 | I/O | I/O | I/O | I/O |
| E15 | I/O | I/O | I/O | I/O |
| E16 | I/O | I/O | I/O | I/O |
| F1 | I/O | I/O | I/O | I/O |
| F2 | I/O | I/O | I/O | I/O |
| F3 | I/O | I/O | I/O | I/O |
| F4 | I/O | I/O | I/O | I/O |
| F5 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| F6 | GND | GND | GND | GND |
| F7 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| F8 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| F9 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| F10 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| F11 | GND | GND | GND | GND |
| F12 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| F13 | I/O | I/O | I/O | I/O |
| F14 | I/O | I/O | I/O | I/O |
| F15 | I/O | I/O | I/O | I/O |
| F16 | I/O | I/O | I/O | I/O |
| G1 | I/O | I/O | I/O | I/O |
| G2 | I/O | I/O | I/O | I/O |
| G3 | I/O | I/O | I/O | I/O |
| G4 | I/O | I/O | I/O | I/O |
| G5 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| G6 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| G7 | GND | GND | GND | GND |
| G8 | GND | GND | GND | GND |
| G9 | GND | GND | GND | GND |

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** |
| G10 | GND | GND | GND | GND |
| G11 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| G12 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| G13 | I/O | I/O | I/O | I/O |
| G14 | I/O | I/O | I/O | I/O |
| G15 | I/O | I/O | I/O | I/O |
| G16 | I/O | I/O | I/O | I/O |
| H1 | I/O / GL1 | I/O / GL1 | I/O / GL1 | I/O / GL1 |
| H2 | NPECL1 | NPECL1 | NPECL1 | NPECL1 |
| H3 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 | I/O / GLMX1 |
| H4 | AGND | AGND | AGND | AGND |
| H5 | I/O | I/O | I/O | I/O |
| H6 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| H7 | GND | GND | GND | GND |
| H8 | GND | GND | GND | GND |
| H9 | GND | GND | GND | GND |
| H10 | GND | GND | GND | GND |
| H11 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| H12 | I/O | I/O | I/O | I/O |
| H13 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 | I/O / GLMX2 |
| H14 | NPECL2 | NPECL2 | NPECL2 | NPECL2 |
| H15 | AGND | AGND | AGND | AGND |
| H16 | I/O / GL4 | I/O / GL4 | I/O / GL4 | I/O / GL4 |
| J1 | I/O / GL2 | I/O / GL2 | I/O / GL2 | I/O / GL2 |
| J2 | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input | PPECL1 / Input |
| J3 | AVDD | AVDD | AVDD | AVDD |
| J4 | I/O | I/O | I/O | I/O |
| J5 | I/O | I/O | I/O | I/O |
| J6 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| J7 | GND | GND | GND | GND |
| J8 | GND | GND | GND | GND |
| J9 | GND | GND | GND | GND |
| J10 | GND | GND | GND | GND |
| J11 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |

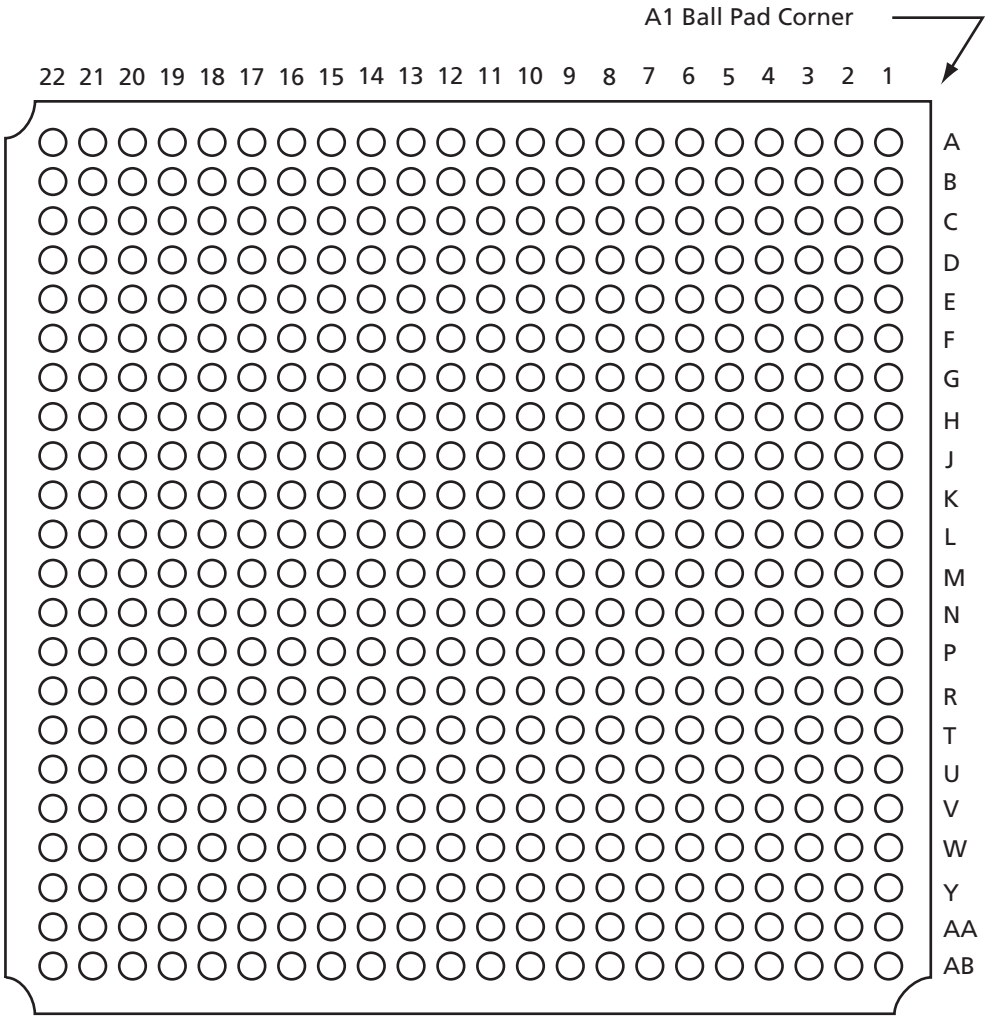
| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** |
| J12 | I/O | I/O | I/O | I/O |
| J13 | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input | PPECL2 / Input |
| J14 | I/O | I/O | I/O | I/O |
| J15 | AVDD | AVDD | AVDD | AVDD |
| J16 | I/O / GL3 | I/O / GL3 | I/O / GL3 | I/O / GL3 |
| K1 | I/O | I/O | I/O | I/O |
| K2 | I/O | I/O | I/O | I/O |
| K3 | I/O | I/O | I/O | I/O |
| K4 | I/O | I/O | I/O | I/O |
| K5 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| K6 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| K7 | GND | GND | GND | GND |
| K8 | GND | GND | GND | GND |
| K9 | GND | GND | GND | GND |
| K10 | GND | GND | GND | GND |
| K11 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| K12 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| K13 | I/O | I/O | I/O | I/O |
| K14 | I/O | I/O | I/O | I/O |
| K15 | I/O | I/O | I/O | I/O |
| K16 | I/O | I/O | I/O | I/O |
| L1 | I/O | I/O | I/O | I/O |
| L2 | I/O | I/O | I/O | I/O |
| L3 | I/O | I/O | I/O | I/O |
| L4 | I/O | I/O | I/O | I/O |
| L5 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| L6 | GND | GND | GND | GND |
| L7 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| L8 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| L9 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| L10 | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ | $V_{DD}$ |
| L11 | GND | GND | GND | GND |
| L12 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| L13 | I/O | I/O | I/O | I/O |

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** |
| L14 | I/O | I/O | I/O | I/O |
| L15 | I/O | I/O | I/O | I/O |
| L16 | I/O | I/O | I/O | I/O |
| M1 | I/O | I/O | I/O | I/O |
| M2 | I/O | I/O | I/O | I/O |
| M3 | I/O | I/O | I/O | I/O |
| M4 | I/O | I/O | I/O | I/O |
| M5 | I/O | I/O | I/O | I/O |
| M6 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| M7 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| M8 | I/O | I/O | I/O | I/O |
| M9 | I/O | I/O | I/O | I/O |
| M10 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| M11 | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ | $V_{DDP}$ |
| M12 | I/O | I/O | I/O | I/O |
| M13 | I/O | I/O | I/O | I/O |
| M14 | I/O | I/O | I/O | I/O |
| M15 | I/O | I/O | I/O | I/O |
| M16 | I/O | I/O | I/O | I/O |
| N1 | I/O | I/O | I/O | I/O |
| N2 | I/O | I/O | I/O | I/O |
| N3 | I/O | I/O | I/O | I/O |
| N4 | I/O | I/O | I/O | I/O |
| N5 | I/O | I/O | I/O | I/O |
| N6 | I/O | I/O | I/O | I/O |
| N7 | I/O | I/O | I/O | I/O |
| N8 | I/O | I/O | I/O | I/O |
| N9 | I/O | I/O | I/O | I/O |
| N10 | I/O | I/O | I/O | I/O |
| N11 | I/O | I/O | I/O | I/O |
| N12 | I/O | I/O | I/O | I/O |
| N13 | I/O | I/O | I/O | I/O |
| N14 | RCK | RCK | RCK | RCK |
| N15 | I/O | I/O | I/O | I/O |
| N16 | I/O | I/O | I/O | I/O |

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** |
| P1 | I/O | I/O | I/O | I/O |
| P2 | I/O | I/O | I/O | I/O |
| P3 | I/O | I/O | I/O | I/O |
| P4 | I/O | I/O | I/O | I/O |
| P5 | I/O | I/O | I/O | I/O |
| P6 | I/O | I/O | I/O | I/O |
| P7 | I/O | I/O | I/O | I/O |
| P8 | I/O | I/O | I/O | I/O |
| P9 | I/O | I/O | I/O | I/O |
| P10 | I/O | I/O | I/O | I/O |
| P11 | I/O | I/O | I/O | I/O |
| P12 | I/O | I/O | I/O | I/O |
| P13 | TCK | TCK | TCK | TCK |
| P14 | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ | $V_{PP}$ |
| P15 | TRST | TRST | TRST | TRST |
| P16 | I/O | I/O | I/O | I/O |
| R1 | I/O | I/O | I/O | I/O |
| R2 | I/O | I/O | I/O | I/O |
| R3 | I/O | I/O | I/O | I/O |
| R4 | I/O | I/O | I/O | I/O |
| R5 | I/O | I/O | I/O | I/O |
| R6 | I/O | I/O | I/O | I/O |
| R7 | I/O | I/O | I/O | I/O |
| R8 | I/O | I/O | I/O | I/O |
| R9 | I/O | I/O | I/O | I/O |
| R10 | I/O | I/O | I/O | I/O |
| R11 | I/O | I/O | I/O | I/O |
| R12 | I/O | I/O | I/O | I/O |
| R13 | I/O | I/O | I/O | I/O |
| R14 | TDI | TDI | TDI | TDI |
| R15 | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ | $V_{PN}$ |
| R16 | TDO | TDO | TDO | TDO |
| T1 | GND | GND | GND | GND |
| T2 | I/O | I/O | I/O | I/O |
| T3 | I/O | I/O | I/O | I/O |

| 256-Pin FBGA | | | | |
|---|---|---|---|---|
| **Pin Number** | **APA150 Function** | **APA300 Function** | **APA450 Function** | **APA600 Function** |
| T4 | I/O | I/O | I/O | I/O |
| T5 | I/O | I/O | I/O | I/O |
| T6 | I/O | I/O | I/O | I/O |
| T7 | I/O | I/O | I/O | I/O |
| T8 | I/O | I/O | I/O | I/O |
| T9 | I/O | I/O | I/O | I/O |
| T10 | I/O | I/O | I/O | I/O |
| T11 | I/O | I/O | I/O | I/O |
| T12 | I/O | I/O | I/O | I/O |
| T13 | I/O | I/O | I/O | I/O |
| T14 | I/O | I/O | I/O | I/O |
| T15 | TMS | TMS | TMS | TMS |
| T16 | GND | GND | GND | GND |

# 484-Pin FBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| A1 | GND | GND |
| A2 | GND | GND |
| A3 | $V_{DDP}$ | $V_{DDP}$ |
| A4 | I/O | I/O |
| A5 | I/O | I/O |
| A6 | I/O | I/O |
| A7 | I/O | I/O |
| A8 | I/O | I/O |
| A9 | I/O | I/O |
| A10 | I/O | I/O |
| A11 | I/O | I/O |
| A12 | I/O | I/O |
| A13 | I/O | I/O |
| A14 | I/O | I/O |
| A15 | I/O | I/O |
| A16 | I/O | I/O |
| A17 | I/O | I/O |
| A18 | I/O | I/O |
| A19 | I/O | I/O |
| A20 | $V_{DDP}$ | $V_{DDP}$ |
| A21 | GND | GND |
| A22 | GND | GND |
| B1 | GND | GND |
| B2 | $V_{DDP}$ | $V_{DDP}$ |
| B3 | I/O | I/O |
| B4 | I/O | I/O |
| B5 | I/O | I/O |
| B6 | I/O | I/O |
| B7 | I/O | I/O |
| B8 | I/O | I/O |
| B9 | I/O | I/O |
| B10 | I/O | I/O |
| B11 | I/O | I/O |
| B12 | I/O | I/O |
| B13 | I/O | I/O |
| B14 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| B15 | I/O | I/O |
| B16 | I/O | I/O |
| B17 | I/O | I/O |
| B18 | I/O | I/O |
| B19 | I/O | I/O |
| B20 | I/O | I/O |
| B21 | $V_{DDP}$ | $V_{DDP}$ |
| B22 | GND | GND |
| C1 | $V_{DDP}$ | $V_{DDP}$ |
| C2 | NC | I/O |
| C3 | I/O | I/O |
| C4 | I/O | I/O |
| C5 | GND | GND |
| C6 | I/O | I/O |
| C7 | I/O | I/O |
| C8 | $V_{DD}$ | $V_{DD}$ |
| C9 | $V_{DD}$ | $V_{DD}$ |
| C10 | I/O | I/O |
| C11 | I/O | I/O |
| C12 | NC | I/O |
| C13 | NC | I/O |
| C14 | $V_{DD}$ | $V_{DD}$ |
| C15 | $V_{DD}$ | $V_{DD}$ |
| C16 | NC | I/O |
| C17 | I/O | I/O |
| C18 | GND | GND |
| C19 | I/O | I/O |
| C20 | I/O | I/O |
| C21 | I/O | I/O |
| C22 | $V_{DDP}$ | $V_{DDP}$ |
| D1 | I/O | I/O |
| D2 | I/O | I/O |
| D3 | NC | I/O |
| D4 | GND | GND |
| D5 | I/O | I/O |
| D6 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| D7 | I/O | I/O |
| D8 | I/O | I/O |
| D9 | I/O | I/O |
| D10 | I/O | I/O |
| D11 | I/O | I/O |
| D12 | I/O | I/O |
| D13 | I/O | I/O |
| D14 | I/O | I/O |
| D15 | I/O | I/O |
| D16 | I/O | I/O |
| D17 | I/O | I/O |
| D18 | I/O | I/O |
| D19 | GND | GND |
| D20 | I/O | I/O |
| D21 | I/O | I/O |
| D22 | I/O | I/O |
| E1 | I/O | I/O |
| E2 | NC | I/O |
| E3 | GND | GND |
| E4 | I/O | I/O |
| E5 | I/O | I/O |
| E6 | I/O | I/O |
| E7 | I/O | I/O |
| E8 | I/O | I/O |
| E9 | I/O | I/O |
| E10 | I/O | I/O |
| E11 | I/O | I/O |
| E12 | I/O | I/O |
| E13 | I/O | I/O |
| E14 | I/O | I/O |
| E15 | I/O | I/O |
| E16 | I/O | I/O |
| E17 | I/O | I/O |
| E18 | I/O | I/O |
| E19 | I/O | I/O |
| E20 | GND | GND |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| E21 | I/O | I/O |
| E22 | I/O | I/O |
| F1 | I/O | I/O |
| F2 | I/O | I/O |
| F3 | I/O | I/O |
| F4 | I/O | I/O |
| F5 | I/O | I/O |
| F6 | I/O | I/O |
| F7 | I/O | I/O |
| F8 | I/O | I/O |
| F9 | I/O | I/O |
| F10 | I/O | I/O |
| F11 | I/O | I/O |
| F12 | I/O | I/O |
| F13 | I/O | I/O |
| F14 | I/O | I/O |
| F15 | I/O | I/O |
| F16 | I/O | I/O |
| F17 | I/O | I/O |
| F18 | I/O | I/O |
| F19 | I/O | I/O |
| F20 | I/O | I/O |
| F21 | I/O | I/O |
| F22 | NC | I/O |
| G1 | I/O | I/O |
| G2 | I/O | I/O |
| G3 | NC | I/O |
| G4 | I/O | I/O |
| G5 | I/O | I/O |
| G6 | I/O | I/O |
| G7 | I/O | I/O |
| G8 | I/O | I/O |
| G9 | I/O | I/O |
| G10 | I/O | I/O |
| G11 | I/O | I/O |
| G12 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| G13 | I/O | I/O |
| G14 | I/O | I/O |
| G15 | I/O | I/O |
| G16 | I/O | I/O |
| G17 | I/O | I/O |
| G18 | I/O | I/O |
| G19 | I/O | I/O |
| G20 | I/O | I/O |
| G21 | I/O | I/O |
| G22 | I/O | I/O |
| H1 | I/O | I/O |
| H2 | I/O | I/O |
| H3 | $V_{DD}$ | $V_{DD}$ |
| H4 | I/O | I/O |
| H5 | I/O | I/O |
| H6 | I/O | I/O |
| H7 | I/O | I/O |
| H8 | I/O | I/O |
| H9 | $V_{DDP}$ | $V_{DDP}$ |
| H10 | $V_{DDP}$ | $V_{DDP}$ |
| H11 | I/O | I/O |
| H12 | I/O | I/O |
| H13 | $V_{DDP}$ | $V_{DDP}$ |
| H14 | $V_{DDP}$ | $V_{DDP}$ |
| H15 | I/O | I/O |
| H16 | I/O | I/O |
| H17 | I/O | I/O |
| H18 | I/O | I/O |
| H19 | I/O | I/O |
| H20 | $V_{DD}$ | $V_{DD}$ |
| H21 | I/O | I/O |
| H22 | I/O | I/O |
| J1 | I/O | I/O |
| J2 | I/O | I/O |
| J3 | NC | I/O |
| J4 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| J5 | I/O | I/O |
| J6 | I/O | I/O |
| J7 | I/O | I/O |
| J8 | $V_{DDP}$ | $V_{DDP}$ |
| J9 | GND | GND |
| J10 | $V_{DD}$ | $V_{DD}$ |
| J11 | $V_{DD}$ | $V_{DD}$ |
| J12 | $V_{DD}$ | $V_{DD}$ |
| J13 | $V_{DD}$ | $V_{DD}$ |
| J14 | GND | GND |
| J15 | $V_{DDP}$ | $V_{DDP}$ |
| J16 | I/O | I/O |
| J17 | I/O | I/O |
| J18 | I/O | I/O |
| J19 | I/O | I/O |
| J20 | NC | I/O |
| J21 | I/O | I/O |
| J22 | I/O | I/O |
| K1 | I/O | I/O |
| K2 | I/O | I/O |
| K3 | NC | I/O |
| K4 | I/O | I/O |
| K5 | I/O | I/O |
| K6 | I/O | I/O |
| K7 | I/O | I/O |
| K8 | $V_{DDP}$ | $V_{DDP}$ |
| K9 | $V_{DD}$ | $V_{DD}$ |
| K10 | GND | GND |
| K11 | GND | GND |
| K12 | GND | GND |
| K13 | GND | GND |
| K14 | $V_{DD}$ | $V_{DD}$ |
| K15 | $V_{DDP}$ | $V_{DDP}$ |
| K16 | I/O | I/O |
| K17 | I/O | I/O |
| K18 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| K19 | I/O | I/O |
| K20 | I/O | I/O |
| K21 | I/O | I/O |
| K22 | I/O | I/O |
| L1 | NC | I/O |
| L2 | I/O | I/O |
| L3 | I/O | I/O |
| L4 | I/O / GL1 | I/O / GL1 |
| L5 | NPECL1 | NPECL1 |
| L6 | I/O / GLMX1 | I/O / GLMX1 |
| L7 | AGND | AGND |
| L8 | I/O | I/O |
| L9 | $V_{DD}$ | $V_{DD}$ |
| L10 | GND | GND |
| L11 | GND | GND |
| L12 | GND | GND |
| L13 | GND | GND |
| L14 | $V_{DD}$ | $V_{DD}$ |
| L15 | I/O | I/O |
| L16 | I/O / GLMX2 | I/O / GLMX2 |
| L17 | NPECL2 | NPECL2 |
| L18 | AGND | AGND |
| L19 | I/O / GL4 | I/O / GL4 |
| L20 | I/O | I/O |
| L21 | I/O | I/O |
| L22 | I/O | I/O |
| M1 | I/O | I/O |
| M2 | I/O | I/O |
| M3 | I/O | I/O |
| M4 | I/O / GL2 | I/O / GL2 |
| M5 | PPECL1 / Input | PPECL1 / Input |
| M6 | AVDD | AVDD |
| M7 | I/O | I/O |
| M8 | I/O | I/O |
| M9 | $V_{DD}$ | $V_{DD}$ |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| M10 | GND | GND |
| M11 | GND | GND |
| M12 | GND | GND |
| M13 | GND | GND |
| M14 | $V_{DD}$ | $V_{DD}$ |
| M15 | I/O | I/O |
| M16 | PPECL2 / Input | PPECL2 / Input |
| M17 | I/O | I/O |
| M18 | AVDD | AVDD |
| M19 | I/O / GL3 | I/O / GL3 |
| M20 | I/O | I/O |
| M21 | I/O | I/O |
| M22 | I/O | I/O |
| N1 | I/O | I/O |
| N2 | I/O | I/O |
| N3 | NC | I/O |
| N4 | I/O | I/O |
| N5 | I/O | I/O |
| N6 | I/O | I/O |
| N7 | I/O | I/O |
| N8 | $V_{DDP}$ | $V_{DDP}$ |
| N9 | $V_{DD}$ | $V_{DD}$ |
| N10 | GND | GND |
| N11 | GND | GND |
| N12 | GND | GND |
| N13 | GND | GND |
| N14 | $V_{DD}$ | $V_{DD}$ |
| N15 | $V_{DDP}$ | $V_{DDP}$ |
| N16 | I/O | I/O |
| N17 | I/O | I/O |
| N18 | I/O | I/O |
| N19 | I/O | I/O |
| N20 | NC | I/O |
| N21 | I/O | I/O |
| N22 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| P1 | I/O | I/O |
| P2 | I/O | I/O |
| P3 | I/O | I/O |
| P4 | I/O | I/O |
| P5 | I/O | I/O |
| P6 | I/O | I/O |
| P7 | I/O | I/O |
| P8 | $V_{DDP}$ | $V_{DDP}$ |
| P9 | GND | GND |
| P10 | $V_{DD}$ | $V_{DD}$ |
| P11 | $V_{DD}$ | $V_{DD}$ |
| P12 | $V_{DD}$ | $V_{DD}$ |
| P13 | $V_{DD}$ | $V_{DD}$ |
| P14 | GND | GND |
| P15 | $V_{DDP}$ | $V_{DDP}$ |
| P16 | I/O | I/O |
| P17 | I/O | I/O |
| P18 | I/O | I/O |
| P19 | I/O | I/O |
| P20 | NC | I/O |
| P21 | I/O | I/O |
| P22 | I/O | I/O |
| R1 | I/O | I/O |
| R2 | I/O | I/O |
| R3 | $V_{DD}$ | $V_{DD}$ |
| R4 | I/O | I/O |
| R5 | I/O | I/O |
| R6 | I/O | I/O |
| R7 | I/O | I/O |
| R8 | I/O | I/O |
| R9 | $V_{DDP}$ | $V_{DDP}$ |
| R10 | $V_{DDP}$ | $V_{DDP}$ |
| R11 | I/O | I/O |
| R12 | I/O | I/O |
| R13 | $V_{DDP}$ | $V_{DDP}$ |
| R14 | $V_{DDP}$ | $V_{DDP}$ |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| R15 | I/O | I/O |
| R16 | I/O | I/O |
| R17 | I/O | I/O |
| R18 | I/O | I/O |
| R19 | I/O | I/O |
| R20 | $V_{DD}$ | $V_{DD}$ |
| R21 | I/O | I/O |
| R22 | I/O | I/O |
| T1 | I/O | I/O |
| T2 | I/O | I/O |
| T3 | NC | I/O |
| T4 | I/O | I/O |
| T5 | I/O | I/O |
| T6 | I/O | I/O |
| T7 | I/O | I/O |
| T8 | I/O | I/O |
| T9 | I/O | I/O |
| T10 | I/O | I/O |
| T11 | I/O | I/O |
| T12 | I/O | I/O |
| T13 | I/O | I/O |
| T14 | I/O | I/O |
| T15 | I/O | I/O |
| T16 | I/O | I/O |
| T17 | RCK | RCK |
| T18 | I/O | I/O |
| T19 | I/O | I/O |
| T20 | NC | I/O |
| T21 | I/O | I/O |
| T22 | I/O | I/O |
| U1 | I/O | I/O |
| U2 | I/O | I/O |
| U3 | I/O | I/O |
| U4 | I/O | I/O |
| U5 | I/O | I/O |
| U6 | I/O | I/O |

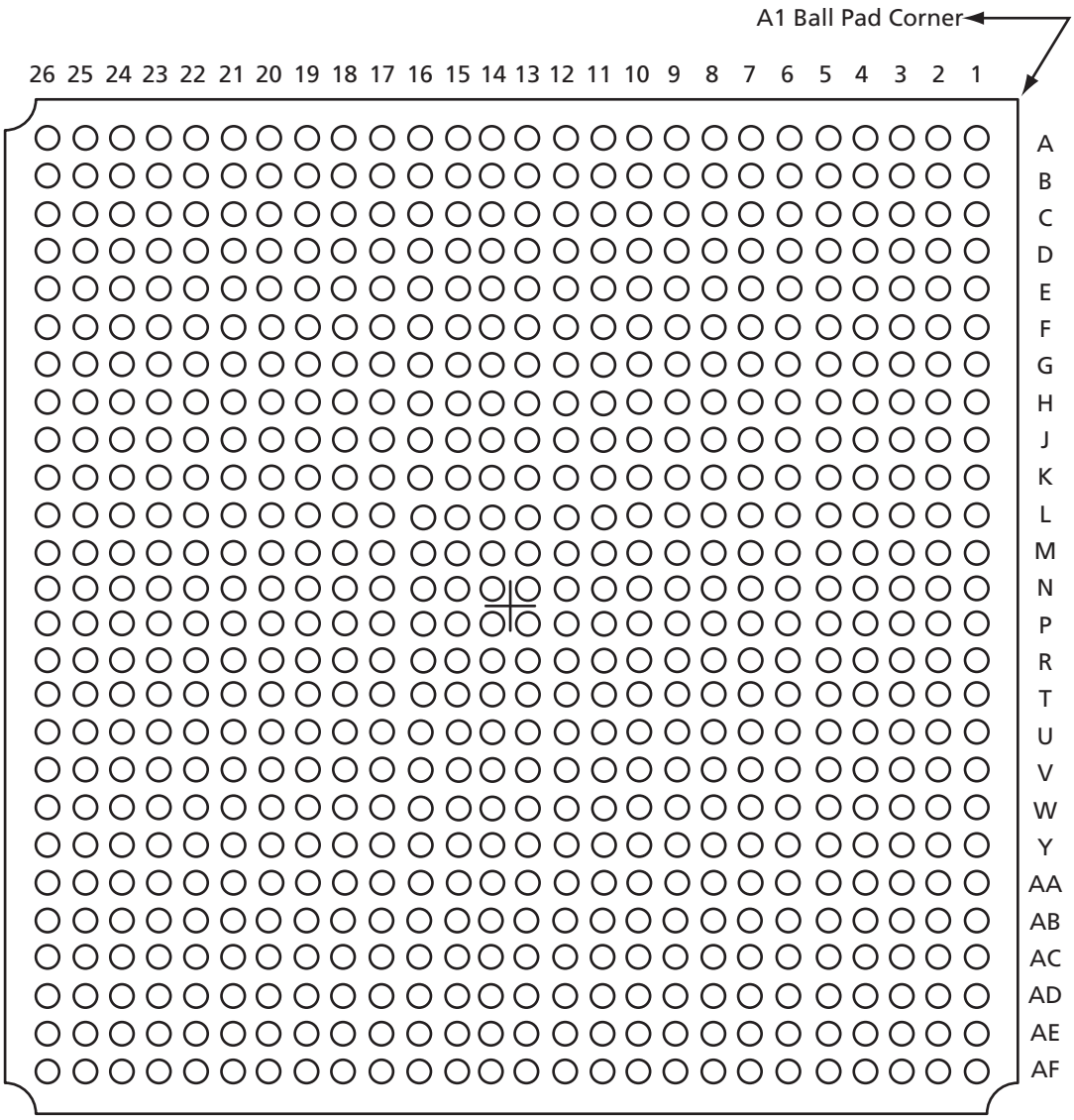
| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| U7 | I/O | I/O |
| U8 | I/O | I/O |
| U9 | I/O | I/O |
| U10 | I/O | I/O |
| U11 | I/O | I/O |
| U12 | I/O | I/O |
| U13 | I/O | I/O |
| U14 | I/O | I/O |
| U15 | I/O | I/O |
| U16 | TCK | TCK |
| U17 | $V_{PP}$ | $V_{PP}$ |
| U18 | TRST | TRST |
| U19 | I/O | I/O |
| U20 | NC | I/O |
| U21 | I/O | I/O |
| U22 | I/O | I/O |
| V1 | I/O | I/O |
| V2 | I/O | I/O |
| V3 | GND | GND |
| V4 | I/O | I/O |
| V5 | I/O | I/O |
| V6 | I/O | I/O |
| V7 | I/O | I/O |
| V8 | I/O | I/O |
| V9 | I/O | I/O |
| V10 | I/O | I/O |
| V11 | I/O | I/O |
| V12 | I/O | I/O |
| V13 | I/O | I/O |
| V14 | I/O | I/O |
| V15 | I/O | I/O |
| V16 | I/O | I/O |
| V17 | TDI | TDI |
| V18 | $V_{PN}$ | $V_{PN}$ |
| V19 | TDO | TDO |
| V20 | GND | GND |

| 484-Pin FBGA | | |
|---|---|---|
| Pin Number | APA450 Function | APA600 Function |
| V21 | NC | I/O |
| V22 | I/O | I/O |
| W1 | NC | I/O |
| W2 | I/O | I/O |
| W3 | I/O | I/O |
| W4 | GND | GND |
| W5 | I/O | I/O |
| W6 | I/O | I/O |
| W7 | I/O | I/O |
| W8 | I/O | I/O |
| W9 | I/O | I/O |
| W10 | I/O | I/O |
| W11 | I/O | I/O |
| W12 | I/O | I/O |
| W13 | I/O | I/O |
| W14 | I/O | I/O |
| W15 | I/O | I/O |
| W16 | I/O | I/O |
| W17 | I/O | I/O |
| W18 | TMS | TMS |
| W19 | GND | GND |
| W20 | NC | I/O |
| W21 | NC | I/O |
| W22 | I/O | I/O |
| Y1 | $V_{DDP}$ | $V_{DDP}$ |
| Y2 | I/O | I/O |
| Y3 | I/O | I/O |
| Y4 | I/O | I/O |
| Y5 | GND | GND |
| Y6 | I/O | I/O |
| Y7 | I/O | I/O |
| Y8 | $V_{DD}$ | $V_{DD}$ |
| Y9 | $V_{DD}$ | $V_{DD}$ |
| Y10 | I/O | I/O |
| Y11 | I/O | I/O |
| Y12 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA450 Function** | **APA600 Function** |
| Y13 | I/O | I/O |
| Y14 | $V_{DD}$ | $V_{DD}$ |
| Y15 | $V_{DD}$ | $V_{DD}$ |
| Y16 | I/O | I/O |
| Y17 | I/O | I/O |
| Y18 | GND | GND |
| Y19 | I/O | I/O |
| Y20 | I/O | I/O |
| Y21 | NC | I/O |
| Y22 | $V_{DDP}$ | $V_{DDP}$ |
| AA1 | GND | GND |
| AA2 | $V_{DDP}$ | $V_{DDP}$ |
| AA3 | I/O | I/O |
| AA4 | I/O | I/O |
| AA5 | I/O | I/O |
| AA6 | I/O | I/O |
| AA7 | I/O | I/O |
| AA8 | I/O | I/O |
| AA9 | I/O | I/O |
| AA10 | I/O | I/O |
| AA11 | I/O | I/O |
| AA12 | I/O | I/O |
| AA13 | I/O | I/O |
| AA14 | I/O | I/O |
| AA15 | I/O | I/O |
| AA16 | I/O | I/O |
| AA17 | I/O | I/O |
| AA18 | NC | I/O |
| AA19 | NC | I/O |
| AA20 | I/O | I/O |
| AA21 | $V_{DDP}$ | $V_{DDP}$ |
| AA22 | GND | GND |
| AB1 | GND | GND |
| AB2 | GND | GND |
| AB3 | $V_{DDP}$ | $V_{DDP}$ |
| AB4 | I/O | I/O |

| 484-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA450 Function** | **APA600 Function** |
| AB5 | I/O | I/O |
| AB6 | I/O | I/O |
| AB7 | I/O | I/O |
| AB8 | I/O | I/O |
| AB9 | I/O | I/O |
| AB10 | I/O | I/O |
| AB11 | I/O | I/O |
| AB12 | I/O | I/O |
| AB13 | I/O | I/O |
| AB14 | I/O | I/O |
| AB15 | I/O | I/O |
| AB16 | I/O | I/O |
| AB17 | I/O | I/O |
| AB18 | NC | I/O |
| AB19 | I/O | I/O |
| AB20 | $V_{DDP}$ | $V_{DDP}$ |
| AB21 | GND | GND |
| AB22 | GND | GND |

# 676-Pin FBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| A1 | GND | GND |
| A2 | GND | GND |
| A3 | I/O | I/O |
| A4 | I/O | I/O |
| A5 | I/O | I/O |
| A6 | I/O | I/O |
| A7 | I/O | I/O |
| A8 | I/O | I/O |
| A9 | I/O | I/O |
| A10 | I/O | I/O |
| A11 | I/O | I/O |
| A12 | I/O | I/O |
| A13 | I/O | I/O |
| A14 | I/O | I/O |
| A15 | I/O | I/O |
| A16 | I/O | I/O |
| A17 | I/O | I/O |
| A18 | I/O | I/O |
| A19 | I/O | I/O |
| A20 | I/O | I/O |
| A21 | I/O | I/O |
| A22 | I/O | I/O |
| A23 | I/O | I/O |
| A24 | I/O | I/O |
| A25 | GND | GND |
| A26 | GND | GND |
| B1 | GND | GND |
| B2 | GND | GND |
| B3 | GND | GND |
| B4 | GND | GND |
| B5 | I/O | I/O |
| B6 | I/O | I/O |
| B7 | I/O | I/O |
| B8 | I/O | I/O |
| B9 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| B10 | I/O | I/O |
| B11 | I/O | I/O |
| B12 | I/O | I/O |
| B13 | I/O | I/O |
| B14 | I/O | I/O |
| B15 | I/O | I/O |
| B16 | I/O | I/O |
| B17 | I/O | I/O |
| B18 | I/O | I/O |
| B19 | I/O | I/O |
| B20 | I/O | I/O |
| B21 | I/O | I/O |
| B22 | I/O | I/O |
| B23 | I/O | I/O |
| B24 | I/O | I/O |
| B25 | GND | GND |
| B26 | GND | GND |
| C1 | GND | GND |
| C2 | GND | GND |
| C3 | GND | GND |
| C4 | GND | GND |
| C5 | I/O | I/O |
| C6 | I/O | I/O |
| C7 | I/O | I/O |
| C8 | I/O | I/O |
| C9 | I/O | I/O |
| C10 | I/O | I/O |
| C11 | I/O | I/O |
| C12 | I/O | I/O |
| C13 | I/O | I/O |
| C14 | I/O | I/O |
| C15 | I/O | I/O |
| C16 | I/O | I/O |
| C17 | I/O | I/O |
| C18 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| C19 | I/O | I/O |
| C20 | I/O | I/O |
| C21 | I/O | I/O |
| C22 | I/O | I/O |
| C23 | I/O | I/O |
| C24 | I/O | I/O |
| C25 | I/O | I/O |
| C26 | I/O | I/O |
| D1 | I/O | I/O |
| D2 | I/O | I/O |
| D3 | GND | GND |
| D4 | I/O | I/O |
| D5 | I/O | I/O |
| D6 | I/O | I/O |
| D7 | I/O | I/O |
| D8 | I/O | I/O |
| D9 | I/O | I/O |
| D10 | I/O | I/O |
| D11 | I/O | I/O |
| D12 | I/O | I/O |
| D13 | I/O | I/O |
| D14 | I/O | I/O |
| D15 | I/O | I/O |
| D16 | I/O | I/O |
| D17 | I/O | I/O |
| D18 | I/O | I/O |
| D19 | I/O | I/O |
| D20 | I/O | I/O |
| D21 | I/O | I/O |
| D22 | I/O | I/O |
| D23 | I/O | I/O |
| D24 | I/O | I/O |
| D25 | I/O | I/O |
| D26 | I/O | I/O |
| E1 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| E2 | I/O | I/O |
| E3 | I/O | I/O |
| E4 | I/O | I/O |
| E5 | I/O | I/O |
| E6 | I/O | I/O |
| E7 | I/O | I/O |
| E8 | I/O | I/O |
| E9 | I/O | I/O |
| E10 | I/O | I/O |
| E11 | I/O | I/O |
| E12 | I/O | I/O |
| E13 | I/O | I/O |
| E14 | I/O | I/O |
| E15 | I/O | I/O |
| E16 | I/O | I/O |
| E17 | I/O | I/O |
| E18 | I/O | I/O |
| E19 | I/O | I/O |
| E20 | I/O | I/O |
| E21 | I/O | I/O |
| E22 | I/O | I/O |
| E23 | I/O | I/O |
| E24 | I/O | I/O |
| E25 | I/O | I/O |
| E26 | I/O | I/O |
| F1 | I/O | I/O |
| F2 | I/O | I/O |
| F3 | I/O | I/O |
| F4 | I/O | I/O |
| F5 | GND | GND |
| F6 | I/O | I/O |
| F7 | NC | NC |
| F8 | I/O | I/O |
| F9 | I/O | I/O |
| F10 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| F11 | I/O | I/O |
| F12 | I/O | I/O |
| F13 | I/O | I/O |
| F14 | I/O | I/O |
| F15 | I/O | I/O |
| F16 | I/O | I/O |
| F17 | I/O | I/O |
| F18 | I/O | I/O |
| F19 | I/O | I/O |
| F20 | I/O | I/O |
| F21 | I/O | I/O |
| F22 | I/O | I/O |
| F23 | I/O | I/O |
| F24 | I/O | I/O |
| F25 | I/O | I/O |
| F26 | I/O | I/O |
| G1 | I/O | I/O |
| G2 | I/O | I/O |
| G3 | I/O | I/O |
| G4 | I/O | I/O |
| G5 | I/O | I/O |
| G6 | I/O | I/O |
| G7 | I/O | I/O |
| G8 | $V_{DD}$ | $V_{DD}$ |
| G9 | NC | NC |
| G10 | I/O | I/O |
| G11 | NC | NC |
| G12 | I/O | I/O |
| G13 | NC | NC |
| G14 | I/O | I/O |
| G15 | NC | NC |
| G16 | I/O | I/O |
| G17 | NC | NC |
| G18 | I/O | I/O |
| G19 | $V_{DDP}$ | $V_{DDP}$ |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| G20 | NC | NC |
| G21 | I/O | I/O |
| G22 | I/O | I/O |
| G23 | I/O | I/O |
| G24 | I/O | I/O |
| G25 | I/O | I/O |
| G26 | I/O | I/O |
| H1 | I/O | I/O |
| H2 | I/O | I/O |
| H3 | I/O | I/O |
| H4 | I/O | I/O |
| H5 | I/O | I/O |
| H6 | I/O | I/O |
| H7 | $V_{DDP}$ | $V_{DDP}$ |
| H8 | $V_{DD}$ | $V_{DD}$ |
| H9 | $V_{DDP}$ | $V_{DDP}$ |
| H10 | $V_{DDP}$ | $V_{DDP}$ |
| H11 | $V_{DDP}$ | $V_{DDP}$ |
| H12 | $V_{DDP}$ | $V_{DDP}$ |
| H13 | $V_{DDP}$ | $V_{DDP}$ |
| H14 | $V_{DDP}$ | $V_{DDP}$ |
| H15 | $V_{DDP}$ | $V_{DDP}$ |
| H16 | $V_{DDP}$ | $V_{DDP}$ |
| H17 | $V_{DDP}$ | $V_{DDP}$ |
| H18 | $V_{DDP}$ | $V_{DDP}$ |
| H19 | $V_{DD}$ | $V_{DD}$ |
| H20 | $V_{DD}$ | $V_{DD}$ |
| H21 | I/O | I/O |
| H22 | I/O | I/O |
| H23 | I/O | I/O |
| H24 | I/O | I/O |
| H25 | I/O | I/O |
| H26 | I/O | I/O |
| J1 | I/O | I/O |
| J2 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| J3 | I/O | I/O |
| J4 | I/O | I/O |
| J5 | I/O | I/O |
| J6 | I/O | I/O |
| J7 | NC | NC |
| J8 | $V_{DDP}$ | $V_{DDP}$ |
| J9 | $V_{DD}$ | $V_{DD}$ |
| J10 | $V_{DD}$ | $V_{DD}$ |
| J11 | $V_{DD}$ | $V_{DD}$ |
| J12 | $V_{DD}$ | $V_{DD}$ |
| J13 | $V_{DD}$ | $V_{DD}$ |
| J14 | $V_{DD}$ | $V_{DD}$ |
| J15 | $V_{DD}$ | $V_{DD}$ |
| J16 | $V_{DD}$ | $V_{DD}$ |
| J17 | $V_{DD}$ | $V_{DD}$ |
| J18 | $V_{DD}$ | $V_{DD}$ |
| J19 | $V_{DDP}$ | $V_{DDP}$ |
| J20 | NC | NC |
| J21 | I/O | I/O |
| J22 | I/O | I/O |
| J23 | I/O | I/O |
| J24 | I/O | I/O |
| J25 | I/O | I/O |
| J26 | I/O | I/O |
| K1 | I/O | I/O |
| K2 | I/O | I/O |
| K3 | I/O | I/O |
| K4 | I/O | I/O |
| K5 | I/O | I/O |
| K6 | I/O | I/O |
| K7 | I/O | I/O |
| K8 | $V_{DDP}$ | $V_{DDP}$ |
| K9 | $V_{DD}$ | $V_{DD}$ |
| K10 | GND | GND |
| K11 | GND | GND |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| K12 | GND | GND |
| K13 | GND | GND |
| K14 | GND | GND |
| K15 | GND | GND |
| K16 | GND | GND |
| K17 | GND | GND |
| K18 | $V_{DD}$ | $V_{DD}$ |
| K19 | $V_{DDP}$ | $V_{DDP}$ |
| K20 | I/O | I/O |
| K21 | I/O | I/O |
| K22 | I/O | I/O |
| K23 | I/O | I/O |
| K24 | I/O | I/O |
| K25 | I/O | I/O |
| K26 | I/O | I/O |
| L1 | I/O | I/O |
| L2 | I/O | I/O |
| L3 | I/O | I/O |
| L4 | I/O | I/O |
| L5 | I/O | I/O |
| L6 | I/O | I/O |
| L7 | NC | NC |
| L8 | $V_{DDP}$ | $V_{DDP}$ |
| L9 | $V_{DD}$ | $V_{DD}$ |
| L10 | GND | GND |
| L11 | GND | GND |
| L12 | GND | GND |
| L13 | GND | GND |
| L14 | GND | GND |
| L15 | GND | GND |
| L16 | GND | GND |
| L17 | GND | GND |
| L18 | $V_{DD}$ | $V_{DD}$ |
| L19 | $V_{DDP}$ | $V_{DDP}$ |
| L20 | NC | NC |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| L21 | I/O | I/O |
| L22 | I/O | I/O |
| L23 | I/O | I/O |
| L24 | I/O | I/O |
| L25 | I/O | I/O |
| L26 | I/O | I/O |
| M1 | I/O | I/O |
| M2 | I/O | I/O |
| M3 | I/O | I/O |
| M4 | I/O | I/O |
| M5 | I/O | I/O |
| M6 | I/O | I/O |
| M7 | I/O | I/O |
| M8 | $V_{DDP}$ | $V_{DDP}$ |
| M9 | $V_{DD}$ | $V_{DD}$ |
| M10 | GND | GND |
| M11 | GND | GND |
| M12 | GND | GND |
| M13 | GND | GND |
| M14 | GND | GND |
| M15 | GND | GND |
| M16 | GND | GND |
| M17 | GND | GND |
| M18 | $V_{DD}$ | $V_{DD}$ |
| M19 | $V_{DDP}$ | $V_{DDP}$ |
| M20 | I/O | I/O |
| M21 | I/O | I/O |
| M22 | I/O | I/O |
| M23 | I/O | I/O |
| M24 | I/O | I/O |
| M25 | I/O | I/O |
| M26 | I/O | I/O |
| N1 | I/O / GL1 | I/O / GL1 |
| N2 | AGND | AGND |
| N3 | I/O / GLMX1 | I/O / GLMX1 |

| 676-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA750 Function** |
| N4 | I/O | I/O |
| N5 | NPECL1 | NPECL1 |
| N6 | I/O | I/O |
| N7 | NC | NC |
| N8 | $V_{DDP}$ | $V_{DDP}$ |
| N9 | $V_{DD}$ | $V_{DD}$ |
| N10 | GND | GND |
| N11 | GND | GND |
| N12 | GND | GND |
| N13 | GND | GND |
| N14 | GND | GND |
| N15 | GND | GND |
| N16 | GND | GND |
| N17 | GND | GND |
| N18 | $V_{DD}$ | $V_{DD}$ |
| N19 | $V_{DDP}$ | $V_{DDP}$ |
| N20 | NC | NC |
| N21 | I/O | I/O |
| N22 | I/O / GL3 | I/O / GL3 |
| N23 | I/O | I/O |
| N24 | NPECL2 | NPECL2 |
| N25 | I/O / GL4 | I/O / GL4 |
| N26 | I/O | I/O |
| P1 | I/O / GL2 | I/O / GL2 |
| P2 | AVDD | AVDD |
| P3 | I/O | I/O |
| P4 | I/O | I/O |
| P5 | PPECL1 / Input | PPECL1 / Input |
| P6 | I/O | I/O |
| P7 | I/O | I/O |
| P8 | $V_{DDP}$ | $V_{DDP}$ |
| P9 | $V_{DD}$ | $V_{DD}$ |
| P10 | GND | GND |
| P11 | GND | GND |

| 676-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA750 Function** |
| P12 | GND | GND |
| P13 | GND | GND |
| P14 | GND | GND |
| P15 | GND | GND |
| P16 | GND | GND |
| P17 | GND | GND |
| P18 | $V_{DD}$ | $V_{DD}$ |
| P19 | $V_{DDP}$ | $V_{DDP}$ |
| P20 | I/O | I/O |
| P21 | I/O | I/O |
| P22 | I/O / GLMX2 | I/O / GLMX2 |
| P23 | I/O | I/O |
| P24 | PPECL2 / Input | PPECL2 / Input |
| P25 | AVDD | AVDD |
| P26 | AGND | AGND |
| R1 | I/O | I/O |
| R2 | I/O | I/O |
| R3 | I/O | I/O |
| R4 | I/O | I/O |
| R5 | I/O | I/O |
| R6 | I/O | I/O |
| R7 | NC | NC |
| R8 | $V_{DDP}$ | $V_{DDP}$ |
| R9 | $V_{DD}$ | $V_{DD}$ |
| R10 | GND | GND |
| R11 | GND | GND |
| R12 | GND | GND |
| R13 | GND | GND |
| R14 | GND | GND |
| R15 | GND | GND |
| R16 | GND | GND |
| R17 | GND | GND |
| R18 | $V_{DD}$ | $V_{DD}$ |
| R19 | $V_{DDP}$ | $V_{DDP}$ |

| 676-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA750 Function** |
| R20 | NC | NC |
| R21 | I/O | I/O |
| R22 | I/O | I/O |
| R23 | I/O | I/O |
| R24 | I/O | I/O |
| R25 | I/O | I/O |
| R26 | I/O | I/O |
| T1 | I/O | I/O |
| T2 | I/O | I/O |
| T3 | I/O | I/O |
| T4 | I/O | I/O |
| T5 | I/O | I/O |
| T6 | I/O | I/O |
| T7 | I/O | I/O |
| T8 | $V_{DDP}$ | $V_{DDP}$ |
| T9 | $V_{DD}$ | $V_{DD}$ |
| T10 | GND | GND |
| T11 | GND | GND |
| T12 | GND | GND |
| T13 | GND | GND |
| T14 | GND | GND |
| T15 | GND | GND |
| T16 | GND | GND |
| T17 | GND | GND |
| T18 | $V_{DD}$ | $V_{DD}$ |
| T19 | $V_{DDP}$ | $V_{DDP}$ |
| T20 | I/O | I/O |
| T21 | I/O | I/O |
| T22 | I/O | I/O |
| T23 | I/O | I/O |
| T24 | I/O | I/O |
| T25 | I/O | I/O |
| T26 | I/O | I/O |
| U1 | I/O | I/O |
| U2 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| U3 | I/O | I/O |
| U4 | I/O | I/O |
| U5 | I/O | I/O |
| U6 | I/O | I/O |
| U7 | NC | NC |
| U8 | $V_{DDP}$ | $V_{DDP}$ |
| U9 | $V_{DD}$ | $V_{DD}$ |
| U10 | GND | GND |
| U11 | GND | GND |
| U12 | GND | GND |
| U13 | GND | GND |
| U14 | GND | GND |
| U15 | GND | GND |
| U16 | GND | GND |
| U17 | GND | GND |
| U18 | $V_{DD}$ | $V_{DD}$ |
| U19 | $V_{DDP}$ | $V_{DDP}$ |
| U20 | NC | NC |
| U21 | I/O | I/O |
| U22 | I/O | I/O |
| U23 | I/O | I/O |
| U24 | I/O | I/O |
| U25 | I/O | I/O |
| U26 | I/O | I/O |
| V1 | I/O | I/O |
| V2 | I/O | I/O |
| V3 | I/O | I/O |
| V4 | I/O | I/O |
| V5 | I/O | I/O |
| V6 | I/O | I/O |
| V7 | I/O | I/O |
| V8 | $V_{DDP}$ | $V_{DDP}$ |
| V9 | $V_{DD}$ | $V_{DD}$ |
| V10 | $V_{DD}$ | $V_{DD}$ |
| V11 | $V_{DD}$ | $V_{DD}$ |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| V12 | $V_{DD}$ | $V_{DD}$ |
| V13 | $V_{DD}$ | $V_{DD}$ |
| V14 | $V_{DD}$ | $V_{DD}$ |
| V15 | $V_{DD}$ | $V_{DD}$ |
| V16 | $V_{DD}$ | $V_{DD}$ |
| V17 | $V_{DD}$ | $V_{DD}$ |
| V18 | $V_{DD}$ | $V_{DD}$ |
| V19 | $V_{DDP}$ | $V_{DDP}$ |
| V20 | I/O | I/O |
| V21 | I/O | I/O |
| V22 | I/O | I/O |
| V23 | I/O | I/O |
| V24 | I/O | I/O |
| V25 | I/O | I/O |
| V26 | I/O | I/O |
| W1 | I/O | I/O |
| W2 | I/O | I/O |
| W3 | I/O | I/O |
| W4 | I/O | I/O |
| W5 | I/O | I/O |
| W6 | I/O | I/O |
| W7 | $V_{DD}$ | $V_{DD}$ |
| W8 | $V_{DD}$ | $V_{DD}$ |
| W9 | $V_{DDP}$ | $V_{DDP}$ |
| W10 | $V_{DDP}$ | $V_{DDP}$ |
| W11 | $V_{DDP}$ | $V_{DDP}$ |
| W12 | $V_{DDP}$ | $V_{DDP}$ |
| W13 | $V_{DDP}$ | $V_{DDP}$ |
| W14 | $V_{DDP}$ | $V_{DDP}$ |
| W15 | $V_{DDP}$ | $V_{DDP}$ |
| W16 | $V_{DDP}$ | $V_{DDP}$ |
| W17 | $V_{DDP}$ | $V_{DDP}$ |
| W18 | $V_{DDP}$ | $V_{DDP}$ |
| W19 | $V_{DD}$ | $V_{DD}$ |
| W20 | $V_{DDP}$ | $V_{DDP}$ |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| W21 | I/O | I/O |
| W22 | I/O | I/O |
| W23 | I/O | I/O |
| W24 | I/O | I/O |
| W25 | I/O | I/O |
| W26 | I/O | I/O |
| Y1 | I/O | I/O |
| Y2 | I/O | I/O |
| Y3 | I/O | I/O |
| Y4 | I/O | I/O |
| Y5 | I/O | I/O |
| Y6 | I/O | I/O |
| Y7 | I/O | I/O |
| Y8 | $V_{DDP}$ | $V_{DDP}$ |
| Y9 | NC | NC |
| Y10 | I/O | I/O |
| Y11 | NC | NC |
| Y12 | I/O | I/O |
| Y13 | NC | NC |
| Y14 | I/O | I/O |
| Y15 | NC | NC |
| Y16 | I/O | I/O |
| Y17 | NC | NC |
| Y18 | I/O | I/O |
| Y19 | $V_{DD}$ | $V_{DD}$ |
| Y20 | $V_{PP}$ | $V_{PP}$ |
| Y21 | I/O | I/O |
| Y22 | I/O | I/O |
| Y23 | I/O | I/O |
| Y24 | I/O | I/O |
| Y25 | I/O | I/O |
| Y26 | I/O | I/O |
| AA1 | I/O | I/O |
| AA2 | I/O | I/O |
| AA3 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| AA4 | I/O | I/O |
| AA5 | I/O | I/O |
| AA6 | GND | GND |
| AA7 | I/O | I/O |
| AA8 | I/O | I/O |
| AA9 | I/O | I/O |
| AA10 | I/O | I/O |
| AA11 | I/O | I/O |
| AA12 | I/O | I/O |
| AA13 | I/O | I/O |
| AA14 | I/O | I/O |
| AA15 | I/O | I/O |
| AA16 | I/O | I/O |
| AA17 | I/O | I/O |
| AA18 | I/O | I/O |
| AA19 | I/O | I/O |
| AA20 | I/O | I/O |
| AA21 | TDO | TDO |
| AA22 | GND | GND |
| AA23 | GND | GND |
| AA24 | I/O | I/O |
| AA25 | I/O | I/O |
| AA26 | I/O | I/O |
| AB1 | I/O | I/O |
| AB2 | I/O | I/O |
| AB3 | I/O | I/O |
| AB4 | I/O | I/O |
| AB5 | I/O | I/O |
| AB6 | GND | GND |
| AB7 | GND | GND |
| AB8 | I/O | I/O |
| AB9 | I/O | I/O |
| AB10 | I/O | I/O |
| AB11 | I/O | I/O |
| AB12 | I/O | I/O |

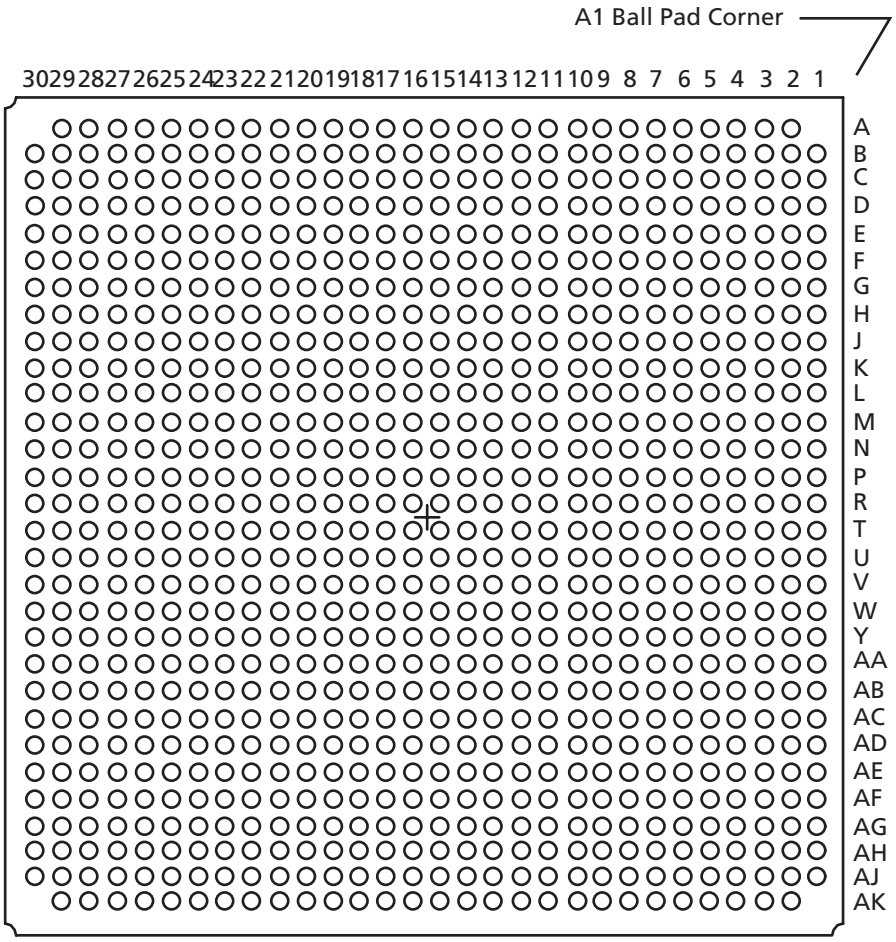
| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| AB13 | I/O | I/O |
| AB14 | I/O | I/O |
| AB15 | I/O | I/O |
| AB16 | I/O | I/O |
| AB17 | I/O | I/O |
| AB18 | I/O | I/O |
| AB19 | I/O | I/O |
| AB20 | I/O | I/O |
| AB21 | TCK | TCK |
| AB22 | TRST | TRST |
| AB23 | I/O | I/O |
| AB24 | I/O | I/O |
| AB25 | I/O | I/O |
| AB26 | I/O | I/O |
| AC1 | I/O | I/O |
| AC2 | I/O | I/O |
| AC3 | I/O | I/O |
| AC4 | I/O | I/O |
| AC5 | GND | GND |
| AC6 | I/O | I/O |
| AC7 | I/O | I/O |
| AC8 | I/O | I/O |
| AC9 | GND | GND |
| AC10 | I/O | I/O |
| AC11 | I/O | I/O |
| AC12 | I/O | I/O |
| AC13 | I/O | I/O |
| AC14 | I/O | I/O |
| AC15 | I/O | I/O |
| AC16 | I/O | I/O |
| AC17 | I/O | I/O |
| AC18 | I/O | I/O |
| AC19 | I/O | I/O |
| AC20 | I/O | I/O |
| AC21 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| AC22 | TMS | TMS |
| AC23 | RCK | RCK |
| AC24 | I/O | I/O |
| AC25 | I/O | I/O |
| AC26 | I/O | I/O |
| AD1 | I/O | I/O |
| AD2 | I/O | I/O |
| AD3 | I/O | I/O |
| AD4 | I/O | I/O |
| AD5 | I/O | I/O |
| AD6 | I/O | I/O |
| AD7 | I/O | I/O |
| AD8 | I/O | I/O |
| AD9 | I/O | I/O |
| AD10 | I/O | I/O |
| AD11 | I/O | I/O |
| AD12 | I/O | I/O |
| AD13 | I/O | I/O |
| AD14 | I/O | I/O |
| AD15 | I/O | I/O |
| AD16 | I/O | I/O |
| AD17 | I/O | I/O |
| AD18 | I/O | I/O |
| AD19 | I/O | I/O |
| AD20 | I/O | I/O |
| AD21 | I/O | I/O |
| AD22 | I/O | I/O |
| AD23 | TDI | TDI |
| AD24 | $V_{PN}$ | $V_{PN}$ |
| AD25 | I/O | I/O |
| AD26 | I/O | I/O |
| AE1 | GND | GND |
| AE2 | GND | GND |
| AE3 | GND | GND |
| AE4 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| AE5 | I/O | I/O |
| AE6 | I/O | I/O |
| AE7 | I/O | I/O |
| AE8 | I/O | I/O |
| AE9 | I/O | I/O |
| AE10 | I/O | I/O |
| AE11 | I/O | I/O |
| AE12 | I/O | I/O |
| AE13 | I/O | I/O |
| AE14 | I/O | I/O |
| AE15 | I/O | I/O |
| AE16 | I/O | I/O |
| AE17 | I/O | I/O |
| AE18 | I/O | I/O |
| AE19 | I/O | I/O |
| AE20 | I/O | I/O |
| AE21 | I/O | I/O |
| AE22 | I/O | I/O |
| AE23 | I/O | I/O |
| AE24 | I/O | I/O |
| AE25 | GND | GND |
| AE26 | GND | GND |
| AF1 | GND | GND |
| AF2 | GND | GND |
| AF3 | GND | GND |
| AF4 | GND | GND |
| AF5 | I/O | I/O |
| AF6 | I/O | I/O |
| AF7 | I/O | I/O |
| AF8 | I/O | I/O |
| AF9 | I/O | I/O |
| AF10 | I/O | I/O |
| AF11 | I/O | I/O |
| AF12 | I/O | I/O |
| AF13 | I/O | I/O |

| 676-Pin FBGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA750 Function |
| AF14 | I/O | I/O |
| AF15 | I/O | I/O |
| AF16 | I/O | I/O |
| AF17 | I/O | I/O |
| AF18 | I/O | I/O |
| AF19 | I/O | I/O |
| AF20 | I/O | I/O |
| AF21 | I/O | I/O |
| AF22 | I/O | I/O |
| AF23 | I/O | I/O |
| AF24 | I/O | I/O |
| AF25 | GND | GND |
| AF26 | GND | GND |

# 896-Pin FBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| A2 | GND | GND |
| A3 | GND | GND |
| A4 | I/O | I/O |
| A5 | GND | GND |
| A6 | I/O | I/O |
| A7 | GND | GND |
| A8 | I/O | I/O |
| A9 | I/O | I/O |
| A10 | I/O | I/O |
| A11 | I/O | I/O |
| A12 | I/O | I/O |
| A13 | I/O | I/O |
| A14 | I/O | I/O |
| A15 | I/O | I/O |
| A16 | I/O | I/O |
| A17 | I/O | I/O |
| A18 | I/O | I/O |
| A19 | I/O | I/O |
| A20 | I/O | I/O |
| A21 | I/O | I/O |
| A22 | I/O | I/O |
| A23 | I/O | I/O |
| A24 | GND | GND |
| A25 | I/O | I/O |
| A26 | GND | GND |
| A27 | I/O | I/O |
| A28 | GND | GND |
| A29 | GND | GND |
| B1 | GND | GND |
| B2 | GND | GND |
| B3 | I/O | I/O |
| B4 | $V_{DD}$ | $V_{DD}$ |
| B5 | I/O | I/O |
| B6 | $V_{DD}$ | $V_{DD}$ |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| B7 | I/O | I/O |
| B8 | I/O | I/O |
| B9 | I/O | I/O |
| B10 | I/O | I/O |
| B11 | I/O | I/O |
| B12 | I/O | I/O |
| B13 | I/O | I/O |
| B14 | I/O | I/O |
| B15 | I/O | I/O |
| B16 | I/O | I/O |
| B17 | I/O | I/O |
| B18 | I/O | I/O |
| B19 | I/O | I/O |
| B20 | I/O | I/O |
| B21 | I/O | I/O |
| B22 | I/O | I/O |
| B23 | I/O | I/O |
| B24 | I/O | I/O |
| B25 | $V_{DD}$ | $V_{DD}$ |
| B26 | I/O | I/O |
| B27 | $V_{DD}$ | $V_{DD}$ |
| B28 | I/O | I/O |
| B29 | GND | GND |
| B30 | GND | GND |
| C1 | GND | GND |
| C2 | I/O | I/O |
| C3 | $V_{DD}$ | $V_{DD}$ |
| C4 | I/O | I/O |
| C5 | $V_{DDP}$ | $V_{DDP}$ |
| C6 | I/O | I/O |
| C7 | I/O | I/O |
| C8 | I/O | I/O |
| C9 | I/O | I/O |
| C10 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| C11 | I/O | I/O |
| C12 | I/O | I/O |
| C13 | I/O | I/O |
| C14 | I/O | I/O |
| C15 | I/O | I/O |
| C16 | I/O | I/O |
| C17 | I/O | I/O |
| C18 | I/O | I/O |
| C19 | I/O | I/O |
| C20 | I/O | I/O |
| C21 | I/O | I/O |
| C22 | I/O | I/O |
| C23 | I/O | I/O |
| C24 | I/O | I/O |
| C25 | I/O | I/O |
| C26 | $V_{DDP}$ | $V_{DDP}$ |
| C27 | I/O | I/O |
| C28 | $V_{DD}$ | $V_{DD}$ |
| C29 | NC | I/O |
| C30 | GND | GND |
| D1 | I/O | I/O |
| D2 | $V_{DD}$ | $V_{DD}$ |
| D3 | I/O | I/O |
| D4 | GND | GND |
| D5 | I/O | I/O |
| D6 | I/O | I/O |
| D7 | I/O | I/O |
| D8 | I/O | I/O |
| D9 | I/O | I/O |
| D10 | I/O | I/O |
| D11 | I/O | I/O |
| D12 | I/O | I/O |
| D13 | I/O | I/O |
| D14 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| D15 | I/O | I/O |
| D16 | I/O | I/O |
| D17 | I/O | I/O |
| D18 | I/O | I/O |
| D19 | I/O | I/O |
| D20 | I/O | I/O |
| D21 | I/O | I/O |
| D22 | I/O | I/O |
| D23 | I/O | I/O |
| D24 | I/O | I/O |
| D25 | I/O | I/O |
| D26 | I/O | I/O |
| D27 | GND | GND |
| D28 | I/O | I/O |
| D29 | $V_{DD}$ | $V_{DD}$ |
| D30 | I/O | I/O |
| E1 | GND | GND |
| E2 | I/O | I/O |
| E3 | $V_{DDP}$ | $V_{DDP}$ |
| E4 | I/O | I/O |
| E5 | $V_{DD}$ | $V_{DD}$ |
| E6 | I/O | I/O |
| E7 | $V_{DDP}$ | $V_{DDP}$ |
| E8 | I/O | I/O |
| E9 | I/O | I/O |
| E10 | I/O | I/O |
| E11 | I/O | I/O |
| E12 | I/O | I/O |
| E13 | I/O | I/O |
| E14 | I/O | I/O |
| E15 | I/O | I/O |
| E16 | I/O | I/O |
| E17 | I/O | I/O |
| E18 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| E19 | I/O | I/O |
| E20 | I/O | I/O |
| E21 | I/O | I/O |
| E22 | I/O | I/O |
| E23 | I/O | I/O |
| E24 | $V_{DDP}$ | $V_{DDP}$ |
| E25 | I/O | I/O |
| E26 | $V_{DD}$ | $V_{DD}$ |
| E27 | I/O | I/O |
| E28 | $V_{DDP}$ | $V_{DDP}$ |
| E29 | I/O | I/O |
| E30 | GND | GND |
| F1 | I/O | I/O |
| F2 | $V_{DD}$ | $V_{DD}$ |
| F3 | I/O | I/O |
| F4 | I/O | I/O |
| F5 | I/O | I/O |
| F6 | GND | GND |
| F7 | I/O | I/O |
| F8 | I/O | I/O |
| F9 | I/O | I/O |
| F10 | I/O | I/O |
| F11 | I/O | I/O |
| F12 | I/O | I/O |
| F13 | I/O | I/O |
| F14 | I/O | I/O |
| F15 | I/O | I/O |
| F16 | I/O | I/O |
| F17 | I/O | I/O |
| F18 | I/O | I/O |
| F19 | I/O | I/O |
| F20 | I/O | I/O |
| F21 | I/O | I/O |
| F22 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| F23 | I/O | I/O |
| F24 | I/O | I/O |
| F25 | GND | GND |
| F26 | I/O | I/O |
| F27 | I/O | I/O |
| F28 | I/O | I/O |
| F29 | $V_{DD}$ | $V_{DD}$ |
| F30 | I/O | I/O |
| G1 | GND | GND |
| G2 | I/O | I/O |
| G3 | I/O | I/O |
| G4 | I/O | I/O |
| G5 | $V_{DDP}$ | $V_{DDP}$ |
| G6 | I/O | I/O |
| G7 | $V_{DD}$ | $V_{DD}$ |
| G8 | I/O | I/O |
| G9 | $V_{DDP}$ | $V_{DDP}$ |
| G10 | I/O | I/O |
| G11 | I/O | I/O |
| G12 | I/O | I/O |
| G13 | I/O | I/O |
| G14 | I/O | I/O |
| G15 | I/O | I/O |
| G16 | I/O | I/O |
| G17 | I/O | I/O |
| G18 | I/O | I/O |
| G19 | I/O | I/O |
| G20 | I/O | I/O |
| G21 | I/O | I/O |
| G22 | $V_{DDP}$ | $V_{DDP}$ |
| G23 | I/O | I/O |
| G24 | $V_{DD}$ | $V_{DD}$ |
| G25 | I/O | I/O |
| G26 | $V_{DDP}$ | $V_{DDP}$ |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| G27 | I/O | I/O |
| G28 | I/O | I/O |
| G29 | I/O | I/O |
| G30 | GND | GND |
| H1 | I/O | I/O |
| H2 | I/O | I/O |
| H3 | I/O | I/O |
| H4 | I/O | I/O |
| H5 | I/O | I/O |
| H6 | I/O | I/O |
| H7 | I/O | I/O |
| H8 | GND | GND |
| H9 | NC | I/O |
| H10 | NC | I/O |
| H11 | NC | I/O |
| H12 | NC | I/O |
| H13 | NC | I/O |
| H14 | NC | I/O |
| H15 | NC | I/O |
| H16 | NC | I/O |
| H17 | NC | I/O |
| H18 | NC | I/O |
| H19 | NC | I/O |
| H20 | NC | I/O |
| H21 | NC | I/O |
| H22 | NC | I/O |
| H23 | GND | GND |
| H24 | I/O | I/O |
| H25 | I/O | I/O |
| H26 | I/O | I/O |
| H27 | I/O | I/O |
| H28 | I/O | I/O |
| H29 | I/O | I/O |
| H30 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| J1 | I/O | I/O |
| J2 | I/O | I/O |
| J3 | I/O | I/O |
| J4 | I/O | I/O |
| J5 | I/O | I/O |
| J6 | I/O | I/O |
| J7 | $V_{DDP}$ | $V_{DDP}$ |
| J8 | I/O | I/O |
| J9 | $V_{DD}$ | $V_{DD}$ |
| J10 | NC | I/O |
| J11 | NC | I/O |
| J12 | NC | I/O |
| J13 | NC | I/O |
| J14 | NC | I/O |
| J15 | NC | I/O |
| J16 | NC | I/O |
| J17 | NC | I/O |
| J18 | NC | I/O |
| J19 | NC | I/O |
| J20 | NC | I/O |
| J21 | NC | I/O |
| J22 | $V_{DD}$ | $V_{DD}$ |
| J23 | I/O | I/O |
| J24 | $V_{DDP}$ | $V_{DDP}$ |
| J25 | I/O | I/O |
| J26 | I/O | I/O |
| J27 | I/O | I/O |
| J28 | I/O | I/O |
| J29 | I/O | I/O |
| J30 | I/O | I/O |
| K1 | I/O | I/O |
| K2 | I/O | I/O |
| K3 | I/O | I/O |
| K4 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| K5 | I/O | I/O |
| K6 | I/O | I/O |
| K7 | I/O | I/O |
| K8 | I/O | I/O |
| K9 | NC | I/O |
| K10 | $V_{DD}$ | $V_{DD}$ |
| K11 | NC | I/O |
| K12 | $V_{DDP}$ | $V_{DDP}$ |
| K13 | $V_{DDP}$ | $V_{DDP}$ |
| K14 | $V_{DDP}$ | $V_{DDP}$ |
| K15 | $V_{DDP}$ | $V_{DDP}$ |
| K16 | $V_{DDP}$ | $V_{DDP}$ |
| K17 | $V_{DDP}$ | $V_{DDP}$ |
| K18 | $V_{DDP}$ | $V_{DDP}$ |
| K19 | $V_{DDP}$ | $V_{DDP}$ |
| K20 | NC | I/O |
| K21 | $V_{DD}$ | $V_{DD}$ |
| K22 | NC | I/O |
| K23 | I/O | I/O |
| K24 | I/O | I/O |
| K25 | I/O | I/O |
| K26 | I/O | I/O |
| K27 | I/O | I/O |
| K28 | I/O | I/O |
| K29 | I/O | I/O |
| K30 | I/O | I/O |
| L1 | I/O | I/O |
| L2 | I/O | I/O |
| L3 | I/O | I/O |
| L4 | I/O | I/O |
| L5 | I/O | I/O |
| L6 | I/O | I/O |
| L7 | I/O | I/O |
| L8 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| L9 | NC | I/O |
| L10 | NC | I/O |
| L11 | $V_{DD}$ | $V_{DD}$ |
| L12 | $V_{DD}$ | $V_{DD}$ |
| L13 | $V_{DD}$ | $V_{DD}$ |
| L14 | $V_{DD}$ | $V_{DD}$ |
| L15 | $V_{DD}$ | $V_{DD}$ |
| L16 | $V_{DD}$ | $V_{DD}$ |
| L17 | $V_{DD}$ | $V_{DD}$ |
| L18 | $V_{DD}$ | $V_{DD}$ |
| L19 | $V_{DD}$ | $V_{DD}$ |
| L20 | $V_{DD}$ | $V_{DD}$ |
| L21 | NC | I/O |
| L22 | NC | I/O |
| L23 | I/O | I/O |
| L24 | I/O | I/O |
| L25 | I/O | I/O |
| L26 | I/O | I/O |
| L27 | I/O | I/O |
| L28 | I/O | I/O |
| L29 | I/O | I/O |
| L30 | I/O | I/O |
| M1 | I/O | I/O |
| M2 | I/O | I/O |
| M3 | I/O | I/O |
| M4 | I/O | I/O |
| M5 | I/O | I/O |
| M6 | I/O | I/O |
| M7 | I/O | I/O |
| M8 | I/O | I/O |
| M9 | NC | I/O |
| M10 | $V_{DDP}$ | $V_{DDP}$ |
| M11 | $V_{DD}$ | $V_{DD}$ |
| M12 | GND | GND |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| M13 | GND | GND |
| M14 | GND | GND |
| M15 | GND | GND |
| M16 | GND | GND |
| M17 | GND | GND |
| M18 | GND | GND |
| M19 | GND | GND |
| M20 | $V_{DD}$ | $V_{DD}$ |
| M21 | $V_{DDP}$ | $V_{DDP}$ |
| M22 | NC | I/O |
| M23 | I/O | I/O |
| M24 | I/O | I/O |
| M25 | I/O | I/O |
| M26 | I/O | I/O |
| M27 | I/O | I/O |
| M28 | I/O | I/O |
| M29 | I/O | I/O |
| M30 | I/O | I/O |
| N1 | I/O | I/O |
| N2 | I/O | I/O |
| N3 | I/O | I/O |
| N4 | I/O | I/O |
| N5 | I/O | I/O |
| N6 | I/O | I/O |
| N7 | I/O | I/O |
| N8 | I/O | I/O |
| N9 | NC | I/O |
| N10 | $V_{DDP}$ | $V_{DDP}$ |
| N11 | $V_{DD}$ | $V_{DD}$ |
| N12 | GND | GND |
| N13 | GND | GND |
| N14 | GND | GND |
| N15 | GND | GND |
| N16 | GND | GND |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| N17 | GND | GND |
| N18 | GND | GND |
| N19 | GND | GND |
| N20 | $V_{DD}$ | $V_{DD}$ |
| N21 | $V_{DDP}$ | $V_{DDP}$ |
| N22 | NC | I/O |
| N23 | I/O | I/O |
| N24 | I/O | I/O |
| N25 | I/O | I/O |
| N26 | I/O | I/O |
| N27 | I/O | I/O |
| N28 | I/O | I/O |
| N29 | I/O | I/O |
| N30 | I/O | I/O |
| P1 | I/O | I/O |
| P2 | I/O | I/O |
| P3 | I/O | I/O |
| P4 | I/O | I/O |
| P5 | I/O | I/O |
| P6 | I/O | I/O |
| P7 | I/O | I/O |
| P8 | I/O | I/O |
| P9 | I/O | I/O |
| P10 | $V_{DDP}$ | $V_{DDP}$ |
| P11 | $V_{DD}$ | $V_{DD}$ |
| P12 | GND | GND |
| P13 | GND | GND |
| P14 | GND | GND |
| P15 | GND | GND |
| P16 | GND | GND |
| P17 | GND | GND |
| P18 | GND | GND |
| P19 | GND | GND |
| P20 | $V_{DD}$ | $V_{DD}$ |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| P21 | $V_{DDP}$ | $V_{DDP}$ |
| P22 | I/O | I/O |
| P23 | I/O | I/O |
| P24 | I/O | I/O |
| P25 | I/O | I/O |
| P26 | I/O | I/O |
| P27 | I/O | I/O |
| P28 | I/O | I/O |
| P29 | I/O | I/O |
| P30 | I/O | I/O |
| R1 | I/O | I/O |
| R2 | I/O / GLMX1 | I/O / GLMX1 |
| R3 | AGND | AGND |
| R4 | NPECL1 | NPECL1 |
| R5 | I/O / GL1 | I/O / GL1 |
| R6 | I/O | I/O |
| R7 | I/O | I/O |
| R8 | I/O | I/O |
| R9 | NC | I/O |
| R10 | $V_{DDP}$ | $V_{DDP}$ |
| R11 | $V_{DD}$ | $V_{DD}$ |
| R12 | GND | GND |
| R13 | GND | GND |
| R14 | GND | GND |
| R15 | GND | GND |
| R16 | GND | GND |
| R17 | GND | GND |
| R18 | GND | GND |
| R19 | GND | GND |
| R20 | $V_{DD}$ | $V_{DD}$ |
| R21 | $V_{DDP}$ | $V_{DDP}$ |
| R22 | I/O | I/O |
| R23 | I/O | I/O |
| R24 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| R25 | I/O | I/O |
| R26 | I/O | I/O |
| R27 | NPECL2 | NPECL2 |
| R28 | AGND | AGND |
| R29 | I/O / GLMX2 | I/O / GLMX2 |
| R30 | I/O | I/O |
| T1 | I/O | I/O |
| T2 | AVDD | AVDD |
| T3 | I/O / GL2 | I/O / GL2 |
| T4 | PPECL1 / Input | PPECL1 / Input |
| T5 | I/O | I/O |
| T6 | I/O | I/O |
| T7 | I/O | I/O |
| T8 | I/O | I/O |
| T9 | I/O | I/O |
| T10 | $V_{DDP}$ | $V_{DDP}$ |
| T11 | $V_{DD}$ | $V_{DD}$ |
| T12 | GND | GND |
| T13 | GND | GND |
| T14 | GND | GND |
| T15 | GND | GND |
| T16 | GND | GND |
| T17 | GND | GND |
| T18 | GND | GND |
| T19 | GND | GND |
| T20 | $V_{DD}$ | $V_{DD}$ |
| T21 | $V_{DDP}$ | $V_{DDP}$ |
| T22 | I/O | I/O |
| T23 | I/O | I/O |
| T24 | I/O | I/O |
| T25 | I/O | I/O |
| T26 | PPECL2 / Input | PPECL2 / Input |
| T27 | I/O / GL4 | I/O / GL4 |
| T28 | I/O / GL3 | I/O / GL3 |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| T29 | AVDD | AVDD |
| T30 | I/O | I/O |
| U1 | I/O | I/O |
| U2 | I/O | I/O |
| U3 | I/O | I/O |
| U4 | I/O | I/O |
| U5 | I/O | I/O |
| U6 | I/O | I/O |
| U7 | I/O | I/O |
| U8 | I/O | I/O |
| U9 | NC | I/O |
| U10 | $V_{DDP}$ | $V_{DDP}$ |
| U11 | $V_{DD}$ | $V_{DD}$ |
| U12 | GND | GND |
| U13 | GND | GND |
| U14 | GND | GND |
| U15 | GND | GND |
| U16 | GND | GND |
| U17 | GND | GND |
| U18 | GND | GND |
| U19 | GND | GND |
| U20 | $V_{DD}$ | $V_{DD}$ |
| U21 | $V_{DDP}$ | $V_{DDP}$ |
| U22 | NC | I/O |
| U23 | I/O | I/O |
| U24 | I/O | I/O |
| U25 | I/O | I/O |
| U26 | I/O | I/O |
| U27 | I/O | I/O |
| U28 | I/O | I/O |
| U29 | I/O | I/O |
| U30 | I/O | I/O |
| V1 | I/O | I/O |
| V2 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA750 Function** | **APA1000 Function** |
| V3 | I/O | I/O |
| V4 | I/O | I/O |
| V5 | I/O | I/O |
| V6 | I/O | I/O |
| V7 | I/O | I/O |
| V8 | I/O | I/O |
| V9 | NC | I/O |
| V10 | $V_{DDP}$ | $V_{DDP}$ |
| V11 | $V_{DD}$ | $V_{DD}$ |
| V12 | GND | GND |
| V13 | GND | GND |
| V14 | GND | GND |
| V15 | GND | GND |
| V16 | GND | GND |
| V17 | GND | GND |
| V18 | GND | GND |
| V19 | GND | GND |
| V20 | $V_{DD}$ | $V_{DD}$ |
| V21 | $V_{DDP}$ | $V_{DDP}$ |
| V22 | NC | I/O |
| V23 | I/O | I/O |
| V24 | I/O | I/O |
| V25 | I/O | I/O |
| V26 | I/O | I/O |
| V27 | I/O | I/O |
| V28 | I/O | I/O |
| V29 | I/O | I/O |
| V30 | I/O | I/O |
| W1 | I/O | I/O |
| W2 | I/O | I/O |
| W3 | I/O | I/O |
| W4 | I/O | I/O |
| W5 | I/O | I/O |
| W6 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA750 Function** | **APA1000 Function** |
| W7 | I/O | I/O |
| W8 | I/O | I/O |
| W9 | NC | I/O |
| W10 | $V_{DDP}$ | $V_{DDP}$ |
| W11 | $V_{DD}$ | $V_{DD}$ |
| W12 | GND | GND |
| W13 | GND | GND |
| W14 | GND | GND |
| W15 | GND | GND |
| W16 | GND | GND |
| W17 | GND | GND |
| W18 | GND | GND |
| W19 | GND | GND |
| W20 | $V_{DD}$ | $V_{DD}$ |
| W21 | $V_{DDP}$ | $V_{DDP}$ |
| W22 | NC | I/O |
| W23 | I/O | I/O |
| W24 | I/O | I/O |
| W25 | I/O | I/O |
| W26 | I/O | I/O |
| W27 | I/O | I/O |
| W28 | I/O | I/O |
| W29 | I/O | I/O |
| W30 | I/O | I/O |
| Y1 | I/O | I/O |
| Y2 | I/O | I/O |
| Y3 | I/O | I/O |
| Y4 | I/O | I/O |
| Y5 | I/O | I/O |
| Y6 | I/O | I/O |
| Y7 | I/O | I/O |
| Y8 | I/O | I/O |
| Y9 | NC | I/O |
| Y10 | NC | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| **Pin Number** | **APA750 Function** | **APA1000 Function** |
| Y11 | $V_{DD}$ | $V_{DD}$ |
| Y12 | $V_{DD}$ | $V_{DD}$ |
| Y13 | $V_{DD}$ | $V_{DD}$ |
| Y14 | $V_{DD}$ | $V_{DD}$ |
| Y15 | $V_{DD}$ | $V_{DD}$ |
| Y16 | $V_{DD}$ | $V_{DD}$ |
| Y17 | $V_{DD}$ | $V_{DD}$ |
| Y18 | $V_{DD}$ | $V_{DD}$ |
| Y19 | $V_{DD}$ | $V_{DD}$ |
| Y20 | $V_{DD}$ | $V_{DD}$ |
| Y21 | NC | I/O |
| Y22 | NC | I/O |
| Y23 | I/O | I/O |
| Y24 | I/O | I/O |
| Y25 | I/O | I/O |
| Y26 | I/O | I/O |
| Y27 | I/O | I/O |
| Y28 | I/O | I/O |
| Y29 | I/O | I/O |
| Y30 | I/O | I/O |
| AA1 | I/O | I/O |
| AA2 | I/O | I/O |
| AA3 | I/O | I/O |
| AA4 | I/O | I/O |
| AA5 | I/O | I/O |
| AA6 | I/O | I/O |
| AA7 | I/O | I/O |
| AA8 | I/O | I/O |
| AA9 | NC | I/O |
| AA10 | $V_{DD}$ | $V_{DD}$ |
| AA11 | NC | I/O |
| AA12 | $V_{DDP}$ | $V_{DDP}$ |
| AA13 | $V_{DDP}$ | $V_{DDP}$ |
| AA14 | $V_{DDP}$ | $V_{DDP}$ |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AA15 | $V_{DDP}$ | $V_{DDP}$ |
| AA16 | $V_{DDP}$ | $V_{DDP}$ |
| AA17 | $V_{DDP}$ | $V_{DDP}$ |
| AA18 | $V_{DDP}$ | $V_{DDP}$ |
| AA19 | $V_{DDP}$ | $V_{DDP}$ |
| AA20 | NC | I/O |
| AA21 | $V_{DD}$ | $V_{DD}$ |
| AA22 | NC | I/O |
| AA23 | I/O | I/O |
| AA24 | I/O | I/O |
| AA25 | I/O | I/O |
| AA26 | I/O | I/O |
| AA27 | I/O | I/O |
| AA28 | I/O | I/O |
| AA29 | I/O | I/O |
| AA30 | I/O | I/O |
| AB1 | I/O | I/O |
| AB2 | I/O | I/O |
| AB3 | I/O | I/O |
| AB4 | I/O | I/O |
| AB5 | I/O | I/O |
| AB6 | I/O | I/O |
| AB7 | $V_{DDP}$ | $V_{DDP}$ |
| AB8 | I/O | I/O |
| AB9 | $V_{DD}$ | $V_{DD}$ |
| AB10 | NC | I/O |
| AB11 | NC | I/O |
| AB12 | NC | I/O |
| AB13 | NC | I/O |
| AB14 | NC | I/O |
| AB15 | NC | I/O |
| AB16 | NC | I/O |
| AB17 | NC | I/O |
| AB18 | NC | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AB19 | NC | I/O |
| AB20 | NC | I/O |
| AB21 | NC | I/O |
| AB22 | $V_{DD}$ | $V_{DD}$ |
| AB23 | I/O | I/O |
| AB24 | $V_{DDP}$ | $V_{DDP}$ |
| AB25 | I/O | I/O |
| AB26 | I/O | I/O |
| AB27 | I/O | I/O |
| AB28 | I/O | I/O |
| AB29 | I/O | I/O |
| AB30 | I/O | I/O |
| AC1 | I/O | I/O |
| AC2 | I/O | I/O |
| AC3 | I/O | I/O |
| AC4 | I/O | I/O |
| AC5 | I/O | I/O |
| AC6 | I/O | I/O |
| AC7 | I/O | I/O |
| AC8 | GND | GND |
| AC9 | NC | I/O |
| AC10 | NC | I/O |
| AC11 | NC | I/O |
| AC12 | NC | I/O |
| AC13 | NC | I/O |
| AC14 | NC | I/O |
| AC15 | NC | I/O |
| AC16 | NC | I/O |
| AC17 | NC | I/O |
| AC18 | NC | I/O |
| AC19 | NC | I/O |
| AC20 | NC | I/O |
| AC21 | NC | I/O |
| AC22 | NC | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AC23 | GND | GND |
| AC24 | I/O | I/O |
| AC25 | I/O | I/O |
| AC26 | I/O | I/O |
| AC27 | I/O | I/O |
| AC28 | I/O | I/O |
| AC29 | I/O | I/O |
| AC30 | I/O | I/O |
| AD1 | GND | GND |
| AD2 | I/O | I/O |
| AD3 | I/O | I/O |
| AD4 | I/O | I/O |
| AD5 | $V_{DDP}$ | $V_{DDP}$ |
| AD6 | I/O | I/O |
| AD7 | $V_{DD}$ | $V_{DD}$ |
| AD8 | I/O | I/O |
| AD9 | $V_{DDP}$ | $V_{DDP}$ |
| AD10 | I/O | I/O |
| AD11 | I/O | I/O |
| AD12 | I/O | I/O |
| AD13 | I/O | I/O |
| AD14 | I/O | I/O |
| AD15 | I/O | I/O |
| AD16 | I/O | I/O |
| AD17 | I/O | I/O |
| AD18 | I/O | I/O |
| AD19 | I/O | I/O |
| AD20 | I/O | I/O |
| AD21 | I/O | I/O |
| AD22 | $V_{DDP}$ | $V_{DDP}$ |
| AD23 | TCK | TCK |
| AD24 | $V_{DD}$ | $V_{DD}$ |
| AD25 | TRST | TRST |
| AD26 | $V_{DDP}$ | $V_{DDP}$ |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AD27 | I/O | I/O |
| AD28 | I/O | I/O |
| AD29 | I/O | I/O |
| AD30 | GND | GND |
| AE1 | I/O | I/O |
| AE2 | $V_{DD}$ | $V_{DD}$ |
| AE3 | I/O | I/O |
| AE4 | I/O | I/O |
| AE5 | I/O | I/O |
| AE6 | GND | GND |
| AE7 | I/O | I/O |
| AE8 | I/O | I/O |
| AE9 | I/O | I/O |
| AE10 | I/O | I/O |
| AE11 | I/O | I/O |
| AE12 | I/O | I/O |
| AE13 | I/O | I/O |
| AE14 | I/O | I/O |
| AE15 | I/O | I/O |
| AE16 | I/O | I/O |
| AE17 | I/O | I/O |
| AE18 | I/O | I/O |
| AE19 | I/O | I/O |
| AE20 | I/O | I/O |
| AE21 | I/O | I/O |
| AE22 | I/O | I/O |
| AE23 | I/O | I/O |
| AE24 | I/O | I/O |
| AE25 | GND | GND |
| AE26 | I/O | I/O |
| AE27 | I/O | I/O |
| AE28 | I/O | I/O |
| AE29 | $V_{DD}$ | $V_{DD}$ |
| AE30 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AF1 | GND | GND |
| AF2 | I/O | I/O |
| AF3 | $V_{DDP}$ | $V_{DDP}$ |
| AF4 | I/O | I/O |
| AF5 | $V_{DD}$ | $V_{DD}$ |
| AF6 | I/O | I/O |
| AF7 | $V_{DDP}$ | $V_{DDP}$ |
| AF8 | I/O | I/O |
| AF9 | I/O | I/O |
| AF10 | I/O | I/O |
| AF11 | I/O | I/O |
| AF12 | I/O | I/O |
| AF13 | I/O | I/O |
| AF14 | I/O | I/O |
| AF15 | I/O | I/O |
| AF16 | I/O | I/O |
| AF17 | I/O | I/O |
| AF18 | I/O | I/O |
| AF19 | I/O | I/O |
| AF20 | I/O | I/O |
| AF21 | I/O | I/O |
| AF22 | I/O | I/O |
| AF23 | I/O | I/O |
| AF24 | $V_{DDP}$ | $V_{DDP}$ |
| AF25 | I/O | I/O |
| AF26 | $V_{DD}$ | $V_{DD}$ |
| AF27 | TDO | TDO |
| AF28 | $V_{DDP}$ | $V_{DDP}$ |
| AF29 | $V_{PN}$ | $V_{PN}$ |
| AF30 | GND | GND |
| AG1 | I/O | I/O |
| AG2 | $V_{DD}$ | $V_{DD}$ |
| AG3 | I/O | I/O |
| AG4 | GND | GND |

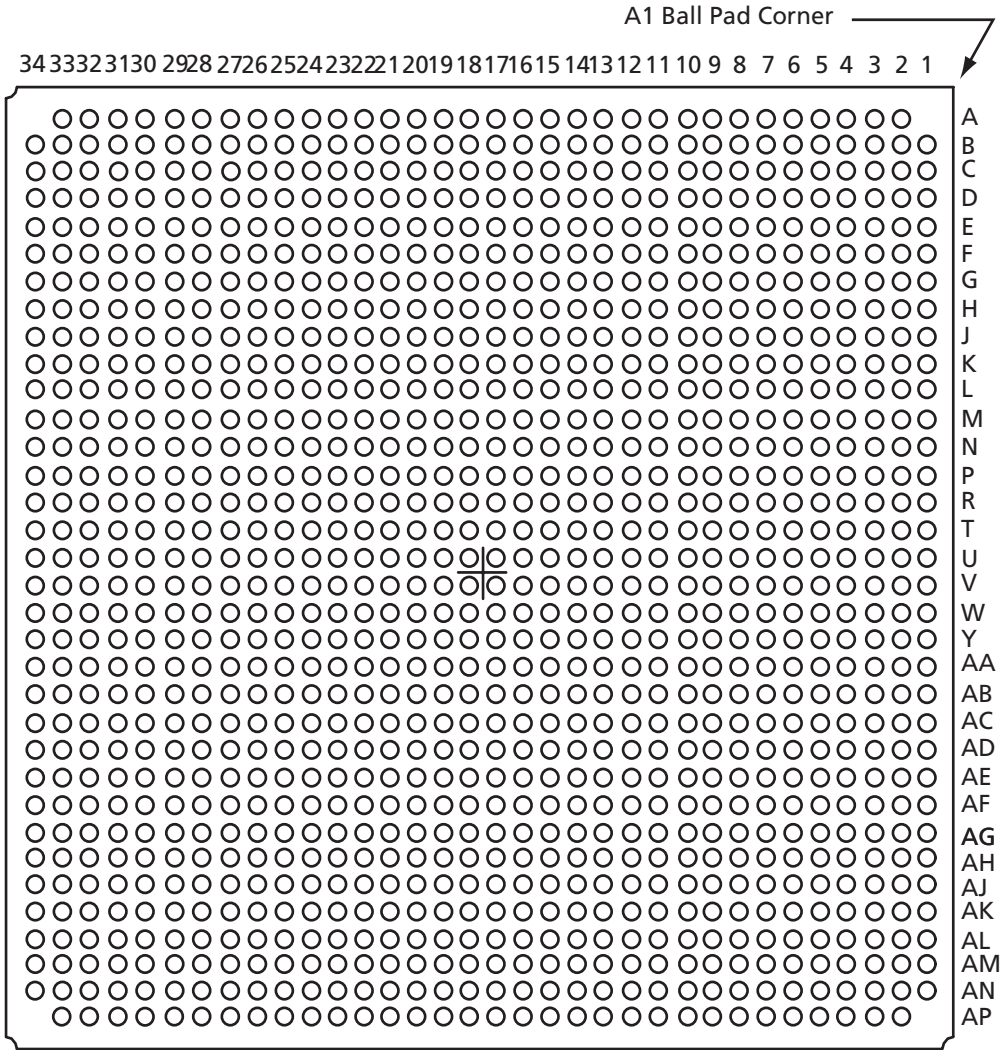
| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AG5 | I/O | I/O |
| AG6 | I/O | I/O |
| AG7 | I/O | I/O |
| AG8 | I/O | I/O |
| AG9 | I/O | I/O |
| AG10 | I/O | I/O |
| AG11 | I/O | I/O |
| AG12 | I/O | I/O |
| AG13 | I/O | I/O |
| AG14 | I/O | I/O |
| AG15 | I/O | I/O |
| AG16 | I/O | I/O |
| AG17 | I/O | I/O |
| AG18 | I/O | I/O |
| AG19 | I/O | I/O |
| AG20 | I/O | I/O |
| AG21 | I/O | I/O |
| AG22 | I/O | I/O |
| AG23 | I/O | I/O |
| AG24 | I/O | I/O |
| AG25 | I/O | I/O |
| AG26 | I/O | I/O |
| AG27 | GND | GND |
| AG28 | RCK | RCK |
| AG29 | $V_{DD}$ | $V_{DD}$ |
| AG30 | I/O | I/O |
| AH1 | GND | GND |
| AH2 | I/O | I/O |
| AH3 | $V_{DD}$ | $V_{DD}$ |
| AH4 | I/O | I/O |
| AH5 | $V_{DDP}$ | $V_{DDP}$ |
| AH6 | I/O | I/O |
| AH7 | I/O | I/O |
| AH8 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AH9 | I/O | I/O |
| AH10 | I/O | I/O |
| AH11 | I/O | I/O |
| AH12 | I/O | I/O |
| AH13 | I/O | I/O |
| AH14 | I/O | I/O |
| AH15 | I/O | I/O |
| AH16 | I/O | I/O |
| AH17 | I/O | I/O |
| AH18 | I/O | I/O |
| AH19 | I/O | I/O |
| AH20 | I/O | I/O |
| AH21 | I/O | I/O |
| AH22 | I/O | I/O |
| AH23 | I/O | I/O |
| AH24 | I/O | I/O |
| AH25 | I/O | I/O |
| AH26 | $V_{DDP}$ | $V_{DDP}$ |
| AH27 | TDI | TDI |
| AH28 | $V_{DD}$ | $V_{DD}$ |
| AH29 | $V_{PP}$ | $V_{PP}$ |
| AH30 | GND | GND |
| AJ1 | GND | GND |
| AJ2 | GND | GND |
| AJ3 | I/O | I/O |
| AJ4 | $V_{DD}$ | $V_{DD}$ |
| AJ5 | I/O | I/O |
| AJ6 | $V_{DD}$ | $V_{DD}$ |
| AJ7 | I/O | I/O |
| AJ8 | I/O | I/O |
| AJ9 | I/O | I/O |
| AJ10 | I/O | I/O |
| AJ11 | I/O | I/O |
| AJ12 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AJ13 | I/O | I/O |
| AJ14 | I/O | I/O |
| AJ15 | I/O | I/O |
| AJ16 | I/O | I/O |
| AJ17 | I/O | I/O |
| AJ18 | I/O | I/O |
| AJ19 | I/O | I/O |
| AJ20 | I/O | I/O |
| AJ21 | I/O | I/O |
| AJ22 | I/O | I/O |
| AJ23 | I/O | I/O |
| AJ24 | I/O | I/O |
| AJ25 | $V_{DD}$ | $V_{DD}$ |
| AJ26 | I/O | I/O |
| AJ27 | $V_{DD}$ | $V_{DD}$ |
| AJ28 | TMS | TMS |
| AJ29 | GND | GND |
| AJ30 | GND | GND |
| AK2 | GND | GND |
| AK3 | GND | GND |
| AK4 | I/O | I/O |
| AK5 | GND | GND |
| AK6 | I/O | I/O |
| AK7 | GND | GND |
| AK8 | I/O | I/O |
| AK9 | I/O | I/O |
| AK10 | I/O | I/O |
| AK11 | I/O | I/O |
| AK12 | I/O | I/O |
| AK13 | I/O | I/O |
| AK14 | I/O | I/O |
| AK15 | I/O | I/O |
| AK16 | I/O | I/O |
| AK17 | I/O | I/O |

| 896-Pin FBGA | | |
|---|---|---|
| Pin Number | APA750 Function | APA1000 Function |
| AK18 | I/O | I/O |
| AK19 | I/O | I/O |
| AK20 | I/O | I/O |
| AK21 | I/O | I/O |
| AK22 | I/O | I/O |
| AK23 | I/O | I/O |
| AK24 | GND | GND |
| AK25 | I/O | I/O |
| AK26 | GND | GND |
| AK27 | I/O | I/O |
| AK28 | GND | GND |
| AK29 | GND | GND |

# 1152-Pin FBGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| A2 | NC |
| A3 | GND |
| A4 | GND |
| A5 | GND |
| A6 | I/O |
| A7 | $V_{DD}$ |
| A8 | $V_{DD}$ |
| A9 | $V_{DD}$ |
| A10 | $V_{DD}$ |
| A11 | I/O |
| A12 | GND |
| A13 | I/O |
| A14 | $V_{DDP}$ |
| A15 | $V_{DDP}$ |
| A16 | I/O |
| A17 | GND |
| A18 | GND |
| A19 | I/O |
| A20 | $V_{DDP}$ |
| A21 | $V_{DDP}$ |
| A22 | I/O |
| A23 | GND |
| A24 | I/O |
| A25 | $V_{DD}$ |
| A26 | $V_{DD}$ |
| A27 | $V_{DD}$ |
| A28 | $V_{DD}$ |
| A29 | I/O |
| A30 | GND |
| A31 | GND |
| A32 | GND |
| A33 | NC |
| B1 | NC |
| B2 | NC |
| B3 | GND |
| B4 | GND |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| B5 | GND |
| B6 | NC |
| B7 | I/O |
| B8 | NC |
| B9 | I/O |
| B10 | NC |
| B11 | I/O |
| B12 | GND |
| B13 | I/O |
| B14 | $V_{DDP}$ |
| B15 | $V_{DDP}$ |
| B16 | I/O |
| B17 | GND |
| B18 | GND |
| B19 | I/O |
| B20 | $V_{DDP}$ |
| B21 | $V_{DDP}$ |
| B22 | I/O |
| B23 | GND |
| B24 | I/O |
| B25 | NC |
| B26 | I/O |
| B27 | NC |
| B28 | I/O |
| B29 | NC |
| B30 | GND |
| B31 | GND |
| B32 | GND |
| B33 | NC |
| B34 | NC |
| C1 | GND |
| C2 | GND |
| C3 | NC |
| C4 | GND |
| C5 | GND |
| C6 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| C7 | GND |
| C8 | I/O |
| C9 | GND |
| C10 | I/O |
| C11 | I/O |
| C12 | I/O |
| C13 | I/O |
| C14 | I/O |
| C15 | I/O |
| C16 | I/O |
| C17 | I/O |
| C18 | I/O |
| C19 | I/O |
| C20 | I/O |
| C21 | I/O |
| C22 | I/O |
| C23 | I/O |
| C24 | I/O |
| C25 | I/O |
| C26 | GND |
| C27 | I/O |
| C28 | GND |
| C29 | I/O |
| C30 | GND |
| C31 | GND |
| C32 | NC |
| C33 | GND |
| C34 | GND |
| D1 | GND |
| D2 | GND |
| D3 | GND |
| D4 | GND |
| D5 | I/O |
| D6 | $V_{DD}$ |
| D7 | I/O |
| D8 | $V_{DD}$ |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| D9 | I/O |
| D10 | I/O |
| D11 | I/O |
| D12 | I/O |
| D13 | I/O |
| D14 | I/O |
| D15 | I/O |
| D16 | I/O |
| D17 | I/O |
| D18 | I/O |
| D19 | I/O |
| D20 | I/O |
| D21 | I/O |
| D22 | I/O |
| D23 | I/O |
| D24 | I/O |
| D25 | I/O |
| D26 | I/O |
| D27 | $V_{DD}$ |
| D28 | I/O |
| D29 | $V_{DD}$ |
| D30 | I/O |
| D31 | GND |
| D32 | GND |
| D33 | GND |
| D34 | GND |
| E1 | GND |
| E2 | GND |
| E3 | GND |
| E4 | I/O |
| E5 | $V_{DD}$ |
| E6 | I/O |
| E7 | $V_{DDP}$ |
| E8 | I/O |
| E9 | I/O |
| E10 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| E11 | I/O |
| E12 | I/O |
| E13 | I/O |
| E14 | I/O |
| E15 | I/O |
| E16 | I/O |
| E17 | I/O |
| E18 | I/O |
| E19 | I/O |
| E20 | I/O |
| E21 | I/O |
| E22 | I/O |
| E23 | I/O |
| E24 | I/O |
| E25 | I/O |
| E26 | I/O |
| E27 | I/O |
| E28 | $V_{DDP}$ |
| E29 | I/O |
| E30 | $V_{DD}$ |
| E31 | I/O |
| E32 | GND |
| E33 | GND |
| E34 | GND |
| F1 | I/O |
| F2 | NC |
| F3 | I/O |
| F4 | $V_{DD}$ |
| F5 | I/O |
| F6 | GND |
| F7 | I/O |
| F8 | I/O |
| F9 | I/O |
| F10 | I/O |
| F11 | I/O |
| F12 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| F13 | I/O |
| F14 | I/O |
| F15 | I/O |
| F16 | I/O |
| F17 | I/O |
| F18 | I/O |
| F19 | I/O |
| F20 | I/O |
| F21 | I/O |
| F22 | I/O |
| F23 | I/O |
| F24 | I/O |
| F25 | I/O |
| F26 | I/O |
| F27 | I/O |
| F28 | I/O |
| F29 | GND |
| F30 | I/O |
| F31 | $V_{DD}$ |
| F32 | I/O |
| F33 | NC |
| F34 | NC |
| G1 | $V_{DD}$ |
| G2 | I/O |
| G3 | GND |
| G4 | I/O |
| G5 | $V_{DDP}$ |
| G6 | I/O |
| G7 | $V_{DD}$ |
| G8 | I/O |
| G9 | $V_{DDP}$ |
| G10 | I/O |
| G11 | I/O |
| G12 | I/O |
| G13 | I/O |
| G14 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| G15 | I/O |
| G16 | I/O |
| G17 | I/O |
| G18 | I/O |
| G19 | I/O |
| G20 | I/O |
| G21 | I/O |
| G22 | I/O |
| G23 | I/O |
| G24 | I/O |
| G25 | I/O |
| G26 | $V_{DDP}$ |
| G27 | I/O |
| G28 | $V_{DD}$ |
| G29 | I/O |
| G30 | $V_{DDP}$ |
| G31 | I/O |
| G32 | GND |
| G33 | I/O |
| G34 | $V_{DD}$ |
| H1 | $V_{DD}$ |
| H2 | NC |
| H3 | I/O |
| H4 | $V_{DD}$ |
| H5 | I/O |
| H6 | I/O |
| H7 | I/O |
| H8 | GND |
| H9 | I/O |
| H10 | I/O |
| H11 | I/O |
| H12 | I/O |
| H13 | I/O |
| H14 | I/O |
| H15 | I/O |
| H16 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| H17 | I/O |
| H18 | I/O |
| H19 | I/O |
| H20 | I/O |
| H21 | I/O |
| H22 | I/O |
| H23 | I/O |
| H24 | I/O |
| H25 | I/O |
| H26 | I/O |
| H27 | GND |
| H28 | I/O |
| H29 | I/O |
| H30 | I/O |
| H31 | $V_{DD}$ |
| H32 | I/O |
| H33 | NC |
| H34 | $V_{DD}$ |
| J1 | $V_{DD}$ |
| J2 | I/O |
| J3 | GND |
| J4 | I/O |
| J5 | I/O |
| J6 | I/O |
| J7 | $V_{DDP}$ |
| J8 | I/O |
| J9 | $V_{DD}$ |
| J10 | I/O |
| J11 | $V_{DDP}$ |
| J12 | I/O |
| J13 | I/O |
| J14 | I/O |
| J15 | I/O |
| J16 | I/O |
| J17 | I/O |
| J18 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| J19 | I/O |
| J20 | I/O |
| J21 | I/O |
| J22 | I/O |
| J23 | I/O |
| J24 | $V_{DDP}$ |
| J25 | I/O |
| J26 | $V_{DD}$ |
| J27 | I/O |
| J28 | $V_{DDP}$ |
| J29 | I/O |
| J30 | I/O |
| J31 | I/O |
| J32 | GND |
| J33 | I/O |
| J34 | $V_{DD}$ |
| K1 | $V_{DD}$ |
| K2 | NC |
| K3 | I/O |
| K4 | I/O |
| K5 | I/O |
| K6 | I/O |
| K7 | I/O |
| K8 | I/O |
| K9 | I/O |
| K10 | GND |
| K11 | I/O |
| K12 | I/O |
| K13 | I/O |
| K14 | I/O |
| K15 | I/O |
| K16 | I/O |
| K17 | I/O |
| K18 | I/O |
| K19 | I/O |
| K20 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| K21 | I/O |
| K22 | I/O |
| K23 | I/O |
| K24 | I/O |
| K25 | GND |
| K26 | I/O |
| K27 | I/O |
| K28 | I/O |
| K29 | I/O |
| K30 | I/O |
| K31 | I/O |
| K32 | I/O |
| K33 | NC |
| K34 | $V_{DD}$ |
| L1 | I/O |
| L2 | I/O |
| L3 | I/O |
| L4 | I/O |
| L5 | I/O |
| L6 | I/O |
| L7 | I/O |
| L8 | I/O |
| L9 | $V_{DDP}$ |
| L10 | I/O |
| L11 | $V_{DD}$ |
| L12 | I/O |
| L13 | I/O |
| L14 | I/O |
| L15 | I/O |
| L16 | I/O |
| L17 | I/O |
| L18 | I/O |
| L19 | I/O |
| L20 | I/O |
| L21 | I/O |
| L22 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| L23 | I/O |
| L24 | $V_{DD}$ |
| L25 | I/O |
| L26 | $V_{DDP}$ |
| L27 | I/O |
| L28 | I/O |
| L29 | I/O |
| L30 | I/O |
| L31 | I/O |
| L32 | I/O |
| L33 | I/O |
| L34 | I/O |
| M1 | GND |
| M2 | GND |
| M3 | I/O |
| M4 | I/O |
| M5 | I/O |
| M6 | I/O |
| M7 | I/O |
| M8 | I/O |
| M9 | I/O |
| M10 | I/O |
| M11 | I/O |
| M12 | $V_{DD}$ |
| M13 | I/O |
| M14 | $V_{DDP}$ |
| M15 | $V_{DDP}$ |
| M16 | $V_{DDP}$ |
| M17 | $V_{DDP}$ |
| M18 | $V_{DDP}$ |
| M19 | $V_{DDP}$ |
| M20 | $V_{DDP}$ |
| M21 | $V_{DDP}$ |
| M22 | I/O |
| M23 | $V_{DD}$ |
| M24 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| M25 | I/O |
| M26 | I/O |
| M27 | I/O |
| M28 | I/O |
| M29 | I/O |
| M30 | I/O |
| M31 | I/O |
| M32 | I/O |
| M33 | GND |
| M34 | GND |
| N1 | I/O |
| N2 | I/O |
| N3 | I/O |
| N4 | I/O |
| N5 | I/O |
| N6 | I/O |
| N7 | I/O |
| N8 | I/O |
| N9 | I/O |
| N10 | I/O |
| N11 | I/O |
| N12 | I/O |
| N13 | $V_{DD}$ |
| N14 | $V_{DD}$ |
| N15 | $V_{DD}$ |
| N16 | $V_{DD}$ |
| N17 | $V_{DD}$ |
| N18 | $V_{DD}$ |
| N19 | $V_{DD}$ |
| N20 | $V_{DD}$ |
| N21 | $V_{DD}$ |
| N22 | $V_{DD}$ |
| N23 | I/O |
| N24 | I/O |
| N25 | I/O |
| N26 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| N27 | I/O |
| N28 | I/O |
| N29 | I/O |
| N30 | I/O |
| N31 | I/O |
| N32 | I/O |
| N33 | I/O |
| N34 | I/O |
| P1 | $V_{DDP}$ |
| P2 | $V_{DDP}$ |
| P3 | I/O |
| P4 | I/O |
| P5 | I/O |
| P6 | I/O |
| P7 | I/O |
| P8 | I/O |
| P9 | I/O |
| P10 | I/O |
| P11 | I/O |
| P12 | $V_{DDP}$ |
| P13 | $V_{DD}$ |
| P14 | GND |
| P15 | GND |
| P16 | GND |
| P17 | GND |
| P18 | GND |
| P19 | GND |
| P20 | GND |
| P21 | GND |
| P22 | $V_{DD}$ |
| P23 | $V_{DDP}$ |
| P24 | I/O |
| P25 | I/O |
| P26 | I/O |
| P27 | I/O |
| P28 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| P29 | I/O |
| P30 | I/O |
| P31 | I/O |
| P32 | I/O |
| P33 | $V_{DDP}$ |
| P34 | $V_{DDP}$ |
| R1 | $V_{DDP}$ |
| R2 | $V_{DDP}$ |
| R3 | I/O |
| R4 | I/O |
| R5 | I/O |
| R6 | I/O |
| R7 | I/O |
| R8 | I/O |
| R9 | I/O |
| R10 | I/O |
| R11 | I/O |
| R12 | $V_{DDP}$ |
| R13 | $V_{DD}$ |
| R14 | GND |
| R15 | GND |
| R16 | GND |
| R17 | GND |
| R18 | GND |
| R19 | GND |
| R20 | GND |
| R21 | GND |
| R22 | $V_{DD}$ |
| R23 | $V_{DDP}$ |
| R24 | I/O |
| R25 | I/O |
| R26 | I/O |
| R27 | I/O |
| R28 | I/O |
| R29 | I/O |
| R30 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| R31 | I/O |
| R32 | I/O |
| R33 | $V_{DDP}$ |
| R34 | $V_{DDP}$ |
| T1 | I/O |
| T2 | I/O |
| T3 | I/O |
| T4 | I/O |
| T5 | I/O |
| T6 | I/O |
| T7 | I/O |
| T8 | I/O |
| T9 | I/O |
| T10 | I/O |
| T11 | I/O |
| T12 | $V_{DDP}$ |
| T13 | $V_{DD}$ |
| T14 | GND |
| T15 | GND |
| T16 | GND |
| T17 | GND |
| T18 | GND |
| T19 | GND |
| T20 | GND |
| T21 | GND |
| T22 | $V_{DD}$ |
| T23 | $V_{DDP}$ |
| T24 | I/O |
| T25 | I/O |
| T26 | I/O |
| T27 | I/O |
| T28 | I/O |
| T29 | I/O |
| T30 | I/O |
| T31 | I/O |
| T32 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| T33 | I/O |
| T34 | I/O |
| U1 | GND |
| U2 | GND |
| U3 | I/O |
| U4 | I/O / GLMX1 |
| U5 | AGND |
| U6 | NPECL1 |
| U7 | I/O / GL1 |
| U8 | I/O |
| U9 | I/O |
| U10 | I/O |
| U11 | I/O |
| U12 | $V_{DDP}$ |
| U13 | $V_{DD}$ |
| U14 | GND |
| U15 | GND |
| U16 | GND |
| U17 | GND |
| U18 | GND |
| U19 | GND |
| U20 | GND |
| U21 | GND |
| U22 | $V_{DD}$ |
| U23 | $V_{DDP}$ |
| U24 | I/O |
| U25 | I/O |
| U26 | I/O |
| U27 | I/O |
| U28 | I/O |
| U29 | NPECL2 |
| U30 | AGND |
| U31 | I/O / GLMX2 |
| U32 | I/O |
| U33 | GND |
| U34 | GND |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| V1 | GND |
| V2 | GND |
| V3 | I/O |
| V4 | AVDD |
| V5 | I/O / GL2 |
| V6 | PPECL1 / Input |
| V7 | I/O |
| V8 | I/O |
| V9 | I/O |
| V10 | I/O |
| V11 | I/O |
| V12 | $V_{DDP}$ |
| V13 | $V_{DD}$ |
| V14 | GND |
| V15 | GND |
| V16 | GND |
| V17 | GND |
| V18 | GND |
| V19 | GND |
| V20 | GND |
| V21 | GND |
| V22 | $V_{DD}$ |
| V23 | $V_{DDP}$ |
| V24 | I/O |
| V25 | I/O |
| V26 | I/O |
| V27 | I/O |
| V28 | PPECL2 / Input |
| V29 | I/O / GL4 |
| V30 | I/O / GL3 |
| V31 | AVDD |
| V32 | I/O |
| V33 | GND |
| V34 | GND |
| W1 | I/O |
| W2 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| W3 | I/O |
| W4 | I/O |
| W5 | I/O |
| W6 | I/O |
| W7 | I/O |
| W8 | I/O |
| W9 | I/O |
| W10 | I/O |
| W11 | I/O |
| W12 | $V_{DDP}$ |
| W13 | $V_{DD}$ |
| W14 | GND |
| W15 | GND |
| W16 | GND |
| W17 | GND |
| W18 | GND |
| W19 | GND |
| W20 | GND |
| W21 | GND |
| W22 | $V_{DD}$ |
| W23 | $V_{DDP}$ |
| W24 | I/O |
| W25 | I/O |
| W26 | I/O |
| W27 | I/O |
| W28 | I/O |
| W29 | I/O |
| W30 | I/O |
| W31 | I/O |
| W32 | I/O |
| W33 | I/O |
| W34 | I/O |
| Y1 | $V_{DDP}$ |
| Y2 | $V_{DDP}$ |
| Y3 | I/O |
| Y4 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| Y5 | I/O |
| Y6 | I/O |
| Y7 | I/O |
| Y8 | I/O |
| Y9 | I/O |
| Y10 | I/O |
| Y11 | I/O |
| Y12 | $V_{DDP}$ |
| Y13 | $V_{DD}$ |
| Y14 | GND |
| Y15 | GND |
| Y16 | GND |
| Y17 | GND |
| Y18 | GND |
| Y19 | GND |
| Y20 | GND |
| Y21 | GND |
| Y22 | $V_{DD}$ |
| Y23 | $V_{DDP}$ |
| Y24 | I/O |
| Y25 | I/O |
| Y26 | I/O |
| Y27 | I/O |
| Y28 | I/O |
| Y29 | I/O |
| Y30 | I/O |
| Y31 | I/O |
| Y32 | I/O |
| Y33 | $V_{DDP}$ |
| Y34 | $V_{DDP}$ |
| AA1 | $V_{DDP}$ |
| AA2 | $V_{DDP}$ |
| AA3 | I/O |
| AA4 | I/O |
| AA5 | I/O |
| AA6 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AA7 | I/O |
| AA8 | I/O |
| AA9 | I/O |
| AA10 | I/O |
| AA11 | I/O |
| AA12 | $V_{DDP}$ |
| AA13 | $V_{DD}$ |
| AA14 | GND |
| AA15 | GND |
| AA16 | GND |
| AA17 | GND |
| AA18 | GND |
| AA19 | GND |
| AA20 | GND |
| AA21 | GND |
| AA22 | $V_{DD}$ |
| AA23 | $V_{DDP}$ |
| AA24 | I/O |
| AA25 | I/O |
| AA26 | I/O |
| AA27 | I/O |
| AA28 | I/O |
| AA29 | I/O |
| AA30 | I/O |
| AA31 | I/O |
| AA32 | I/O |
| AA33 | $V_{DDP}$ |
| AA34 | $V_{DDP}$ |
| AB1 | I/O |
| AB2 | I/O |
| AB3 | I/O |
| AB4 | I/O |
| AB5 | I/O |
| AB6 | I/O |
| AB7 | I/O |
| AB8 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AB9 | I/O |
| AB10 | I/O |
| AB11 | I/O |
| AB12 | I/O |
| AB13 | $V_{DD}$ |
| AB14 | $V_{DD}$ |
| AB15 | $V_{DD}$ |
| AB16 | $V_{DD}$ |
| AB17 | $V_{DD}$ |
| AB18 | $V_{DD}$ |
| AB19 | $V_{DD}$ |
| AB20 | $V_{DD}$ |
| AB21 | $V_{DD}$ |
| AB22 | $V_{DD}$ |
| AB23 | I/O |
| AB24 | I/O |
| AB25 | I/O |
| AB26 | I/O |
| AB27 | I/O |
| AB28 | I/O |
| AB29 | I/O |
| AB30 | I/O |
| AB31 | I/O |
| AB32 | I/O |
| AB33 | I/O |
| AB34 | I/O |
| AC1 | GND |
| AC2 | GND |
| AC3 | I/O |
| AC4 | I/O |
| AC5 | I/O |
| AC6 | I/O |
| AC7 | I/O |
| AC8 | I/O |
| AC9 | I/O |
| AC10 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AC11 | I/O |
| AC12 | $V_{DD}$ |
| AC13 | I/O |
| AC14 | $V_{DDP}$ |
| AC15 | $V_{DDP}$ |
| AC16 | $V_{DDP}$ |
| AC17 | $V_{DDP}$ |
| AC18 | $V_{DDP}$ |
| AC19 | $V_{DDP}$ |
| AC20 | $V_{DDP}$ |
| AC21 | $V_{DDP}$ |
| AC22 | I/O |
| AC23 | $V_{DD}$ |
| AC24 | I/O |
| AC25 | I/O |
| AC26 | I/O |
| AC27 | I/O |
| AC28 | I/O |
| AC29 | I/O |
| AC30 | I/O |
| AC31 | I/O |
| AC32 | I/O |
| AC33 | GND |
| AC34 | GND |
| AD1 | I/O |
| AD2 | I/O |
| AD3 | I/O |
| AD4 | I/O |
| AD5 | I/O |
| AD6 | I/O |
| AD7 | I/O |
| AD8 | I/O |
| AD9 | $V_{DDP}$ |
| AD10 | I/O |
| AD11 | $V_{DD}$ |
| AD12 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AD13 | I/O |
| AD14 | I/O |
| AD15 | I/O |
| AD16 | I/O |
| AD17 | I/O |
| AD18 | I/O |
| AD19 | I/O |
| AD20 | I/O |
| AD21 | I/O |
| AD22 | I/O |
| AD23 | I/O |
| AD24 | $V_{DD}$ |
| AD25 | I/O |
| AD26 | $V_{DDP}$ |
| AD27 | I/O |
| AD28 | I/O |
| AD29 | I/O |
| AD30 | I/O |
| AD31 | I/O |
| AD32 | I/O |
| AD33 | I/O |
| AD34 | I/O |
| AE1 | $V_{DD}$ |
| AE2 | NC |
| AE3 | I/O |
| AE4 | I/O |
| AE5 | I/O |
| AE6 | I/O |
| AE7 | I/O |
| AE8 | I/O |
| AE9 | I/O |
| AE10 | GND |
| AE11 | I/O |
| AE12 | I/O |
| AE13 | I/O |
| AE14 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AE15 | I/O |
| AE16 | I/O |
| AE17 | I/O |
| AE18 | I/O |
| AE19 | I/O |
| AE20 | I/O |
| AE21 | I/O |
| AE22 | I/O |
| AE23 | I/O |
| AE24 | I/O |
| AE25 | GND |
| AE26 | I/O |
| AE27 | I/O |
| AE28 | I/O |
| AE29 | I/O |
| AE30 | I/O |
| AE31 | I/O |
| AE32 | I/O |
| AE33 | NC |
| AE34 | $V_{DD}$ |
| AF1 | $V_{DD}$ |
| AF2 | I/O |
| AF3 | GND |
| AF4 | I/O |
| AF5 | I/O |
| AF6 | I/O |
| AF7 | $V_{DDP}$ |
| AF8 | I/O |
| AF9 | $V_{DD}$ |
| AF10 | I/O |
| AF11 | $V_{DDP}$ |
| AF12 | I/O |
| AF13 | I/O |
| AF14 | I/O |
| AF15 | I/O |
| AF16 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AF17 | I/O |
| AF18 | I/O |
| AF19 | I/O |
| AF20 | I/O |
| AF21 | I/O |
| AF22 | I/O |
| AF23 | I/O |
| AF24 | $V_{DDP}$ |
| AF25 | TCK |
| AF26 | $V_{DD}$ |
| AF27 | TRST |
| AF28 | $V_{DDP}$ |
| AF29 | I/O |
| AF30 | I/O |
| AF31 | I/O |
| AF32 | GND |
| AF33 | I/O |
| AF34 | $V_{DD}$ |
| AG1 | $V_{DD}$ |
| AG2 | NC |
| AG3 | I/O |
| AG4 | $V_{DD}$ |
| AG5 | I/O |
| AG6 | I/O |
| AG7 | I/O |
| AG8 | GND |
| AG9 | I/O |
| AG10 | I/O |
| AG11 | I/O |
| AG12 | I/O |
| AG13 | I/O |
| AG14 | I/O |
| AG15 | I/O |
| AG16 | I/O |
| AG17 | I/O |
| AG18 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AG19 | I/O |
| AG20 | I/O |
| AG21 | I/O |
| AG22 | I/O |
| AG23 | I/O |
| AG24 | I/O |
| AG25 | I/O |
| AG26 | I/O |
| AG27 | GND |
| AG28 | I/O |
| AG29 | I/O |
| AG30 | I/O |
| AG31 | $V_{DD}$ |
| AG32 | I/O |
| AG33 | NC |
| AG34 | $V_{DD}$ |
| AH1 | $V_{DD}$ |
| AH2 | I/O |
| AH3 | GND |
| AH4 | I/O |
| AH5 | $V_{DDP}$ |
| AH6 | I/O |
| AH7 | $V_{DD}$ |
| AH8 | I/O |
| AH9 | $V_{DDP}$ |
| AH10 | I/O |
| AH11 | I/O |
| AH12 | I/O |
| AH13 | I/O |
| AH14 | I/O |
| AH15 | I/O |
| AH16 | I/O |
| AH17 | I/O |
| AH18 | I/O |
| AH19 | I/O |
| AH20 | I/O |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AH21 | I/O |
| AH22 | I/O |
| AH23 | I/O |
| AH24 | I/O |
| AH25 | I/O |
| AH26 | $V_{DDP}$ |
| AH27 | I/O |
| AH28 | $V_{DD}$ |
| AH29 | TDO |
| AH30 | $V_{DDP}$ |
| AH31 | $V_{PN}$ |
| AH32 | GND |
| AH33 | I/O |
| AH34 | $V_{DD}$ |
| AJ1 | I/O |
| AJ2 | NC |
| AJ3 | I/O |
| AJ4 | $V_{DD}$ |
| AJ5 | I/O |
| AJ6 | GND |
| AJ7 | I/O |
| AJ8 | I/O |
| AJ9 | I/O |
| AJ10 | I/O |
| AJ11 | I/O |
| AJ12 | I/O |
| AJ13 | I/O |
| AJ14 | I/O |
| AJ15 | I/O |
| AJ16 | I/O |
| AJ17 | I/O |
| AJ18 | I/O |
| AJ19 | I/O |
| AJ20 | I/O |
| AJ21 | I/O |
| AJ22 | I/O |

| 1152-Pin FBGA | |
|---|---|
| Pin Number | APA1000 Function |
| AJ23 | I/O |
| AJ24 | I/O |
| AJ25 | I/O |
| AJ26 | I/O |
| AJ27 | I/O |
| AJ28 | I/O |
| AJ29 | GND |
| AJ30 | RCK |
| AJ31 | $V_{DD}$ |
| AJ32 | I/O |
| AJ33 | NC |
| AJ34 | NC |
| AK1 | GND |
| AK2 | GND |
| AK3 | GND |
| AK4 | I/O |
| AK5 | $V_{DD}$ |
| AK6 | I/O |
| AK7 | $V_{DDP}$ |
| AK8 | I/O |
| AK9 | I/O |
| AK10 | I/O |
| AK11 | I/O |
| AK12 | I/O |
| AK13 | I/O |
| AK14 | I/O |
| AK15 | I/O |
| AK16 | I/O |
| AK17 | I/O |
| AK18 | I/O |
| AK19 | I/O |
| AK20 | I/O |
| AK21 | I/O |
| AK22 | I/O |
| AK23 | I/O |
| AK24 | I/O |

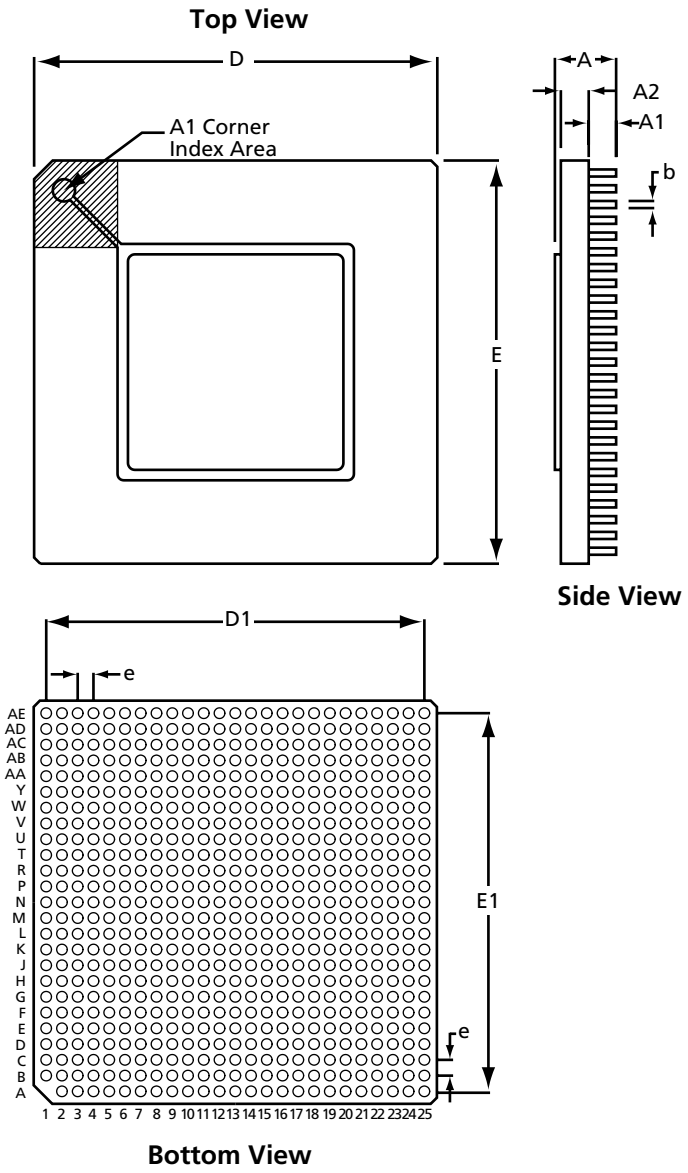
| 1152-Pin FBGA | |
|---|---|
| Pin Number | APA1000 Function |
| AK25 | I/O |
| AK26 | I/O |
| AK27 | I/O |
| AK28 | $V_{DDP}$ |
| AK29 | TDI |
| AK30 | $V_{DD}$ |
| AK31 | $V_{PP}$ |
| AK32 | GND |
| AK33 | GND |
| AK34 | GND |
| AL1 | GND |
| AL2 | GND |
| AL3 | GND |
| AL4 | GND |
| AL5 | I/O |
| AL6 | $V_{DD}$ |
| AL7 | I/O |
| AL8 | $V_{DD}$ |
| AL9 | I/O |
| AL10 | I/O |
| AL11 | I/O |
| AL12 | I/O |
| AL13 | I/O |
| AL14 | I/O |
| AL15 | I/O |
| AL16 | I/O |
| AL17 | I/O |
| AL18 | I/O |
| AL19 | I/O |
| AL20 | I/O |
| AL21 | I/O |
| AL22 | I/O |
| AL23 | I/O |
| AL24 | I/O |
| AL25 | I/O |
| AL26 | I/O |

| 1152-Pin FBGA | |
|---|---|
| Pin Number | APA1000 Function |
| AL27 | $V_{DD}$ |
| AL28 | I/O |
| AL29 | $V_{DD}$ |
| AL30 | TMS |
| AL31 | GND |
| AL32 | GND |
| AL33 | GND |
| AL34 | GND |
| AM1 | GND |
| AM2 | GND |
| AM3 | NC |
| AM4 | GND |
| AM5 | GND |
| AM6 | I/O |
| AM7 | GND |
| AM8 | I/O |
| AM9 | GND |
| AM10 | I/O |
| AM11 | I/O |
| AM12 | I/O |
| AM13 | I/O |
| AM14 | I/O |
| AM15 | I/O |
| AM16 | I/O |
| AM17 | I/O |
| AM18 | I/O |
| AM19 | I/O |
| AM20 | I/O |
| AM21 | I/O |
| AM22 | I/O |
| AM23 | I/O |
| AM24 | I/O |
| AM25 | I/O |
| AM26 | GND |
| AM27 | I/O |
| AM28 | GND |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AM29 | I/O |
| AM30 | GND |
| AM31 | GND |
| AM32 | NC |
| AM33 | GND |
| AM34 | GND |
| AN1 | NC |
| AN2 | NC |
| AN3 | GND |
| AN4 | GND |
| AN5 | GND |
| AN6 | NC |
| AN7 | I/O |
| AN8 | NC |
| AN9 | I/O |
| AN10 | NC |
| AN11 | I/O |
| AN12 | GND |
| AN13 | I/O |
| AN14 | $V_{DDP}$ |
| AN15 | $V_{DDP}$ |
| AN16 | I/O |
| AN17 | GND |
| AN18 | GND |
| AN19 | I/O |
| AN20 | $V_{DDP}$ |
| AN21 | $V_{DDP}$ |
| AN22 | I/O |
| AN23 | GND |
| AN24 | I/O |
| AN25 | NC |
| AN26 | I/O |
| AN27 | NC |
| AN28 | I/O |
| AN29 | NC |
| AN30 | GND |

| 1152-Pin FBGA | |
|---|---|
| **Pin Number** | **APA1000 Function** |
| AN31 | GND |
| AN32 | GND |
| AN33 | NC |
| AN34 | NC |
| AP2 | NC |
| AP3 | GND |
| AP4 | GND |
| AP5 | GND |
| AP6 | I/O |
| AP7 | $V_{DD}$ |
| AP8 | $V_{DD}$ |
| AP9 | $V_{DD}$ |
| AP10 | $V_{DD}$ |
| AP11 | I/O |
| AP12 | GND |
| AP13 | I/O |
| AP14 | $V_{DDP}$ |
| AP15 | $V_{DDP}$ |
| AP16 | I/O |
| AP17 | GND |
| AP18 | GND |
| AP19 | I/O |
| AP20 | $V_{DDP}$ |
| AP21 | $V_{DDP}$ |
| AP22 | I/O |
| AP23 | GND |
| AP24 | I/O |
| AP25 | $V_{DD}$ |
| AP26 | $V_{DD}$ |
| AP27 | $V_{DD}$ |
| AP28 | $V_{DD}$ |
| AP29 | I/O |
| AP30 | GND |
| AP31 | GND |
| AP32 | GND |
| AP33 | NC |

# 624-Pin CCGA/LGA




## Note

For Package Manufacturing and Environmental information, visit the Package Resource center at http://www.actel.com/products/rescenter/package/index.html.

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| A2 | I/O | I/O |
| A3 | I/O | I/O |
| A4 | I/O | I/O |
| A5 | I/O | I/O |
| A6 | I/O | I/O |
| A7 | I/O | I/O |
| A8 | I/O | I/O |
| A9 | I/O | I/O |
| A10 | I/O | I/O |
| A11 | I/O | I/O |
| A12 | I/O | I/O |
| A13 | I/O | I/O |
| A14 | I/O | I/O |
| A15 | I/O | I/O |
| A16 | I/O | I/O |
| A17 | I/O | I/O |
| A18 | I/O | I/O |
| A19 | I/O | I/O |
| A20 | I/O | I/O |
| A21 | I/O | I/O |
| A22 | I/O | I/O |
| A23 | I/O | I/O |
| A24 | $V_{DDP}$ | $V_{DDP}$ |
| A25 | GND | GND |
| B1 | I/O | I/O |
| B2 | GND | GND |
| B3 | $V_{DDP}$ | $V_{DDP}$ |
| B4 | I/O | I/O |
| B5 | I/O | I/O |
| B6 | I/O | I/O |
| B7 | I/O | I/O |
| B8 | I/O | I/O |
| B9 | I/O | I/O |
| B10 | I/O | I/O |
| B11 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| B12 | I/O | I/O |
| B13 | I/O | I/O |
| B14 | I/O | I/O |
| B15 | I/O | I/O |
| B16 | I/O | I/O |
| B17 | I/O | I/O |
| B18 | I/O | I/O |
| B19 | I/O | I/O |
| B20 | I/O | I/O |
| B21 | I/O | I/O |
| B22 | I/O | I/O |
| B23 | $V_{DD}$ | $V_{DD}$ |
| B24 | GND | GND |
| B25 | $V_{DDP}$ | $V_{DDP}$ |
| C1 | I/O | I/O |
| C2 | $V_{DDP}$ | $V_{DDP}$ |
| C3 | GND | GND |
| C4 | $V_{DD}$ | $V_{DD}$ |
| C5 | I/O | I/O |
| C6 | I/O | I/O |
| C7 | GND | GND |
| C8 | I/O | I/O |
| C9 | I/O | I/O |
| C10 | I/O | I/O |
| C11 | I/O | I/O |
| C12 | I/O | I/O |
| C13 | I/O | I/O |
| C14 | I/O | I/O |
| C15 | I/O | I/O |
| C16 | I/O | I/O |
| C17 | I/O | I/O |
| C18 | I/O | I/O |
| C19 | GND | GND |
| C20 | I/O | I/O |
| C21 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| C22 | I/O | I/O |
| C23 | GND | GND |
| C24 | $V_{DD}$ | $V_{DD}$ |
| C25 | I/O | I/O |
| D1 | I/O | I/O |
| D2 | I/O | I/O |
| D3 | $V_{DD}$ | $V_{DD}$ |
| D4 | GND | GND |
| D5 | I/O | I/O |
| D6 | I/O | I/O |
| D7 | I/O | I/O |
| D8 | I/O | I/O |
| D9 | I/O | I/O |
| D10 | I/O | I/O |
| D11 | GND | GND |
| D12 | I/O | I/O |
| D13 | I/O | I/O |
| D14 | I/O | I/O |
| D15 | GND | GND |
| D16 | I/O | I/O |
| D17 | I/O | I/O |
| D18 | I/O | I/O |
| D19 | I/O | I/O |
| D20 | I/O | I/O |
| D21 | I/O | I/O |
| D22 | I/O | I/O |
| D23 | I/O | I/O |
| D24 | I/O | I/O |
| D25 | I/O | I/O |
| E1 | I/O | I/O |
| E2 | I/O | I/O |
| E3 | I/O | I/O |
| E4 | I/O | I/O |
| E5 | I/O | I/O |
| E6 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| E7 | I/O | I/O |
| E8 | I/O | I/O |
| E9 | I/O | I/O |
| E10 | I/O | I/O |
| E11 | I/O | I/O |
| E12 | I/O | I/O |
| E13 | I/O | I/O |
| E14 | I/O | I/O |
| E15 | I/O | I/O |
| E16 | I/O | I/O |
| E17 | I/O | I/O |
| E18 | I/O | I/O |
| E19 | I/O | I/O |
| E20 | I/O | I/O |
| E21 | I/O | I/O |
| E22 | I/O | I/O |
| E23 | I/O | I/O |
| E24 | I/O | I/O |
| E25 | I/O | I/O |
| F1 | I/O | I/O |
| F2 | I/O | I/O |
| F3 | I/O | I/O |
| F4 | I/O | I/O |
| F5 | I/O | I/O |
| F6 | I/O | I/O |
| F7 | I/O | I/O |
| F8 | GND | GND |
| F9 | I/O | I/O |
| F10 | I/O | I/O |
| F11 | I/O | I/O |
| F12 | I/O | I/O |
| F13 | I/O | I/O |
| F14 | I/O | I/O |
| F15 | I/O | I/O |
| F16 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| F17 | I/O | I/O |
| F18 | GND | GND |
| F19 | I/O | I/O |
| F20 | I/O | I/O |
| F21 | I/O | I/O |
| F22 | I/O | I/O |
| F23 | I/O | I/O |
| F24 | I/O | I/O |
| F25 | I/O | I/O |
| G1 | I/O | I/O |
| G2 | I/O | I/O |
| G3 | I/O | I/O |
| G4 | I/O | I/O |
| G5 | I/O | I/O |
| G6 | I/O | I/O |
| G7 | I/O | I/O |
| G8 | I/O | I/O |
| G9 | I/O | I/O |
| G10 | I/O | I/O |
| G11 | I/O | I/O |
| G12 | I/O | I/O |
| G13 | I/O | I/O |
| G14 | I/O | I/O |
| G15 | I/O | I/O |
| G16 | I/O | I/O |
| G17 | I/O | I/O |
| G18 | I/O | I/O |
| G19 | I/O | I/O |
| G20 | I/O | I/O |
| G21 | I/O | I/O |
| G22 | I/O | I/O |
| G23 | I/O | I/O |
| G24 | I/O | I/O |
| G25 | I/O | I/O |
| H1 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| H2 | I/O | I/O |
| H3 | GND | GND |
| H4 | I/O | I/O |
| H5 | I/O | I/O |
| H6 | I/O | I/O |
| H7 | I/O | I/O |
| H8 | $V_{DDP}$ | $V_{DDP}$ |
| H9 | $V_{DDP}$ | $V_{DDP}$ |
| H10 | $V_{DDP}$ | $V_{DDP}$ |
| H11 | $V_{DDP}$ | $V_{DDP}$ |
| H12 | $V_{DDP}$ | $V_{DDP}$ |
| H13 | $V_{DDP}$ | $V_{DDP}$ |
| H14 | $V_{DDP}$ | $V_{DDP}$ |
| H15 | $V_{DDP}$ | $V_{DDP}$ |
| H16 | $V_{DDP}$ | $V_{DDP}$ |
| H17 | $V_{DDP}$ | $V_{DDP}$ |
| H18 | $V_{DDP}$ | $V_{DDP}$ |
| H19 | I/O | I/O |
| H20 | I/O | I/O |
| H21 | I/O | I/O |
| H22 | I/O | I/O |
| H23 | GND | GND |
| H24 | I/O | I/O |
| H25 | I/O | I/O |
| J1 | I/O | I/O |
| J2 | I/O | I/O |
| J3 | I/O | I/O |
| J4 | I/O | I/O |
| J5 | I/O | I/O |
| J6 | GND | GND |
| J7 | I/O | I/O |
| J8 | $V_{DDP}$ | $V_{DDP}$ |
| J9 | GND | GND |
| J10 | GND | GND |
| J11 | GND | GND |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| J12 | GND | GND |
| J13 | GND | GND |
| J14 | GND | GND |
| J15 | GND | GND |
| J16 | GND | GND |
| J17 | GND | GND |
| J18 | $V_{DDP}$ | $V_{DDP}$ |
| J19 | I/O | I/O |
| J20 | GND | GND |
| J21 | I/O | I/O |
| J22 | I/O | I/O |
| J23 | I/O | I/O |
| J24 | I/O | I/O |
| J25 | I/O | I/O |
| K1 | I/O | I/O |
| K2 | I/O | I/O |
| K3 | I/O | I/O |
| K4 | I/O | I/O |
| K5 | I/O | I/O |
| K6 | I/O | I/O |
| K7 | I/O | I/O |
| K8 | $V_{DDP}$ | $V_{DDP}$ |
| K9 | GND | GND |
| K10 | $V_{DD}$ | $V_{DD}$ |
| K11 | $V_{DD}$ | $V_{DD}$ |
| K12 | $V_{DD}$ | $V_{DD}$ |
| K13 | $V_{DD}$ | $V_{DD}$ |
| K14 | $V_{DD}$ | $V_{DD}$ |
| K15 | $V_{DD}$ | $V_{DD}$ |
| K16 | $V_{DD}$ | $V_{DD}$ |
| K17 | GND | GND |
| K18 | $V_{DDP}$ | $V_{DDP}$ |
| K19 | I/O | I/O |
| K20 | I/O | I/O |
| K21 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| K22 | I/O | I/O |
| K23 | I/O | I/O |
| K24 | I/O | I/O |
| K25 | I/O | I/O |
| L1 | I/O | I/O |
| L2 | I/O | I/O |
| L3 | I/O | I/O |
| L4 | I/O | I/O |
| L5 | I/O | I/O |
| L6 | I/O | I/O |
| L7 | I/O | I/O |
| L8 | $V_{DDP}$ | $V_{DDP}$ |
| L9 | GND | GND |
| L10 | $V_{DD}$ | $V_{DD}$ |
| L11 | GND | GND |
| L12 | GND | GND |
| L13 | GND | GND |
| L14 | GND | GND |
| L15 | GND | GND |
| L16 | $V_{DD}$ | $V_{DD}$ |
| L17 | GND | GND |
| L18 | $V_{DDP}$ | $V_{DDP}$ |
| L19 | I/O | I/O |
| L20 | I/O | I/O |
| L21 | I/O | I/O |
| L22 | I/O | I/O |
| L23 | I/O | I/O |
| L24 | I/O | I/O |
| L25 | I/O | I/O |
| M1 | I/O | I/O |
| M2 | I/O | I/O |
| M3 | I/O | I/O |
| M4 | AGND | AGND |
| M5 | NPECL1 | NPECL1 |
| M6 | I/O / GL2 | I/O / GL2 |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| M7 | I/O / GLMX1 | I/O / GLMX1 |
| M8 | $V_{DDP}$ | $V_{DDP}$ |
| M9 | GND | GND |
| M10 | $V_{DD}$ | $V_{DD}$ |
| M11 | GND | GND |
| M12 | GND | GND |
| M13 | GND | GND |
| M14 | GND | GND |
| M15 | GND | GND |
| M16 | $V_{DD}$ | $V_{DD}$ |
| M17 | GND | GND |
| M18 | $V_{DDP}$ | $V_{DDP}$ |
| M19 | I/O / GLMX2 | I/O / GLMX2 |
| M20 | I/O / GL4 | I/O / GL4 |
| M21 | NPECL2 | NPECL2 |
| M22 | AGND | AGND |
| M23 | I/O | I/O |
| M24 | I/O | I/O |
| M25 | I/O | I/O |
| N1 | I/O | I/O |
| N2 | I/O | I/O |
| N3 | I/O | I/O |
| N4 | AVDD | AVDD |
| N5 | PPECL1 / Input | PPECL1 / Input |
| N6 | I/O / GL1 | I/O / GL1 |
| N7 | I/O | I/O |
| N8 | $V_{DDP}$ | $V_{DDP}$ |
| N9 | GND | GND |
| N10 | $V_{DD}$ | $V_{DD}$ |
| N11 | GND | GND |
| N12 | GND | GND |
| N13 | GND | GND |
| N14 | GND | GND |
| N15 | GND | GND |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA1000 Function** |
| N16 | $V_{DD}$ | $V_{DD}$ |
| N17 | GND | GND |
| N18 | $V_{DDP}$ | $V_{DDP}$ |
| N19 | I/O | I/O |
| N20 | I/O / GL3 | I/O / GL3 |
| N21 | PPECL2 / Input | PPECL2 / Input |
| N22 | AVDD | AVDD |
| N23 | I/O | I/O |
| N24 | I/O | I/O |
| N25 | I/O | I/O |
| P1 | I/O | I/O |
| P2 | I/O | I/O |
| P3 | I/O | I/O |
| P4 | GND | GND |
| P5 | I/O | I/O |
| P6 | I/O | I/O |
| P7 | I/O | I/O |
| P8 | $V_{DDP}$ | $V_{DDP}$ |
| P9 | GND | GND |
| P10 | $V_{DD}$ | $V_{DD}$ |
| P11 | GND | GND |
| P12 | GND | GND |
| P13 | GND | GND |
| P14 | GND | GND |
| P15 | GND | GND |
| P16 | $V_{DD}$ | $V_{DD}$ |
| P17 | GND | GND |
| P18 | $V_{DDP}$ | $V_{DDP}$ |
| P19 | I/O | I/O |
| P20 | I/O | I/O |
| P21 | I/O | I/O |
| P22 | GND | GND |
| P23 | I/O | I/O |
| P24 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA1000 Function** |
| P25 | I/O | I/O |
| R1 | I/O | I/O |
| R2 | I/O | I/O |
| R3 | I/O | I/O |
| R4 | I/O | I/O |
| R5 | I/O | I/O |
| R6 | I/O | I/O |
| R7 | I/O | I/O |
| R8 | $V_{DDP}$ | $V_{DDP}$ |
| R9 | GND | GND |
| R10 | $V_{DD}$ | $V_{DD}$ |
| R11 | GND | GND |
| R12 | GND | GND |
| R13 | GND | GND |
| R14 | GND | GND |
| R15 | GND | GND |
| R16 | $V_{DD}$ | $V_{DD}$ |
| R17 | GND | GND |
| R18 | $V_{DDP}$ | $V_{DDP}$ |
| R19 | I/O | I/O |
| R20 | I/O | I/O |
| R21 | I/O | I/O |
| R22 | I/O | I/O |
| R23 | I/O | I/O |
| R24 | I/O | I/O |
| R25 | I/O | I/O |
| T1 | I/O | I/O |
| T2 | I/O | I/O |
| T3 | I/O | I/O |
| T4 | I/O | I/O |
| T5 | I/O | I/O |
| T6 | I/O | I/O |
| T7 | I/O | I/O |
| T8 | $V_{DDP}$ | $V_{DDP}$ |
| T9 | GND | GND |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA1000 Function** |
| T10 | $V_{DD}$ | $V_{DD}$ |
| T11 | $V_{DD}$ | $V_{DD}$ |
| T12 | $V_{DD}$ | $V_{DD}$ |
| T13 | $V_{DD}$ | $V_{DD}$ |
| T14 | $V_{DD}$ | $V_{DD}$ |
| T15 | $V_{DD}$ | $V_{DD}$ |
| T16 | $V_{DD}$ | $V_{DD}$ |
| T17 | GND | GND |
| T18 | $V_{DDP}$ | $V_{DDP}$ |
| T19 | I/O | I/O |
| T20 | I/O | I/O |
| T21 | I/O | I/O |
| T22 | I/O | I/O |
| T23 | I/O | I/O |
| T24 | I/O | I/O |
| T25 | I/O | I/O |
| U1 | I/O | I/O |
| U2 | I/O | I/O |
| U3 | I/O | I/O |
| U4 | I/O | I/O |
| U5 | I/O | I/O |
| U6 | GND | GND |
| U7 | I/O | I/O |
| U8 | $V_{DDP}$ | $V_{DDP}$ |
| U9 | GND | GND |
| U10 | GND | GND |
| U11 | GND | GND |
| U12 | GND | GND |
| U13 | GND | GND |
| U14 | GND | GND |
| U15 | GND | GND |
| U16 | GND | GND |
| U17 | GND | GND |
| U18 | $V_{DDP}$ | $V_{DDP}$ |
| U19 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA1000 Function** |
| U20 | GND | GND |
| U21 | I/O | I/O |
| U22 | I/O | I/O |
| U23 | I/O | I/O |
| U24 | I/O | I/O |
| U25 | I/O | I/O |
| V1 | I/O | I/O |
| V2 | I/O | I/O |
| V3 | GND | GND |
| V4 | I/O | I/O |
| V5 | I/O | I/O |
| V6 | I/O | I/O |
| V7 | I/O | I/O |
| V8 | $V_{DDP}$ | $V_{DDP}$ |
| V9 | $V_{DDP}$ | $V_{DDP}$ |
| V10 | $V_{DDP}$ | $V_{DDP}$ |
| V11 | $V_{DDP}$ | $V_{DDP}$ |
| V12 | $V_{DDP}$ | $V_{DDP}$ |
| V13 | $V_{DDP}$ | $V_{DDP}$ |
| V14 | $V_{DDP}$ | $V_{DDP}$ |
| V15 | $V_{DDP}$ | $V_{DDP}$ |
| V16 | $V_{DDP}$ | $V_{DDP}$ |
| V17 | $V_{DDP}$ | $V_{DDP}$ |
| V18 | $V_{DDP}$ | $V_{DDP}$ |
| V19 | RCK | RCK |
| V20 | I/O | I/O |
| V21 | I/O | I/O |
| V22 | I/O | I/O |
| V23 | GND | GND |
| V24 | I/O | I/O |
| V25 | I/O | I/O |
| W1 | I/O | I/O |
| W2 | I/O | I/O |
| W3 | I/O | I/O |
| W4 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA1000 Function** |
| W5 | I/O | I/O |
| W6 | I/O | I/O |
| W7 | I/O | I/O |
| W8 | I/O | I/O |
| W9 | I/O | I/O |
| W10 | I/O | I/O |
| W11 | I/O | I/O |
| W12 | I/O | I/O |
| W13 | I/O | I/O |
| W14 | I/O | I/O |
| W15 | I/O | I/O |
| W16 | I/O | I/O |
| W17 | I/O | I/O |
| W18 | I/O | I/O |
| W19 | TMS | TMS |
| W20 | TDO | TDO |
| W21 | I/O | I/O |
| W22 | I/O | I/O |
| W23 | I/O | I/O |
| W24 | I/O | I/O |
| W25 | I/O | I/O |
| Y1 | I/O | I/O |
| Y2 | I/O | I/O |
| Y3 | I/O | I/O |
| Y4 | I/O | I/O |
| Y5 | I/O | I/O |
| Y6 | I/O | I/O |
| Y7 | I/O | I/O |
| Y8 | GND | GND |
| Y9 | I/O | I/O |
| Y10 | I/O | I/O |
| Y11 | I/O | I/O |
| Y12 | I/O | I/O |
| Y13 | I/O | I/O |
| Y14 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| **Pin Number** | **APA600 Function** | **APA1000 Function** |
| Y15 | I/O | I/O |
| Y16 | I/O | I/O |
| Y17 | GND | GND |
| Y18 | I/O | I/O |
| Y19 | TCK | TCK |
| Y20 | VPP | VPP |
| Y21 | VPN | VPN |
| Y22 | I/O | I/O |
| Y23 | I/O | I/O |
| Y24 | I/O | I/O |
| Y25 | I/O | I/O |
| AA1 | I/O | I/O |
| AA2 | I/O | I/O |
| AA3 | I/O | I/O |
| AA4 | I/O | I/O |
| AA5 | I/O | I/O |
| AA6 | I/O | I/O |
| AA7 | I/O | I/O |
| AA8 | I/O | I/O |
| AA9 | I/O | I/O |
| AA10 | I/O | I/O |
| AA11 | I/O | I/O |
| AA12 | I/O | I/O |
| AA13 | I/O | I/O |
| AA14 | I/O | I/O |
| AA15 | I/O | I/O |
| AA16 | I/O | I/O |
| AA17 | I/O | I/O |
| AA18 | I/O | I/O |
| AA19 | I/O | I/O |
| AA20 | TDI | TDI |
| AA21 | TRST | TRST |
| AA22 | I/O | I/O |
| AA23 | I/O | I/O |
| AA24 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| AA25 | I/O | I/O |
| AB1 | I/O | I/O |
| AB2 | I/O | I/O |
| AB3 | I/O | I/O |
| AB4 | I/O | I/O |
| AB5 | I/O | I/O |
| AB6 | I/O | I/O |
| AB7 | I/O | I/O |
| AB8 | I/O | I/O |
| AB9 | I/O | I/O |
| AB10 | I/O | I/O |
| AB11 | GND | GND |
| AB12 | I/O | I/O |
| AB13 | I/O | I/O |
| AB14 | I/O | I/O |
| AB15 | GND | GND |
| AB16 | I/O | I/O |
| AB17 | I/O | I/O |
| AB18 | I/O | I/O |
| AB19 | I/O | I/O |
| AB20 | I/O | I/O |
| AB21 | I/O | I/O |
| AB22 | I/O | I/O |
| AB23 | I/O | I/O |
| AB24 | I/O | I/O |
| AB25 | I/O | I/O |
| AC1 | I/O | I/O |
| AC2 | $V_{DD}$ | $V_{DD}$ |
| AC3 | GND | GND |
| AC4 | I/O | I/O |
| AC5 | I/O | I/O |
| AC6 | I/O | I/O |
| AC7 | GND | GND |
| AC8 | I/O | I/O |
| AC9 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| AC10 | I/O | I/O |
| AC11 | I/O | I/O |
| AC12 | I/O | I/O |
| AC13 | I/O | I/O |
| AC14 | I/O | I/O |
| AC15 | I/O | I/O |
| AC16 | I/O | I/O |
| AC17 | I/O | I/O |
| AC18 | I/O | I/O |
| AC19 | GND | GND |
| AC20 | I/O | I/O |
| AC21 | I/O | I/O |
| AC22 | I/O | I/O |
| AC23 | I/O | I/O |
| AC24 | $V_{DD}$ | $V_{DD}$ |
| AC25 | I/O | I/O |
| AD1 | $V_{DDP}$ | $V_{DDP}$ |
| AD2 | GND | GND |
| AD3 | $V_{DD}$ | $V_{DD}$ |
| AD4 | I/O | I/O |
| AD5 | I/O | I/O |
| AD6 | I/O | I/O |
| AD7 | I/O | I/O |
| AD8 | I/O | I/O |
| AD9 | I/O | I/O |
| AD10 | I/O | I/O |
| AD11 | I/O | I/O |
| AD12 | I/O | I/O |
| AD13 | I/O | I/O |
| AD14 | I/O | I/O |
| AD15 | I/O | I/O |
| AD16 | I/O | I/O |
| AD17 | I/O | I/O |
| AD18 | I/O | I/O |
| AD19 | I/O | I/O |

| 624-Pin CCGA/LGA | | |
|---|---|---|
| Pin Number | APA600 Function | APA1000 Function |
| AD20 | I/O | I/O |
| AD21 | I/O | I/O |
| AD22 | I/O | I/O |
| AD23 | $V_{DD}$ | $V_{DD}$ |
| AD24 | GND | GND |
| AD25 | $V_{DDP}$ | $V_{DDP}$ |
| AE1 | GND | GND |
| AE2 | $V_{DDP}$ | $V_{DDP}$ |
| AE3 | I/O | I/O |
| AE4 | I/O | I/O |
| AE5 | I/O | I/O |
| AE6 | I/O | I/O |
| AE7 | I/O | I/O |
| AE8 | I/O | I/O |
| AE9 | I/O | I/O |
| AE10 | I/O | I/O |
| AE11 | I/O | I/O |
| AE12 | I/O | I/O |
| AE13 | I/O | I/O |
| AE14 | I/O | I/O |
| AE15 | I/O | I/O |
| AE16 | I/O | I/O |
| AE17 | I/O | I/O |
| AE18 | I/O | I/O |
| AE19 | I/O | I/O |
| AE20 | I/O | I/O |
| AE21 | I/O | I/O |
| AE22 | I/O | I/O |
| AE23 | I/O | I/O |
| AE24 | $V_{DDP}$ | $V_{DDP}$ |
| AE25 | GND | GND |

# Datasheet Information

## List of Changes

The following table lists critical changes that were made in the current version of the document.

| Previous version | Changes in current version (v5.2) | Page |
|---|---|---|
| v5.1 | MIL-STD-883 was added to the datasheet. | N/A |
| | $V_{CC}$ and $V_{CCI}$ were changed to $V_{DDP}$. | N/A |
| | Table 1-9 was updated to include 135°C. | page 1-20 |
| v5.0 | In the "208-Pin PQFP" table, the following pin numbers have been updated:<br>**Pin Number** **Function**<br>24 I/O / GL2<br>30 I/O / GL1 | page 2-6 |
| | In the "208-Pin CQFP" table, the following pin numbers have been updated:<br>**Pin Number** **Function**<br>23 I/O / GLMX1<br>24 I/O / GL2<br>28 PPECL1 / Input<br>30 I/O / GL1<br>128 I/O / GL3<br>129 PPECL2 / Input<br>134 I/O / GL4<br>135 I/O / GLMX2 | page 2-13 |
| | In the "624-Pin CCGA/LGA" table, the following pin numbers have been updated:<br>**Pin Number** **Function**<br>M6 I/O / GL2<br>M7 I/O / GLMX1<br>M19 I/O / GLMX2<br>M20 I/O / GL4<br>N5 PPECL1 / Input<br>N6 I/O / GL1<br>N20 I/O / GL3<br>N21 PPECL2 / Input | page 2-82 |
| v4.1 | MIL-STD 883B data will be added into this datasheet after the MIL-STD 883B qualification is complete. | |
| | Green packaging information in the "Ordering Information" section was updated. | page ii |
| | The "Temperature Grade Offerings" table was updated for the CG624. | page iii |
| | The "Ordering Information" section was updated. | page ii |
| | The "Live at Power-Up" section is new. | page 1-3 |
| | Note 2 in Figure 1-4 was updated. | page 1-4 |
| | The 3.3 V column in Table 1-3 was updated. | page 1-9 |
| | The "Input/Output Blocks" section was updated. | page 1-9 |
| | The note was removed from Table 1-4. | page 1-9 |
| | The "Power-Up Sequencing" section was updated. | page 1-10 |
| | The first bullet in the "ProASICPLUS Clock Management System" section was updated. | page 1-13 |
| | The first paragraph in the "Performance Retention" section was updated. | page 1-33 |

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|---|---|---|
| | Mixed Voltage was removed from Table 1-19. | page 1-35 |
| | Table 1-20 was updated. | page 1-35 |
| | Mixed Mode Voltage was removed from Table 1-21 and the Military/MIL-STD-883B column was updated. | page 1-36 |
| | All tables from page 1-42 to page 1-51 were updated. | page 1-42 to page 1-51 |
| | Table 1-48 is new. | page 1-53 |
| | Figure 1-30 is new. | page 1-53 |
| | Note 1 in Table 1-50 was updated. | page 1-55 |
| | The notes in Table 1-54 were updated. | page 1-59 |
| | A note was added to Figure 1-48. | page 1-72 |
| | A note was added to Table 1-66. | Table 1-66 |
| | The "TRST Test Reset Input" section was updated in the "Pin Description" section. | page 1-73 |
| | The "624-Pin CCGA/LGA" section was updated for the APA600 and APA1000. Please review all pin data. | page 2-81 |
| v4.0 | Figure 1-20 was updated. | page 1-19 |
| | Table 1-46 was updated. | page 1-52 |
| | The "1152-Pin FBGA" figure was updated. | page 2-69 |
| | Pin names were changed to more accurately reflect the multiple functions supported by each pin. | |
| v3.5 | The ProASIC^PLUS and ProASIC^PLUS Military/Aerospace datasheets were combined. This document now supports Commercial, Industrial, and Military Temperature devices. | |
| | Table 1 was updated. | page i-i |
| | The "Ordering Information" section was updated. | page i-ii |
| | "Plastic Device Resources" table was updated. | page i-ii |
| | The Long Term Jitter Peak-to-Peak Max. in the "PLL Electrical Specifications" table was updated. | page 1-21 |
| | The "Calculating Typical Power Dissipation" section was updated. | page 1-30 |
| | "Performance Retention" section | page 1-33 |
| | Table 1-18 | page 1-34 |
| | Table 1-20 was updated. | page 1-35 |
| | Table 1-21 was updated. | page 1-36 |
| | Table 1-22 was updated. | page 1-38 |
| | Table 1-46 was updated. | page 1-52 |
| v3.4 | The "Temperature Grade Offerings" table is new. | page i-iii |
| | The "Speed Grade and Temperature Matrix" table is new. | page i-iii |
| | The "ProASICPLUS Clock Management System" section was updated. | page 1-13 |
| | The "Lock Signal" section was updated. | page 1-16 |
| | The "PLL Electrical Specifications" table was updated. | page 1-21 |
| | The "User Security" section was updated. | page 1-22 |
| | The "Design Environment" section was updated. | page 1-27 |
| | Table 1-15 was updated. | page 1-29 |
| | The "Asynchronous FIFO Full and Empty Transitions" section was updated. | page 1-65 |
| | The "AVDD PLL Power Supply" section in the "Pin Description" section was updated. | page 1-73 |

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|---|---|---|
| v3.3 | The "144-Pin TQFP" table on page 2-4 was updated. The following pins changed:<br>Pin 15 = GLMX1<br>Pin 16 = GL1<br>Pin 21 = GL2<br>Pin 88 = GL3<br>Pin93 = GL4<br>Pin 94 = GLMX2 | page 2-4 |
| v3.2 | The "ProASICPLUS Clock Management System" section was updated. | page 1-13 |
| | Figure 1-14 was updated. | page 1-14 |
| | Table 1-7 is new. | page 1-15 |
| | Figure 1-20 was updated. | page 1-19 |
| | The "PLL Electrical Specifications" section was updated. | page 1-21 |
| | Figure 1-26 was updated. | page 1-42 |
| | In the "Calculating Typical Power Dissipation" section, P9 was changed to 7.5 mW. | page 1-30 |
| | The "Programming, Storage, and Operating Limits" section was updated. | page 1-33 |
| | The "Recommended Design Practice for VPN/VPP" section was updated. | page 1-74 |
| v3.1 | The datasheet was updated to include references to guidelines concerning the use of certain ProASIC PLUS I/O standards. | |
| v3.0 | In Table 1-2 on page 1-8, the Memory Rows – Bottom coordinates were changed. | page 1-8 |
| | Figure 1-8 was updated. | page 1-8 |
| | The $V_{IL}$ Minimum in the Table 1-22 was changed from 0.3 to –0.3. | page 1-38 |
| | In the "Output Buffer Delays" section, the OB25LPLL $t_{DHL}$ Standard changed to 5.3. | page 1-44 |
| | In the "Sample Macrocell Library Listing" section, the AND2 Standard maximum changed to 0.7 and the –F maximum changed to 0.8. | page 1-51 |
| v2.0 | The Table 1 was updated. | page i-i |
| | The "Ordering Information" section was updated. | page i-ii |
| | The "Plastic Device Resources" section was updated. | page i-ii |
| | The "ProASICPLUS Architecture" section was updated. | page 1-2 |
| | Table 1-2 was updated. | page 1-8 |
| | Table 1-8 is new. | page 1-16 |
| | Figure 1-11 is new. | page 1-10 |
| | The Introduction section in the "ProASICPLUS Clock Management System" section was updated. | page 1-13 |
| | The "Physical Implementation" section was updated. | page 1-13 |
| | The "Functional Description" on page 1-13 was updated. | page 1-13 |
| | Figure 1-14 on page 1-14 through Figure 1-20 on page 1-19 were updated. | page 1-14 to page 1-19 |
| | The "PLL Electrical Specifications" on page 1-21 was updated. | page 1-21 |
| | Figure 1-25 on page 1-26 was updated. | page 1-26 |
| | The "Calculating Typical Power Dissipation" on page 1-30 was updated. | page 1-30 |
| | The 'Nominal Supply Voltages' section was updated. | page 1-34 |
| | The Table 1-22 was updated. | page 1-38 |
| | The "Tristate Buffer Delays" on page 1-42 was updated. | page 1-42 |
| | The "Output Buffer Delays" on page 1-44 was updated. | page 1-44 |
| | The"Input Buffer Delays" on page 1-46 was updated. | page 1-46 |
| | "Global Routing Skew" on page 1-50 was updated. | page 1-50 |
| | The"Sample Macrocell Library Listing" on page 1-51 was updated. | page 1-51 |

<table>
<tr><th>Previous version</th><th>Changes in current version (v5.2)</th><th>Page</th></tr>
<tr><td>v2.0 (continued)</td><td>The "Pin Description" on page 1-73 was updated.</td><td>page 1-73</td></tr>
<tr><td></td><td>The following pins have been changed in the "100-Pin TQFP" table:<br>Pin Number | Function | Pin Number | Function<br>10 | I/O (GLMX1) | 60 | GL3<br>11 | GL1 | 61 | PPECL2 (I/P)<br>13 | NPECL1 | 63 | NPECL2<br>15 | PPECL1(I/P) | 65 | GL4<br>16 | GL2 | 66 | I/O (GLMX2)</td><td>page 2-1</td></tr>
<tr><td></td><td>"144-Pin TQFP" section is new.</td><td>page 2-3</td></tr>
<tr><td></td><td>The following pins have been changed in the "208-Pin PQFP" table:<br>Pin Number | Function | Pin Number | Function<br>23 | I/O (GLMX1) | 128 | GL3<br>24 | GL1 | 129 | PPECL2 (I/P)<br>26 | NPECL1 | 132 | NPECL2<br>28 | PPECL1 (I/P) | 134 | GL4<br>30 | GL2 | 135 | I/O (GLMX2)</td><td>page 2-5</td></tr>
<tr><td></td><td>The following pins have been changed in the "456-Pin PBGA" table:<br>Pin Number | Function | Pin Number | Function<br>M1 | GL1 | N22 | NPECL2<br>M2 | GL2 | N23 | GL3<br>M22 | GL4 | N25 | I/O (GLMX2)<br>N2 | I/O (GLMX1) | P5 | NPECL1<br>N4 | PPECL1 (I/P) | P26 | PPECL2 (I/P)</td><td>page 2-22</td></tr>
<tr><td></td><td>The following pins have been changed in the "144-Pin FBGA" table:<br>Pin Number | Function | Pin Number | Function<br>C2 | GL2 | F9 | GL4<br>D12 | I/O (GLMX2 | )F11 | PPECL2 (I/P<br>E11 | NPECL2 | F12 | GL3<br>F1 | GL1 | G1 | PPECL1 (I/P)<br>F3 | I/O (GLMX1) | G4 | NPECL1</td><td>page 2-37</td></tr>
<tr><td></td><td>The following pins have been changed in the "256-Pin FBGA" table:<br>Pin Number | Function | Pin Number | Function<br>H1 | GL1 | H16 | GL4<br>H2 | NPECL1 | J1 | GL2<br>H3 | I/O (GLMX1) | J2 | PPECL1 (I/P)<br>H13 | I/O (GLMX2) | J13 | PPECL2 (I/P)<br>H14 | NPECL2 | J16 | GL3</td><td>page 2-40</td></tr>
<tr><td></td><td>The following pins have been changed in the "484-Pin FBGA" table:<br>Pin Number | Function | Pin Number | Function<br>L4 | GL1 | L19 | GL4<br>L5 | NPECL1 | M4 | GL2<br>L6 | I/O (GLMX1) | M5 | PPECL1 (I/P)<br>L16 | I/O (GLMX2) | M16 | PPECL2 (I/P)<br>L17 | NPECL2 | M19 | GL3</td><td>page 2-45</td></tr>
<tr><td></td><td>The following pins have been changed in the "676-Pin FBGA" table:<br>Pin Number | Function | Pin Number | Function<br>N1 | GL1 | N25 | GL4<br>N3 | I/O (GLMX1) | P1 | GL2<br>N5 | NPECL1 | P5 | PPECL1 (I/P)<br>N22 | GL3 | P22 | I/O (GLMX2)<br>N24 | NPECL2 | P24 | PPECL2 (I/P)</td><td>page 2-51</td></tr>
</table>

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|---|---|---|
| | The following pins have been changed in the "896-Pin FBGA" table:<br>**Pin Number** **Function** **Pin Number** **Function**<br>R2 I/O (GLMX1) T3 GL2<br>R4 NPECL1 T4 PPECL1 (I/P)<br>R5 GL1 T26 PPECL2 (I/P)<br>R27 NPECL2 T27 GL4<br>R29 I/O (GLMX2) T28 GL3 | page 2-59 |
| | The following pins have been changed in the "1152-Pin FBGA" table:<br>**Pin Number** **Function** **Pin Number** **Function**<br>U4 I/O (GLMX1) U29 NPECL2<br>U6 NPECL1 U31 I/O (GLMX2)<br>U7 GL1 V28 PPECL2 (I/P)<br>V5 GL2 V29 GL4<br>V6 PPECL1 (I/P) V30 GL3 | page 2-69 |
| Advanced v0.7 | The "ProASICPLUS Architecture" section was updated. | page 1-2 |
| | The "Array Coordinates" section and Table 1-2 are new. | page 1-8 |
| | The "Power-Up Sequencing" section is new. | page 1-10 |
| | "I/O Features" section was updated. | page 1-9 |
| | The "Timing Control and Characteristics" section was updated. "Physical Implementation" section, "Functional Description" section, "Lock Signal" section, and "PLL Configuration Options" section are new. | page 1-13 to page 1-16 |
| | "PLL Block – Top-Level View and Detailed PLL Block Diagram" section was updated. | page 1-14 |
| | Figure 1-15 was updated. | page 1-15 |
| | "Sample Implementations" section, "Adjustable Clock Delay" section, and the "Clock Skew Minimization" section are new. | page 1-16 |
| | Figure 1-16, Figure 1-17, Figure 1-18, Figure 1-19, and Figure 1-20 are new. | page 1-17 to page 1-19 |
| | The "PLL Electrical Specifications" section is new. | page 1-21 |
| | The "Design Environment" section was updated. | page 1-27 |
| | Figure 1-26 was updated. | page 1-42 |
| | The "Calculating Typical Power Dissipation" section was updated. | page 1-30 |
| | The "DC Electrical Specifications (VDDP = 2.5 V ±0.2V)" section was updated. | page 1-36 |
| | The Table 1-22 was updated. | page 1-38 |
| | The "DC Specifications (3.3 V PCI Operation)1" section was updated. | page 1-40 |
| | The "Tristate Buffer Delays" section (the figure and table) have been updated. | page 1-42 |
| | The "Output Buffer Delays" section (the figure and table) have been updated. | page 1-44 |
| | The "Input Buffer Delays" section was updated. | page 1-46 |
| | The "Global Input Buffer Delays" section was updated. | page 1-48 |
| | The "Predicted Global Routing Delay" section was updated. | page 1-50 |
| | The "Global Routing Skew" section was updated. | page 1-50 |
| | The "Sample Macrocell Library Listing" section was updated. | page 1-51 |
| | The "Pin Description" section was updated. GLMX is new. | page 1-73 |
| | The "Recommended Design Practice for VPN/VPP" section was updated. | page 1-74 |
| | Pin AK31 of FG1152 for the APA1000 changed to $V_{PP}$ | page 2-69 |
| (Advanced v0.6) | The "Features and Benefits" on page i-i were updated. | page i-i |
| | The "ProASICPLUS Product Profile" on page i-i was updated. | page i-i |
| | The "Ordering Information" on page i-ii was updated. | page i-ii |
| | The "Plastic Device Resources" on page i-ii was updated. | page i-ii |
| | The "ProASICPLUS Architecture" on page 1-2 was updated. | page 1-2 |

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|---|---|---|
| Advanced v0.6 (continued) | Table 1-1 was updated. | page 1-7 |
| | Figure 1-14 was updated. | page 1-14 |
| | The "Design Environment" section was updated. | page 1-27 |
| | The "Package Thermal Characteristics" section was updated. | page 1-29 |
| | The "Calculating Typical Power Dissipation" section was updated. | page 1-30 |
| | The "Absolute Maximum Ratings*" section was updated. | page 1-33 |
| | The "Programming, Storage, and Operating Limits" section was updated. | page 1-33 |
| | The 'Nominal Supply Voltages' section was updated. | page 1-34 |
| | The "Recommended Operating Conditions" section was updated. | page 1-35 |
| | The "DC Electrical Specifications (VDDP = 2.5 V ±0.2V)" section was updated. | page 1-36 |
| | The "DC Electrical Specifications (VDDP = 3.3 V ±0.3 V and VDD = 2.5 V ±0.2 V)" section was updated. | page 1-38 |
| | The "Synchronous Write and Read to the Same Location" section was updated. | page 1-61 |
| | The "Asynchronous Write and Synchronous Read to the Same Location" section was updated. | page 1-62 |
| | The "Asynchronous FIFO Read" section was updated. | page 1-67 |
| | The "Pin Description" section has been updated. | page 1-73 |
| | The "Recommended Design Practice for VPN/VPP" section is new. | page 1-74 |
| | The "100-Pin TQFP" section is new. | page 2-1 |
| | The "484-Pin FBGA" section is new. | page 2-45 |
| Advanced v0.5 | The description for the $V_{PN}$ pin has changed. | page 1-74 |
| Advanced v0.4 | The "Plastic Device Resources" section has been updated. | page i-ii |
| | Figure 1-12 and Figure 1-13 have been updated. | page 1-14 |
| | The "Tristate Buffer Delays" section has been updated. | page 1-42 |
| | The "Output Buffer Delays" section has been updated. | page 1-44 |
| | The "Input Buffer Delays" section has been updated. | page 1-46 |
| | The "Global Input Buffer Delays" section has been updated. | page 1-48 |
| | The "456-Pin PBGA" section has been updated. | page 2-22 |
| | The "676-Pin FBGA" section has been updated. | page 2-51 |
| Advanced v0.3 | The "ProASICPLUS Product Profile" section has been changed. | page i-i |
| | The "Plastic Device Resources" section has been updated. | page i-ii |
| | The "ProASICPLUS I/O Power Supply Voltages" sectionhas been updated. | page 1-9 |
| | WDATA has ben changed to DI, and RDATA has been changed to DO to make them consistent with the signal names found in the *Macro Library Guide*. | |
| | Figure 1-21 and Figure 1-22 have been updated. | page 1-24 and page 1-25 |
| | The "Design Environment" section and Figure 1-26 have been updated. | page 1-27 and page 1-42 |
| | The table in the "Package Thermal Characteristics" section has been updated. | page 1-29 |
| | The "Calculating Typical Power Dissipation" section is new. | page 1-30 |
| | The "Programming, Storage, and Operating Limits" section is new. | page 1-33 |
| | The 'Nominal Supply Voltages' section has been updated. | page 1-34 |
| | The "DC Electrical Specifications (VDDP = 2.5 V ±0.2V)" section was updated. | page 1-36 |
| | The "DC Electrical Specifications (VDDP = 3.3 V ±0.3 V and VDD = 2.5 V ±0.2 V)" section was updated. | page 1-38 |
| | The "Recommended Operating Conditions" section was updated. | page 1-35 |
| | The "ProASICPLUS Clock Management System" section was updated. | page 1-13 |

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|---|---|---|
| Advanced v0.3 (continued) | Figure 1-14 was updated. | page 1-14 |
| | Figure 1-13 is new. | page 1-12 |
| | Tables 5, 6, and 7 from Advanced v0.3 were removed. | |
| | The "Memory Block SRAM Interface Signals" section was updated. | page 1-24 |
| | The "Memory Block FIFO Interface Signals" section was updated. | page 1-25 |
| | All pinout tables have been updated, and several packages are new:<br>208-Pin PQFP – APA150, APA300, APA450, APA600<br>456-Pin PBGA – APA150, APA300, APA450, APA600<br>144-Pin FBGA – APA150, APA300, APA450<br>256-Pin FBGA – APA150, APA300, APA450, APA600<br>676-Pin FBGA – APA600 | |
| Advanced v0.1 | Figure 1-23 has been updated. | page 1-26 |

# Data Sheet Categories

In order to provide the latest information to designers, some datasheets are published before data has been fully characterized. Datasheets are designated as "Product Brief," "Advanced," "Production," and "Datasheet Supplement." The definition of these categories are as follows:

## Product Brief

The product brief is a summarized version of a datasheet (advanced or production) containing general product information. This brief gives an overview of specific device and family information.

## Advanced

This datasheet 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.

## Unmarked (production)

This datasheet version contains information that is considered to be final.

## Datasheet Supplement

The datasheet supplement gives specific device information for a derivative family that differs from the general family datasheet. The supplement is to be used in conjunction with the datasheet to obtain more detailed information and for specifications that do not differ between the two families.

# Export Administration Regulations (EAR)

The products described in this datasheet are subject to the Export Administration Regulations (EAR). They could require an approved export license prior to export from the United States. An export includes release of product or disclosure of technology to a foreign national inside or outside the United States.

http://www.actel.com

**Actel Corporation**

2061 Stierlin Court
Mountain View, CA
94043-4655 USA
**Phone** 650.318.4200
**Fax** 650.318.4600

**Actel Europe Ltd.**

Dunlop House, Riverside Way
Camberley, Surrey GU15 3YL
United Kingdom
**Phone** +44 (0) 1276 401 450
**Fax** +44 (0) 1276 401 490

**Actel Japan**
www.jp.actel.com

EXOS Ebisu Bldg. 4F
1-24-14 Ebisu Shibuya-ku
Tokyo 150 Japan
**Phone** +81.03.3445.7671
**Fax** +81.03.3445.7668

**Actel Hong Kong**
www.actel.com.cn

Suite 2114, Two Pacific Place
88 Queensway, Admiralty
Hong Kong
**Phone** +852 2185 6460
**Fax** +852 2185 6488

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