

# QuickLogic PolarPro<sup>®</sup> Device Data Sheet — QL1P075, QL1P100, QL1P200, and QL1P300



## ● ● ● ● ● Combining Low Power, Performance, Density, and Embedded RAM

### Device Highlights

#### Low Power Programmable Logic

- As low as 2.2  $\mu$ A
- 0.18  $\mu$ m, six layer metal CMOS process
- 1.8 V core voltage, 1.8/2.5/3.3 V drive capable I/Os
- Up to 55 kilobits of SRAM
- Up to 238 I/Os available
- Up to 300,000 system gates
- Nonvolatile, instant-on
- IEEE 1149.1 boundary scan testing compliant

#### Embedded Dual-Port SRAM

- Up to twelve dual-port 4-kilobit high performance SRAM blocks
- True dual-port capability
- Embedded synchronous/asynchronous FIFO controller
- Configurable and cascadable aspect ratio

#### Programmable I/O

- Bank programmable drive strength
- Bank programmable slew rate control
- Independent I/O banks capable of supporting multiple I/O standards in one device
- Native support for DDR I/Os
- Bank programmable I/O standards: LVTTTL, LVCMOS, LVCMOS18, PCI, SSTL2, SSTL3 and SSDL18

#### Advanced Clock Network

- Multiple low skew clock networks
  - 1 dedicated global clock network
  - 4 programmable global clock networks

- Quadrant-based segmentable clock networks
  - 20 quad clock networks per device
  - 4 quad clock networks per quadrant
  - 1 dedicated clock network per quadrant
- Two user Configurable Clock Managers (CCMs)

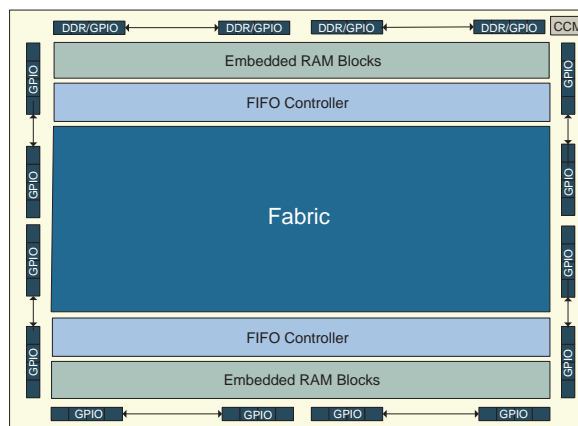
#### Very Low Power (VLP) Mode

- QuickLogic PolarPro has a special VLP pin which can enable a low power sleep mode that significantly reduces the overall power consumption of the device by placing the device in standby
- Enter VLP mode from normal operation in less than 250  $\mu$ s (typical)
- Exit from VLP mode to normal operation in less than 250  $\mu$ s (typical)

#### Security Links

There are several security links to disable JTAG access to the device. Programming these optional links completely disables access to the device from the outside world and provides an extra level of design security not possible in SRAM-based FPGAs.

Figure 1: QuickLogic PolarPro Block Diagram



## Ultra-Low Power FPGA Combining Performance, Density, and Embedded RAM

Table 1: PolarPro QL1P075, QL1P100, QL1P200, and QL1P300 Devices

| Features         |                | QL1P075        | QL1P100        | QL1P200  | QL1P300  |
|------------------|----------------|----------------|----------------|----------|----------|
| Max Gates        |                | 75,000         | 100,000        | 200,000  | 300,000  |
| Logic Cells      |                | 512            | 640            | 1,536    | 1,920    |
| Max I/O          |                | 168            | 184            | 238      | 238      |
| RAM Modules      |                | 8              | 8              | 12       | 12       |
| FIFO Controllers |                | 8              | 8              | 12       | 12       |
| RAM bits         |                | 36,864         | 36,864         | 55,296   | 55,296   |
| CCMs             |                | 2 <sup>a</sup> | 2 <sup>a</sup> | 2        | 2        |
| Packages         | WLCSP (0.5 mm) | 99             | -              | -        | -        |
|                  | TFBGA (0.5 mm) | -              | 121            | -        | -        |
|                  | TFBGA (0.5 mm) | 132            | 132            | 132      | 132      |
|                  | TQFP (0.5 mm)  | 144            | 144            | -        | -        |
|                  | TFBGA (0.8 mm) | 196            | 196            | -        | -        |
|                  | LPGA (1.0 mm)  | 256            | 256            | 256, 324 | 256, 324 |

a. The PolarPro 144-pin TQFP and 132-pin TFBGA devices have one CCM. The PolarPro 99-pin WLCSP, 196-pin TFBGA, 256-pin LPGA and 324-pin LPGA devices have two CCMs.

Table 2: Maximum Usable I/Os

| Device  | 99 WLCSP | 121 TFBGA<br>(6 mm x 6mm) | 132 TFBGA<br>(8 mm x 8 mm) | 144 TQFP<br>(20 mm x 20 mm) | 196 TFBGA<br>(12 mm x 12 mm) | 256 LPGA<br>(17 mm x 17 mm) |
|---------|----------|---------------------------|----------------------------|-----------------------------|------------------------------|-----------------------------|
| QL1P075 | -        | -                         | 77                         | 97                          | 136                          | 168                         |
| QL1P100 | -        | 76                        | 77                         | 97                          | 136                          | 184                         |
| QL1P200 | -        | -                         | 74                         | -                           | -                            | 184                         |
| QL1P300 | 63       | -                         | 74                         | -                           | -                            | 184                         |

## Process Data

The QuickLogic PolarPro is fabricated on a 0.18 $\mu$ m, six layer metal CMOS process. The core voltage is 1.8 V. The I/O voltage input tolerance and output drive can be set as 1.8 V, 2.5 V, and 3.3 V.

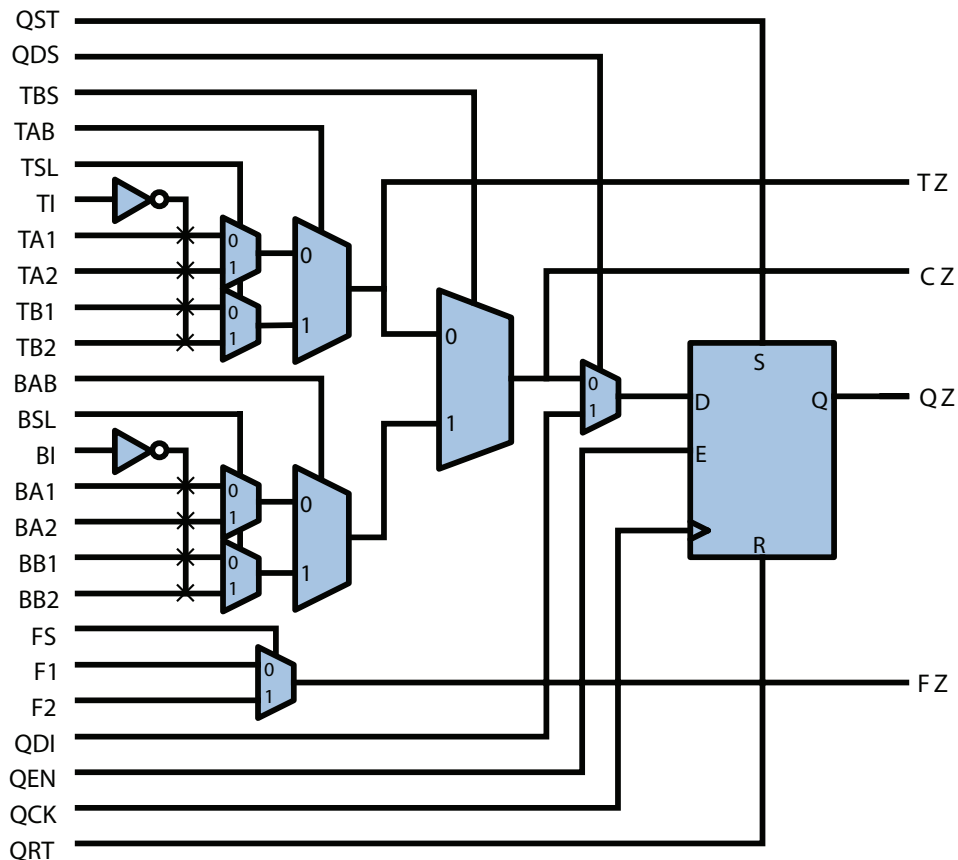
## Programmable Logic Architectural Overview

The QuickLogic PolarPro logic cell structure presented in **Figure 2** is a single register, multiplexer-based logic cell. It is designed for wide fan-in and multiple, simultaneous output functions. The cell has a high fan-in, fits a wide range of functions with up to 24 simultaneous inputs (including register control lines), and four outputs (three combinatorial and one registered). The high logic capacity and fan-in of the logic cell accommodates many user functions with a single level of logic delay.

The QuickLogic PolarPro logic cell can implement:

- Two independent 3-input functions
- Any 4-input function
- 8 to 1 mux function
- Independent 2 to 1 mux function
- Single dedicated register with clock enable, active high set and reset signals
- Direct input selection to the register, which allows combinatorial and register logic to be used separately
- Combinatorial logic that can also be configured as an edge-triggered master-slave D flip-flop

Figure 2: PolarPro Logic Cell



## RAM Modules

The PolarPro QL1P075, QL1P100, QL1P200, and QL1P300 devices have 4-kilobit (4,608 bits) RAM blocks.

The RAM features include:

- Independently configurable read and write data bus widths
- Independent read and write clocks
- Horizontal and vertical concatenation
- Write byte enables
- Selectable pipelined or non-pipelined read data

Figure 3: 4-Kilobit Dual-Port RAM Block

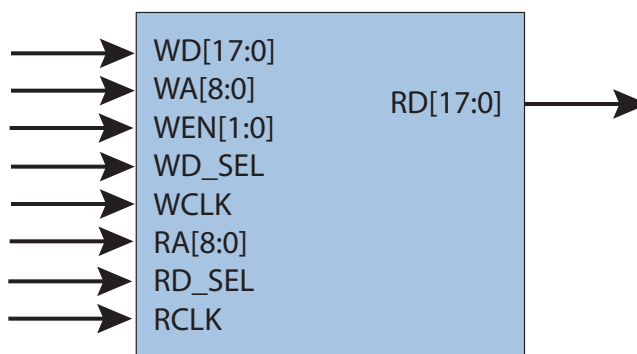


Table 3: RAM Interface Signals

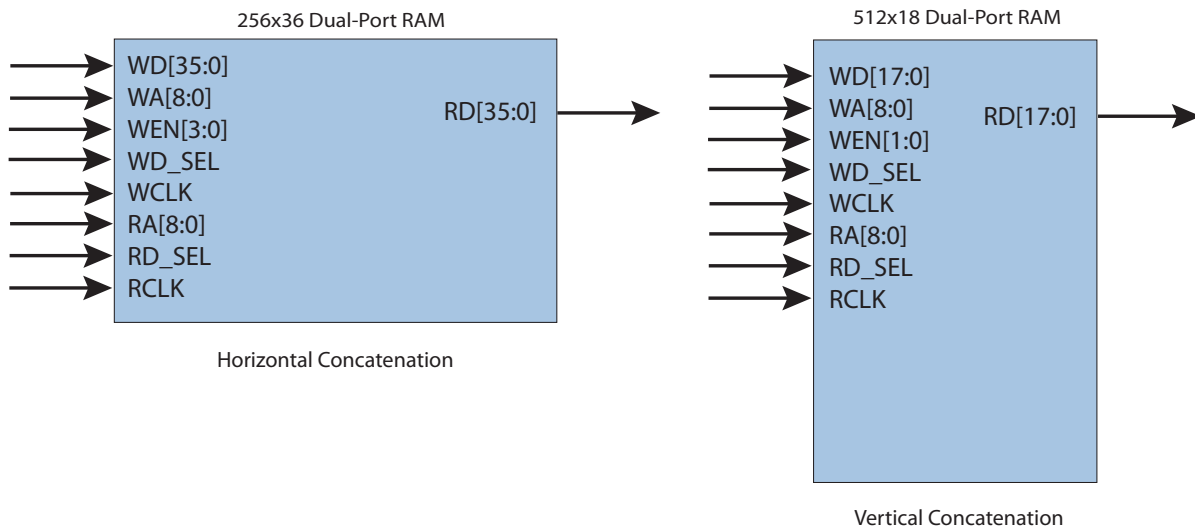
| Signal Name   | Function                         |
|---------------|----------------------------------|
| <b>Inputs</b> |                                  |
| WD [17:0]     | Write Data                       |
| WA [8:0]      | Write Address                    |
| WEN [1:0]     | Write Enable (two 9-bit enables) |
| WD_SEL        | Write Chip Select                |
| WCLK          | Write Clock                      |
| RA [8:0]      | Read Address                     |
| RD_SEL        | Read Chip Select                 |
| RCLK          | Read Clock                       |
| <b>Output</b> |                                  |
| RD [17:0]     | Read Data                        |

The read and write data buses of a RAM block can be arranged to variable bus widths. The bus widths can be configured using the RAM Wizard available in QuickWorks, QuickLogic's development software. The selection of the RAM depth and width determines how the data is addressed.

The RAM blocks also support data concatenation. Designers can cascade multiple RAM modules to increase the depth or width by connecting corresponding address lines together and dividing the words between modules. Generally, this requires the use of additional programmable logic resources. However, when concatenating only two 4-kilobit RAM blocks, they can be concatenated horizontally or vertically without using any additional programmable fabric resources.

For example, two internal 4-kilobit dual-port RAM blocks can be concatenated vertically to create a 512x18 RAM block or horizontally to create a 256x36 RAM block. A block diagram of horizontal and vertical concatenation is displayed in **Figure 4**.

Figure 4: Horizontal and Vertical Concatenation Examples



**Table 4** shows the various RAM configurations supported by the PolarPro RAM modules.

Table 5: Available Dual-Port RAM Configurations

| Device  | Number of RAM Blocks | Depth | Width |
|---------|----------------------|-------|-------|
| QL1P075 | 1                    | 256   | 1-18  |
|         | 1                    | 512   | 1-9   |
| QL1P100 | 2                    | 256   | 1-36  |
| QL1P200 | 2                    | 512   | 1-18  |
| QL1P300 | 2                    | 1024  | 1-9   |

## True Dual-Port RAM

PolarPro dual-port RAM modules can also be concatenated to generate true dual-port RAMs. The true dual-port RAM module's Port1 and Port2 have completely independent read and write ports, and separate read and write clocks. This allows Port1 and Port2 to have different data widths and clock domains. It is important to note that there is no circuitry preventing a write and read operation to the same address space at the same time. Therefore, it is up to the designer to ensure that the same address is not read from and written to

simultaneously, otherwise the data is considered invalid. Likewise, the same address must not be written to from both ports at the same time. However, it is possible to read from the same address. **Figure 5** shows an example of a 256x36 true dual-port RAM.

Figure 5: 256x36 4-Kilobit True Dual-Port RAM Block

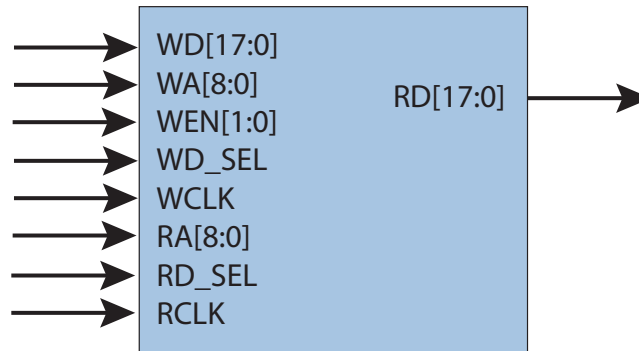


Table 6: True Dual-Port RAM Interface Signals

| Port           | Signal Name    | Function      |
|----------------|----------------|---------------|
| Port1          | <b>Inputs</b>  |               |
|                | Port1_WD[17:0] | Write Data    |
|                | Port1_A[8:0]   | Write Address |
|                | Port1_WEN[1:0] | Write Enable  |
|                | Port1_CS       | Chip Select   |
|                | Port1_CLK      | Clock         |
|                | <b>Output</b>  |               |
| Port1_RD[17:0] | Read Data      |               |
| Port2          | <b>Inputs</b>  |               |
|                | Port2_WD[17:0] | Write Data    |
|                | Port2_A[8:0]   | Write Address |
|                | Port2_WEN[1:0] | Write Enable  |
|                | Port2_CS       | Chip Select   |
|                | Port2_CLK      | Clock         |
|                | <b>Output</b>  |               |
| Port2_RD[17:0] | Read Data      |               |

Table 7: Available True Dual-Port RAM Configurations

| Device             | Depth | Width |
|--------------------|-------|-------|
| QL1P075<br>QL1P100 | 512   | 1-18  |
| QL1P200<br>QL1P300 | 1024  | 1-9   |

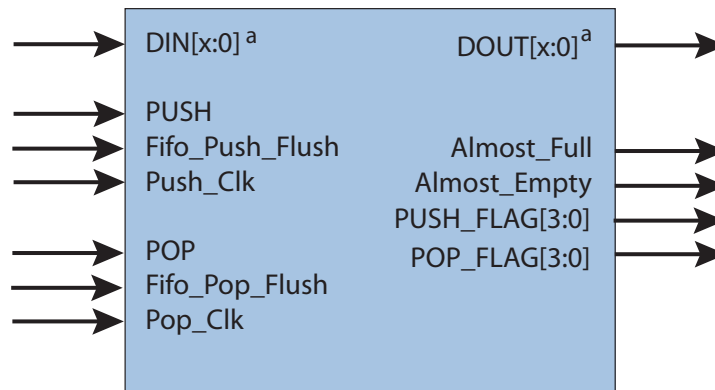
## Embedded FIFO Controllers

Every RAM block can be implemented as a synchronous or asynchronous FIFO. There are built-in FIFO controllers that allow for varying depths and widths without requiring programmable fabric resources.

The PolarPro FIFO controller features include:

- x9, x18 and x36 data bus widths
- Independent PUSH and POP clocks
- Independent programmable data width on PUSH and POP sides
- Configurable synchronous or asynchronous FIFO operation
- 4-bit PUSH and POP level indicators to provide FIFO status outputs for each port
- Pipelined read data to improve timing

Figure 6: FIFO Module



a.  $x = \{1,2,3,\dots,35\}$ .

Table 8: Available FIFO Configurations

| Device                                   | Number of RAM Blocks | Depth | Supported Widths |
|--|----------------------|-------|------------------|
| QL1P075<br>QL1P100<br>QL1P200<br>QL1P300 | 1                    | 256   | 1-18 bits        |
|  | 1                    | 512   | 1-9 bits         |
|  | 2                    | 256   | 1-36 bits        |
|  | 2                    | 512   | 1-18 bits        |
|  | 2                    | 1024  | 1-9 bits         |

Table 9 lists the FIFO controller interface signals.

Table 9: FIFO Interface Signals

| Signal Name         | Width (bits) | Direction | Function                                      |
|---------------------|--------------|-----------|---|
| <b>PUSH Signals</b> |              |           |   |
| DIN                 | 1 to 36      | I         | Data bus input                                |
| PUSH                | 1            | I         | Initiates a data push                         |
| Fifo_Push_Flush     | 1            | I         | Empties the FIFO                              |
| Push_Clk            | 1            | I         | Push data clock                               |
| <b>POP Signals</b>  |              |           |   |
| DOUT                | 1 to 36      | O         | Data bus output                               |
| POP                 | 1            | I         | Initiates a data pop                          |
| Fifo_Pop_Flush      | 1            | I         | Empties the FIFO                              |
| Pop_Clk             | 1            | I         | Pop data clock                                |
| <b>Status Flags</b> |              |           |   |
| Almost_Full         | 1            | O         | Asserted when FIFO has one location available |
| Almost_Empty        | 1            | O         | Asserted when FIFO has one location used      |
| PUSH_FLAG[3:0]      | 4            | O         | FIFO PUSH level indicator                     |
| POP_FLAG[3:0]       | 4            | O         | FIFO POP level indicator                      |

Table 10 and Table 11 highlight the corresponding FIFO level indicator for each 4-bit value of the PUSH\_FLAG and POP\_FLAG outputs.

Table 10: FIFO PUSH Level Indicator Values

| Value  | Status                        |
|--------|-------------------------------|
| 0000   | Full                          |
| 0001   | Empty                         |
| 0010   | Room for more than one-half   |
| 0011   | Room for more than one-fourth |
| 1000   | Room for 8 or more            |
| 1001   | Room for 7                    |
| 1010   | Room for 6                    |
| 1011   | Room for 5                    |
| 1100   | Room for 4                    |
| 1101   | Room for 3                    |
| 1110   | Room for 2                    |
| 1111   | Room for 1                    |
| Others | Reserved                      |



Table 11: FIFO POP Level Interface Signals

| Value  | Status                    |
|--------|---------------------------|
| 0000   | Empty                     |
| 0001   | 1 entry in FIFO           |
| 0010   | 2 entries in FIFO         |
| 0011   | 3 entries in FIFO         |
| 0100   | 4 entries in FIFO         |
| 0101   | 5 entries in FIFO         |
| 0110   | 6 entries in FIFO         |
| 0111   | 7 entries in FIFO         |
| 1000   | 8 or more entries in FIFO |
| 1101   | One-fourth or more full   |
| 1110   | One-half or more full     |
| 1111   | Full                      |
| Others | Reserved                  |

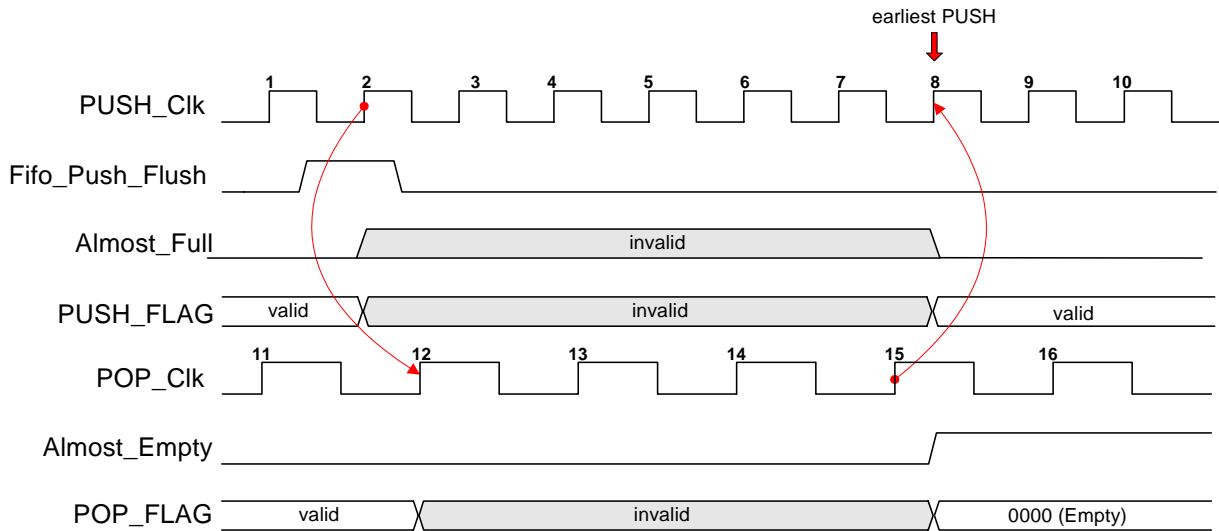
## FIFO Flush Procedure

Both PUSH and POP domains are provided with a flush input signal synchronized to their respective clocks. When a flush is triggered from one side of the FIFO, the signal propagates and re-synchronizes internally to the other clock domain. During a flush operation, the values of the FIFO flags are invalid for a specific number of cycles (see **Figure 7** and **Figure 8**).

As shown in **Figure 7**, when the **Fifo\_Push\_Flush** asserts, the **Almost\_Full** and **PUSH\_FLAG** signals become invalid until the FIFO can flush the data with regards to the Push clock domain as well as the Pop clock domain. After the **Fifo\_Push\_Flush** is asserted, the next rising edge of the Pop clock starts the Pop flush routine.

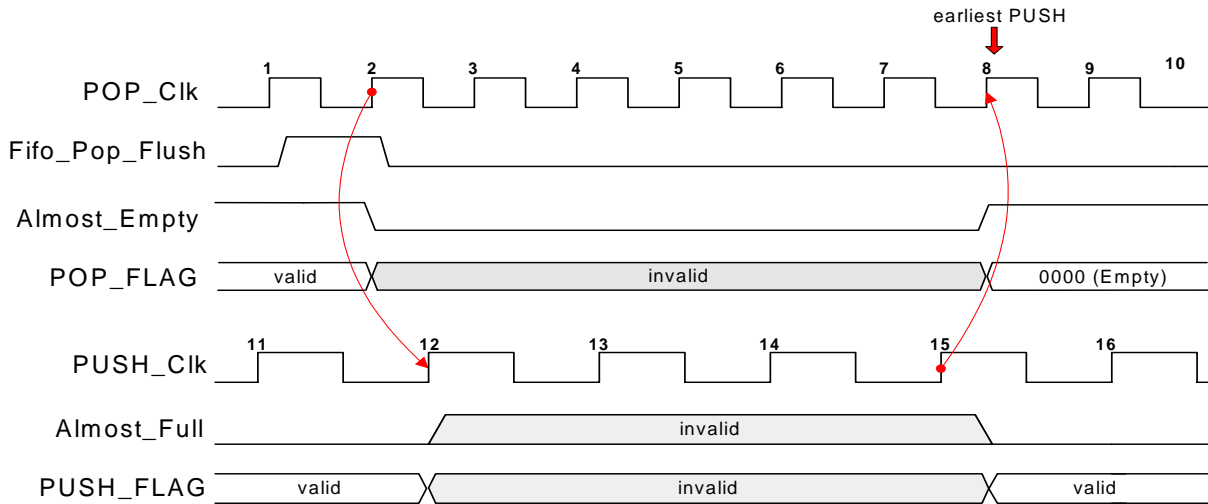
**Figure 7** illustrates a FIFO Flush operation. After the **Fifo\_Push\_Flush** is asserted at 2 (**PUSH\_Clk**), four POP clock cycles (12 through 15) are required to update the **POP\_FLAG**, and **PUSH\_FLAG** signals. The **Almost\_Empty** signal is asserted to indicate that the push flush operation has been completed. On the following rising edge of the **PUSH\_Clk** (8), the **PUSH\_FLAG** is accordingly updated to reflect the successful flush operation.

Figure 7: FIFO Flush from PUSH Side



**Figure 8** illustrates a POP flush operation. After the **Fifo\_Pop\_Flush** is asserted at 2 (**POP\_Clk**), four PUSH clock cycles (12 through 15) are required to update the **POP\_FLAG**, and **PUSH\_FLAG** signals. The **Almost\_Empty** signal is asserted to indicate that the pop flush operation has been completed. On the following rising edge of the **POP\_Clk** (8), the **POP\_FLAG** is updated accordingly to reflect the successful flush operation.

Figure 8: FIFO Flush from POP Side



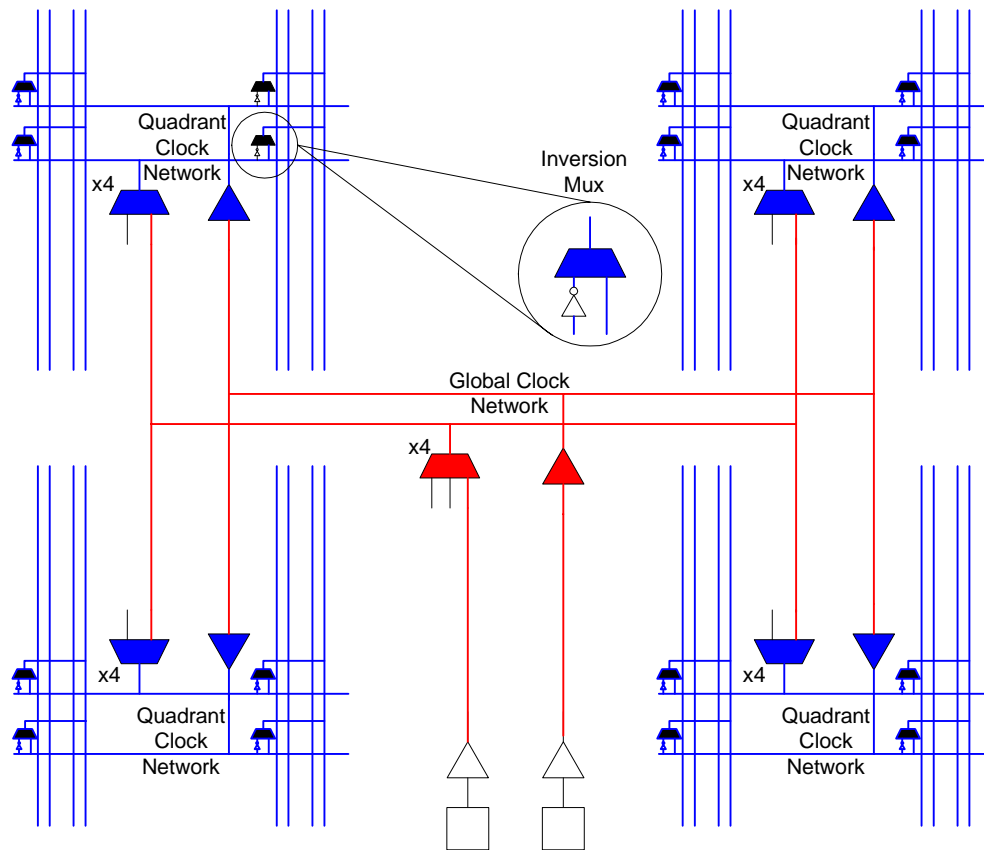
**Figure 7** and **Figure 8** are only true for this particular PUSH-POP clock frequency combination. The clock frequency and phase difference between **POP\_Clk** and **PUSH\_Clk** can cause an additional flush delay of one clock cycle in either domain because of the asynchronous relationship between the two clocks.

## QL1P075, QL1P100, QL1P200, and QL1P300 Clock Network Architecture

### Clock Network Architecture

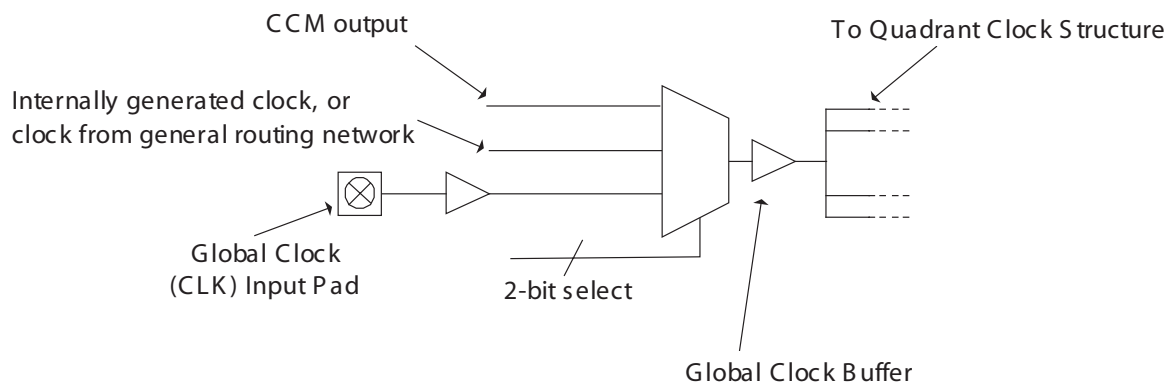
The PolarPro clock network architecture consists of a 2-level H-tree network as shown in Figure 9. The first level of each clock tree (high-lighted in red) spans from the clock input pad to the global clock network and to the center of each quadrant of the chip. The second level (high-lighted in blue) spans from the quadrant clock network to every logic cell inside that quadrant. There are five global clocks in the global clock network, and five quadrant clocks in each quadrant clock network. All global clocks drive the quadrant clock network inputs. The quadrant clocks output to clock inversion muxes, which pass either the original input clock or an inverted version of the input clock to the logic cells in that quadrant. The global clocks can drive RAM block clock inputs and reset, set, enable, and clock inputs to I/O registers. Furthermore, the quadrant clock outputs can be routed to all logic cell inputs.

Figure 9: PolarPro Clock Architecture



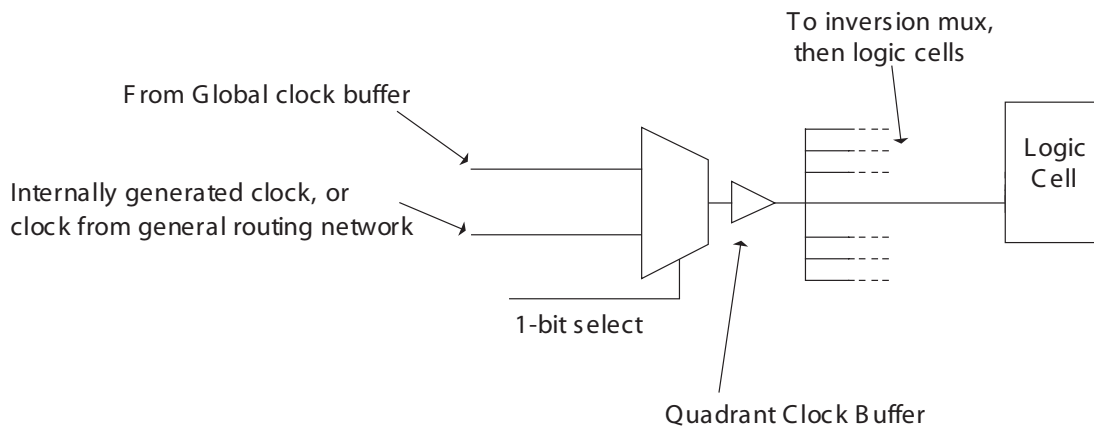
Of the five global clock networks, four can be either driven directly by clock pads, Configurable Clock Manager (CCM) outputs, or internally generated signals. These four global clocks go through 3-input global clock muxes located in the middle of the die. See **Figure 10** for a diagram of a 3-input global clock mux. The fifth is a dedicated global clock network that goes directly to the quadrant clock network and is used as a dedicated fast clock.

Figure 10: Global Clock Structure



**Figure 11** illustrates the quadrant clock 2-input mux.

Figure 11: Quadrant Clock Structure



It is important to note that the select lines for the global clock and quadrant clock muxes are static signals and cannot be changed dynamically during device operation. For more information about global and quadrant clock networks and how to use them, refer to [Application Note 85 Clock Networks in PolarPro Devices](#).

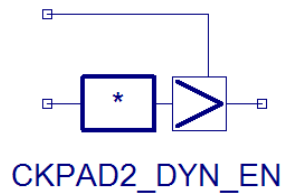
## Dynamic Clock Enable

The QuickLogic PolarPro QL1P200 and larger devices provide a powerful dynamic clock enable feature that allows designers to dynamically enable and disable clocks routed into the QuickLogic device. Associated with each of the five clock inputs is a clock enable, which is an interface signal that can be either dynamically

controlled via a routable signal or tied high or low. Once an incoming clock is disabled, the clock is driven low internally. All the logic that is driven by the clock is held at the state when the clock was disabled. If a reset signal is passed through the clock pad, the dynamic disable should not be used.

As an additional feature, PolarPro devices have built-in deglitching circuitry to prevent clock glitching during transitions so that clocks can be enabled or disabled asynchronously without the possibility of false edge detection within the internal logic. The dynamic clock disable feature can be implemented in Verilog, VHDL, and schematic designs by instantiating the dynamic clock enable macro, CKPAD2\_DYN\_EN. **Figure 12**, shows the schematic representation of the dynamic clock enable macro.

Figure 12: Clock Pad Macro for Dynamic Clock Enable

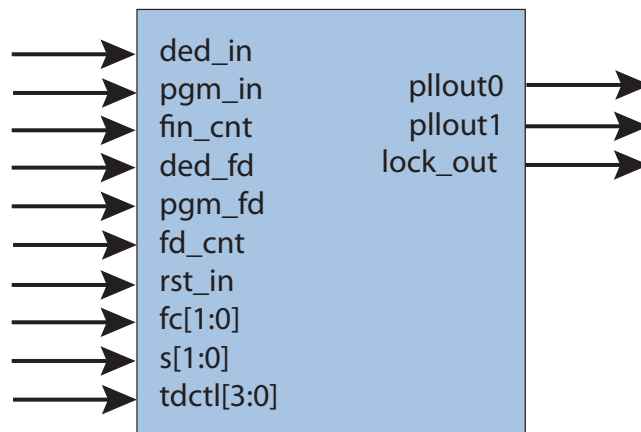


## Configurable Clock Managers (CCMs)

The CCM features include:

- Input frequency range from 10 MHz to 200 MHz
- Output frequency range from 25 MHz to 200 MHz
- Output jitter is less than 200 ps peak-to-peak
- Two outputs: pullout0 (with 0° phase shift), and pullout1 (with an option of 0°, 90°, 180°, or 270° phase shift plus a programmable delay).
- Programmable delay allows delays up to 2.5 ns at 250 ps intervals
- Fixed feedback path
- Output frequency lock time in less than 10 μs

Figure 13: Configurable Clock Manager



The reset signal can be routed from a clock pad or generated using internal logic. The lock\_out signal can be routed to internal logic and/or an output pad. CCM clock outputs can drive the global clock networks, as well as any general purpose I/O pin. Once the CCM has synchronized the output clock to the incoming clock, the lock\_out signal will be asserted to indicate that the output clock is valid. Lock detection requires at least 10 μs after reset to assert lock\_out. The PolarPro CCMs have three modes of operation, based on the input frequency and desired output frequency. **Table 12** indicates the features of each mode.

Table 12: CCM PLL Mode Frequencies

| Output Frequency | Input Frequency Range | Output Frequency Range | PLL Mode  |
|------------------|-----------------------|------------------------|-----------|
| x1               | 25 MHz to 200 MHz     | 25 MHz to 200 MHz      | PLL_MULT1 |
| x2               | 15 MHz to 100 MHz     | 30 MHz to 200 MHz      | PLL_MULT2 |
| x4               | 10 MHz to 50 MHz      | 40 MHz to 200 MHz      | PLL_MULT4 |

## CCM Signals

**Table 13** provides the name, direction, function and description of the CCM ports.

Table 13: CCM Signals

| Signal Name           | Direction | Function                 | Description  |
|-----------------------|-----------|--------------------------|--|
| <b>Routable Ports</b> |           |                          |  |
| ded_fd                | I         | Dedicated Feedback       | Automatically calculated and routed by the software tools.   |
| rst_in                | I         | Reset                    | Active high reset: If rst_in is asserted, pllout0 and pllout1 are reset to 0. This signal must be asserted and then released for lock_out to assert. |
| pllout0               | O         | 0° Phase Clock           | 0° phase clock output.   |
| pllout1               | O         | Configurable Phase Clock | 0°, 90°, 180°, or 270° phase clock output with programmable delay.   |
| lock_out              | O         | Lock Detect              | Active high lock detection signal. Active when the pllout signals correctly output the configured functionality.                                     |
| <b>Static Ports</b>   |           |                          |  |
| fc[1:0]               | I         | Phase Shift Control      | Determines whether pllout1 is 0°, 90°, 180°, or 270° degrees out of phase with pllout0 <sup>a</sup> .  |
| s[1:0]                | I         | Set Mode                 | Determines pllout1 and pllout0 frequency multiplier (x1, x2, or x4).   |
| tdctl[3:0]            | I         | Time Delay Control       | Plout1 programmable delay, configurable in 250 ps increments up to a maximum of 2.5 ns.<br>NOTE: 250 ps can vary depending on process variation.     |

a. The pllout1 output can vary up to -5% with respect to the pllout0 output. Therefore, QuickLogic recommends thorough post-layout simulation in order to verify satisfactory operation of the CCMs.

**Table 14**, **Table 15** and **Table 16** give the values used to configure the Set Mode, Phase Shift Control and Time Delay Control bits.

Table 14: Set Mode Values

| s[1:0] | Multiplier |
|--------|------------|
| 00     | x1         |
| 01     | x2         |
| 10     | x4         |
| 11     | Reserved   |

Table 15: Phase Shift Control Values

| fc[1:0] | Phase Shift (Deg.) |
|---------|--------------------|
| 00      | 0                  |
| 01      | 90                 |
| 10      | 180                |
| 11      | 270                |

Table 16: Time Delay Control Values

| tdctl[3:0] | Time Delay (ps) |
|------------|-----------------|
| 0000       | 0               |
| 0001       | 250             |
| 0010       | 500             |
| 0011       | 750             |
| 0100       | 1000            |
| 0101       | 1250            |
| 0110       | 1500            |
| 0111       | 1750            |
| 1000       | 2000            |
| 1001       | 2250            |
| 1010       | 2500            |
| 1011       | Reserved        |
| 1100       | Reserved        |
| 1101       | Reserved        |
| 1110       | Reserved        |
| 1111       | Reserved        |

## CCM Configurations

The main purpose of the CCM is to align the clock arrival times of two separate clock destinations, whether it is within the FPGA or external to the chip. The difference between the two clock destinations is referred to as clock skew. To correct for clock skew the CCMs can be configured to shift the phase and/or delay of the pllout1 clock output.

In most cases the desired phase or added delay can be accomplished by configuring both the clock source input and feedback input as dedicated. In the case of a dedicated clock source and dedicated feedback, the QuickLogic development software calculates and generates all of the required routing delays to produce the requested configuration.

Table 17: Available Configurations

| Clock               | Feedback           | Example Usage   | Comments                                       |
|---------------------|--------------------|---|--|
| Dedicated clock pad | Dedicated feedback | Standard PLL application. Reduce set-up or clock-to-out time. | If the clock pad and destination are in phase. |

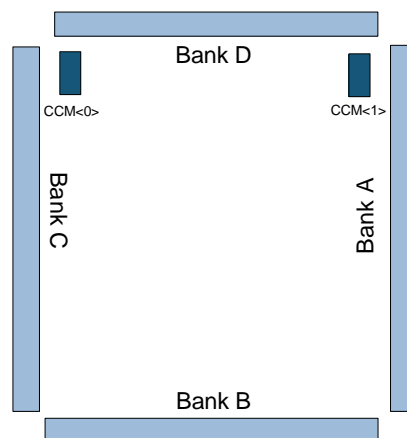
For more information on CCMs and how to use them in QuickWorks, refer to [Application Note 87 Configurable Clock Managers](#).

## Simultaneously Switching Outputs (SSOs) While Using a CCM

SSOs are outputs that transition at the same time in the same direction (either from VCC to GND or GND to VCC). To ensure that the CCMs never lose lock over all possible frequencies of operation, designers must follow the guidelines specified in this section when using the FPGA outputs as SSOs. These guidelines include the number of SSOs placed adjacent to the CCMs and the quality of the power filtering circuit sourcing the CCM block.

**Figure 14** shows a basic layout of the four I/O banks (Bank A, Bank B, Bank C and Bank D) available in PolarPro devices and the relative placement of the two CCMs (CCM<0> and CCM<1>).

Figure 14: Basic Layout of I/O Banks and CCMs

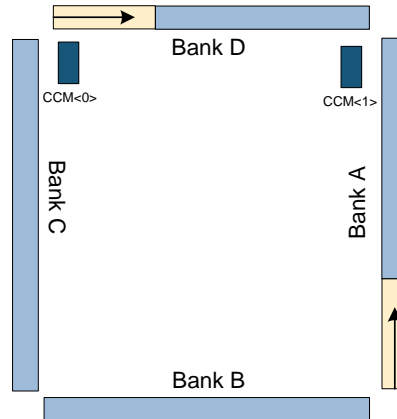


SSOs placed in Bank C and Bank D in close proximity to CCM<0> may affect that CCM's functionality. Similarly, SSOs placed in Bank A and Bank D in close proximity to CCM<1> may affect that CCM's functionality.



**NOTE:** To define the boundary of operation when using SSOs in conjunction with CCMs, add SSOs starting from the far end of a bank relative to the CCMs location. For example, when using CCM<1>, add SSOs in Bank A starting from the far bottom right and in Bank D starting from the far top left (see **Figure 15**). The same applies for CCM<0> in reverse positioning.

Figure 15: Adding SSOs When Using CCM<1>



To ensure proper operation of the CCM(s) use the following guidelines:

1. Limit the number of SSOs in Bank A and Bank D that are synchronous to CCM<1> (i.e., clocked by CCM<1> outputs) and SSOs in Bank C and Bank D that are synchronous to CCM<0> (i.e., clocked by CCM<0> outputs) as shown in **Table 18**, **Table 19**, and **Table 20**.

**NOTE:** For example, refer to row 7 highlighted in **Table 18**. If 56 SSOs are placed with a slew rate setting of Wow, up to 24 SSOs can be placed in Bank A (CCM<1>) or Bank C (CCM<0>) and up to 48 SSOs can be placed in Bank D. Similarly, with a slew rate setting of Slow, up to 36 SSOs can be placed in Bank A (CCM<1>) or Bank C (CCM<0>) and up to 48 SSOs can be placed in Bank D. However, if 60 SSOs are placed on Bank A (CCM<1>) or Bank B (CCM<0>), a slew rate setting of Wow cannot be used, but slew rate settings such as Very Fast, Fast and Slow can be used.

Table 18: Usable Synchronous SSOs at VCCIO = 3.3 V

| Total SSO in<br>(Bank A and<br>Bank D) or<br>(Bank C and<br>Bank D) | Slew Rate Setting                |                       |                                  |                       |                                  |                       |                                  |                       |
|---|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|
|   | Wow                              |                       | Very Fast                        |                       | Fast                             |                       | Slow                             |                       |
|   | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D |
| <b>QL1P075 and QL1P100</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    |
| 24  | 24                               | 24                    | 24                               | 24                    | 24                               | 24                    | 24                               | 24                    |
| 32  | 24                               | 32                    | 32                               | 32                    | 32                               | 32                    | 32                               | 32                    |
| 40  | 24                               | 40                    | 36                               | 40                    | 36                               | 40                    | 36                               | 40                    |
| 48  | 24                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 56  | 24                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 60  |                                  |                       | 36                               | 40                    | 36                               | 48                    | 36                               | 48                    |
| 64  |                                  |                       | 36                               | 40                    | 36                               | 48                    | 36                               | 48                    |
| 72  |                                  |                       |                                  |                       | 36                               | 48                    | 36                               | 48                    |
| 76  |                                  |                       |                                  |                       | 36                               | 40                    | 36                               | 48                    |
| 84  |                                  |                       |                                  |                       |                                  |                       | 36                               | 48                    |
| <b>QL1P200 and QL1P300</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  |                                  |                       | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    |
| 24  |                                  |                       | 24                               | 24                    | 24                               | 24                    | 24                               | 16                    |
| 32  |                                  |                       | 24                               | 32                    | 32                               | 32                    | 32                               | 16                    |
| 40  |                                  |                       | 24                               | 40                    | 36                               | 32                    | 36                               | 16                    |
| 48  |                                  |                       | 24                               | 40                    | 36                               | 32                    | 36                               | 16                    |
| 56  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 60  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 64  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 72  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 76  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 84  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |

Table 19: Usable Synchronous SSOs at VCCIO = 2.5 V

| Total SSO in<br>(Bank A and<br>Bank D) or<br>(Bank C and<br>Bank D) | Slew Rate Setting                |                       |                                  |                       |                                  |                       |                                  |                       |
|---|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|
|   | Wow                              |                       | Very Fast                        |                       | Fast                             |                       | Slow                             |                       |
|   | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D |
| <b>QL1P075 and QL1P100</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    |
| 24  | 24                               | 24                    | 24                               | 24                    | 24                               | 24                    | 24                               | 24                    |
| 32  | 32                               | 32                    | 32                               | 32                    | 32                               | 32                    | 32                               | 32                    |
| 40  | 36                               | 40                    | 36                               | 40                    | 36                               | 40                    | 36                               | 40                    |
| 48  | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 56  | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 60  | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 64  | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 72  | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 76  |                                  |                       | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| 84  |                                  |                       | 36                               | 48                    | 36                               | 48                    | 36                               | 48                    |
| <b>QL1P200 and QL1P300</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    |
| 24  | 0                                | 24                    | 24                               | 24                    | 24                               | 24                    | 24                               | 24                    |
| 32  |                                  |                       | 32                               | 24                    | 32                               | 24                    | 32                               | 32                    |
| 40  |                                  |                       | 36                               | 24                    | 36                               | 24                    | 36                               | 40                    |
| 48  |                                  |                       | 36                               | 24                    | 36                               | 24                    | 36                               | 48                    |
| 56  |                                  |                       | 36                               | 24                    | 36                               | 24                    | 36                               | 48                    |
| 60  |                                  |                       | 36                               | 24                    | 36                               | 24                    | 36                               | 48                    |
| 64  |                                  |                       |                                  |                       |                                  |                       | 36                               | 48                    |
| 72  |                                  |                       |                                  |                       |                                  |                       | 36                               | 48                    |
| 76  |                                  |                       |                                  |                       |                                  |                       | 36                               | 40                    |
| 84  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |

Table 20: Usable Synchronous SSOs at VCCIO = 1.8 V

| Total SSO in<br>(Bank A and<br>Bank D) or<br>(Bank C and<br>Bank D) | Slew Rate Setting                |                       |                                  |                       |                                     |                       |                                     |                       |
|---|----------------------------------|-----------------------|----------------------------------|-----------------------|-------------------------------------|-----------------------|-------------------------------------|-----------------------|
|   | Wow                              |                       | Very Fast                        |                       | Fast                                |                       | Slow                                |                       |
|   | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank<br>A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank<br>A/<br>Bank C | Max. SSO<br>in Bank D |
| <b>QL1P075 and QL1P100</b>  |                                  |                       |                                  |                       |                                     |                       |                                     |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 16  | 16                               | 16                    | 16                               | 16                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 24  | 24                               | 24                    | 24                               | 24                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 32  | 32                               | 32                    | 32                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 40  | 36                               | 40                    | 36                               | 40                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 48  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 56  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 60  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 64  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 72  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 76  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 84  | 36                               | 48                    | 36                               | 48                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| <b>QL1P200 and QL1P300</b>  |                                  |                       |                                  |                       |                                     |                       |                                     |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 16  | 16                               | 16                    | 16                               | 16                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 24  | 24                               | 24                    | 24                               | 24                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 32  | 32                               | 32                    | 32                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 40  | 36                               | 40                    | 36                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 48  | 36                               | 48                    | 36                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 56  | 36                               | 48                    | 36                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 60  | 36                               | 48                    | 36                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 64  | 24                               | 48                    | 32                               | 32                    | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 72  |                                  |                       |                                  |                       | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 76  |                                  |                       |                                  |                       | n/a                                 | n/a                   | n/a                                 | n/a                   |
| 84  |                                  |                       |                                  |                       | n/a                                 | n/a                   | n/a                                 | n/a                   |

- Limit the number of SSOs in Bank A and Bank D that are asynchronous to CCM<1> (i.e., not clocked by CCM<1> outputs) and SSOs in Bank C and Bank D that are asynchronous to CCM<0> (i.e., not clocked by CCM<0> outputs) as shown in **Table 21**, **Table 22**, and **Table 23**.

Table 21: Usable Asynchronous SSOs at VCCIO = 3.3V

| Total SSO in<br>(Bank A and<br>Bank D) or<br>(Bank C and<br>Bank D) | Slew Rate Setting                |                       |                                  |                       |                                  |                       |                                  |                       |
|---|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|
|   | Wow                              |                       | Very Fast                        |                       | Fast                             |                       | Slow                             |                       |
|   | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D |
| <b>QL1P075 and QL1P100</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  |                                  |                       |                                  |                       | 16                               | 16                    | 16                               | 16                    |
| 24  |                                  |                       |                                  |                       | 24                               | 24                    | 24                               | 24                    |
| 32  |                                  |                       |                                  |                       | 32                               | 24                    | 32                               | 24                    |
| 40  |                                  |                       |                                  |                       | 36                               | 24                    | 36                               | 24                    |
| 48  |                                  |                       |                                  |                       | 36                               | 24                    | 36                               | 24                    |
| 56  |                                  |                       |                                  |                       |                                  |                       | 36                               | 24                    |
| 60  |                                  |                       |                                  |                       |                                  |                       | 36                               | 24                    |
| <b>QL1P200 and QL1P300</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 0                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  |                                  |                       | 16                               | 16                    | 16                               | 16                    | 16                               | 8                     |
| 24  |                                  |                       | 16                               | 8                     | 24                               | 24                    | 24                               | 8                     |
| 32  |                                  |                       |                                  |                       | 32                               | 24                    | 32                               | 8                     |
| 40  |                                  |                       |                                  |                       | 36                               | 24                    | 36                               | 8                     |
| 48  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 56  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 60  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |

Table 22: Usable Asynchronous SSOs at VCCIO = 2.5 V

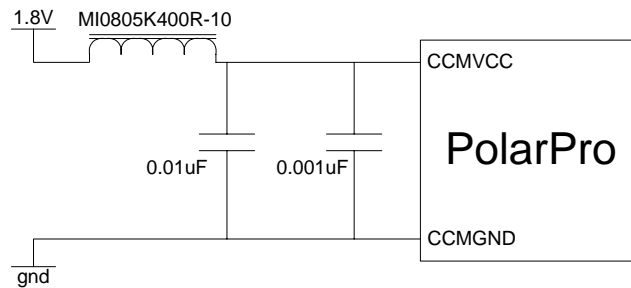
| Total SSO in<br>(Bank A and<br>Bank D) or<br>(Bank C and<br>Bank D) | Slew Rate Setting                |                       |                                  |                       |                                  |                       |                                  |                       |
|---|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|
|   | Wow                              |                       | Very Fast                        |                       | Fast                             |                       | Slow                             |                       |
|   | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D |
| <b>QL1P075 and QL1P100</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    |
| 24  | 16                               | 24                    | 24                               | 24                    | 24                               | 24                    | 24                               | 24                    |
| 32  |                                  |                       | 32                               | 32                    | 32                               | 32                    | 32                               | 32                    |
| 40  |                                  |                       | 36                               | 32                    | 36                               | 32                    | 36                               | 40                    |
| 44  |                                  |                       | 36                               | 32                    | 36                               | 32                    | 36                               | 40                    |
| 48  |                                  |                       | 36                               | 32                    | 36                               | 32                    | 36                               | 40                    |
| 56  |                                  |                       | 32                               | 32                    | 36                               | 32                    | 36                               | 40                    |
| 60  |                                  |                       |                                  |                       | 36                               | 24                    | 36                               | 40                    |
| 64  |                                  |                       |                                  |                       |                                  |                       | 36                               | 40                    |
| 68  |                                  |                       |                                  |                       |                                  |                       | 36                               | 32                    |
| <b>QL1P200 and QL1P300</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     | 8                                | 8                     |
| 16  |                                  |                       | 16                               | 16                    | 16                               | 16                    | 16                               | 16                    |
| 24  |                                  |                       | 24                               | 24                    | 24                               | 24                    | 24                               | 16                    |
| 32  |                                  |                       | 32                               | 24                    | 32                               | 32                    | 32                               | 16                    |
| 40  |                                  |                       | 36                               | 24                    | 36                               | 32                    | 36                               | 16                    |
| 44  |                                  |                       | 36                               | 24                    | 36                               | 32                    | 36                               | 16                    |
| 48  |                                  |                       | 32                               | 24                    | 36                               | 32                    | 36                               | 16                    |
| 56  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 60  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 64  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 68  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |

Table 23: Usable Asynchronous SSOs at VCCIO = 1.8 V

| Total SSO in<br>(Bank A and<br>Bank D) or<br>(Bank C and<br>Bank D) | Slew Rate Setting                |                       |                                  |                       |                                  |                       |                                  |                       |
|---|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|----------------------------------|-----------------------|
|   | Wow                              |                       | Very Fast                        |                       | Fast                             |                       | Slow                             |                       |
|   | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D | Max. SSO<br>in Bank A/<br>Bank C | Max. SSO<br>in Bank D |
| <b>QL1P075 and QL1P100</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | n/a                              | n/a                   | n/a                              | n/a                   |
| 16  | 16                               | 16                    | 16                               | 16                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 24  | 24                               | 24                    | 24                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 32  | 32                               | 32                    | 32                               | 32                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 40  | 32                               | 40                    | 36                               | 40                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 44  | 16                               | 40                    | 36                               | 40                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 48  | 16                               | 40                    | 36                               | 40                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 56  | 16                               | 40                    | 36                               | 40                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 60  |                                  |                       | 36                               | 40                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 64  |                                  |                       | 24                               | 40                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 68  |                                  |                       |                                  |                       | n/a                              | n/a                   | n/a                              | n/a                   |
| <b>QL1P200 and QL1P300</b>  |                                  |                       |                                  |                       |                                  |                       |                                  |                       |
| 8   | 8                                | 8                     | 8                                | 8                     | n/a                              | n/a                   | n/a                              | n/a                   |
| 16  | 16                               | 8                     | 16                               | 16                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 24  | 16                               | 8                     | 24                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 32  |                                  |                       | 32                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 40  |                                  |                       | 36                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 44  |                                  |                       | 36                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 48  |                                  |                       | 36                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 56  |                                  |                       | 36                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 60  |                                  |                       | 36                               | 24                    | n/a                              | n/a                   | n/a                              | n/a                   |
| 64  |                                  |                       |                                  |                       | n/a                              | n/a                   | n/a                              | n/a                   |
| 68  |                                  |                       |                                  |                       | n/a                              | n/a                   | n/a                              | n/a                   |

3. The power supply to the CCMs must have adequate noise filtering circuits. QuickLogic Reference Design boards use the noise filtering circuit shown in **Figure 16**.

Figure 16: Noise Filtering Circuit



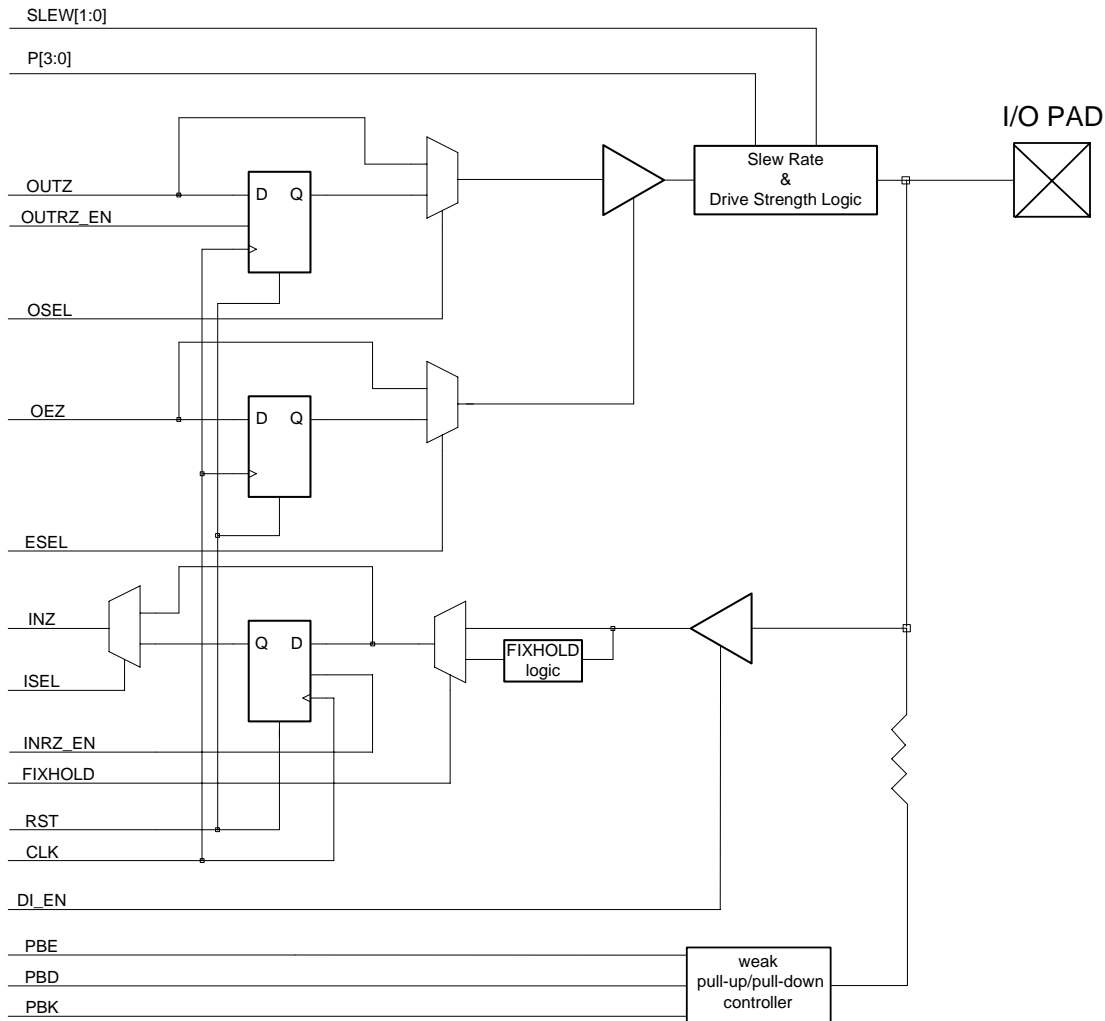
## General Purpose Input Output (GPIO) Cell Structure

The GPIO features include:

- Direct or registered input with input path select
- Direct or registered output with output path select
- Direct or registered output enable with OE path select
- Input buffer enable to reduce power
- Programmable weak keeper, programmable pull-up/pull-down control
- Programmable drive strength
- Configurable slew rate
- Support for JTAG boundary scan



Figure 17: PolarPro GPIO Cell



With bi-directional I/O pins and global clock input pins, the PolarPro device maximizes I/O performance, functionality, and flexibility. All input and I/O pins are 1.8 V, 2.5 V, and 3.3 V tolerant and comply with the specific I/O standard selected. For single-ended I/O standards, the corresponding VCCIO bank input specifies the input tolerance and the output drive voltage. Drive strength and slew rate are configured for an entire bank. Weak keeper, pull-up, and pull-down functions can be configured for individual I/O. The default configuration for QuickLogic QuickWorks software has the drive strength set to 4 and the slew rate set to wow.

Table 24: GPIO Interface Signals

| Signal Name             | Direction | Function                              |
|-------------------------|-----------|---------------------------------------|
| <b>Routable Signals</b> |           |                                       |
| OUTZ                    | I         | Data out from internal logic          |
| OUTRZ_EN                | I         | Enable for registered OUTZ            |
| OEZ                     | I         | Tristate enable for the output signal |
| INZ                     | O         | Input signal to the internal logic    |
| INRZ_EN                 | I         | Enable for registered INZ             |

Table 24: GPIO Interface Signals (Continued)

| Signal Name    | Direction | Function  |
|----------------|-----------|---|
| RST            | I         | Reset for optional registers  |
| CLK            | I         | Clock signal for optional registers   |
| DI_EN          | I         | Enable for I/O input signal. Drives a 1 to internal logic when disabled.  |
| Static Signals |           |   |
| SLEW[1:0]      | I         | 2-bit slew rate control   |
| P[3:0]         | I         | Programmable drive strength   |
| OSEL           | I         | Select signal for registered or flow through OUTZ   |
| ESEL           | I         | Select signal for registered or flow-through OEZ  |
| ISEL           | I         | Select signal for registered or flow-through INZ  |
| FIXHOLD        | I         | Enable control for I/O input delay for hold fixing  |
| PBE            | I         | Input signals for the weak keeper, pull-up/pull-down controller, see <a href="#">Table 25</a> for functional behavior |
| PBD            | I         |   |
| PBK            | I         |   |

## Programmable Weak Keeper, Pull-Up, and Pull-Down

A programmable Weak Keeper, Pull-Up or Pull-Down controller is also available on each General Purpose I/O bank. When implementing the Weak Keeper, Pull-Up, and Pull-Down functions, each I/O can be configured separately. The I/O Weak Pull-Up and Pull-Down eliminates the need for external resistors. When PBK=1 the keeper block is placed into keeper mode. In the keeper mode, the pad pin (if the driver is tristated), will be kept at whichever level it was last forced, either by the driver itself, or by an external driver.

Table 25: Weak Pull-Up, and Pull-Down Controller

| PBK | PBD | PBE | Function                    |
|-----|-----|-----|-----------------------------|
| 0   | 0   | 0   | Tristate (floating)         |
| 0   | 0   | 1   | Weak Pull-Down              |
| 0   | 1   | 1   | Weak Pull-Up                |
| 1   | X   | X   | Weak Keeper (retains state) |
| 0   | 1   | 0   | Reserved                    |

## Programmable Drive Strength

Every GPIO has independent drive strength control. Twelve different drive strength levels are available for designers to choose from. For additional information about corresponding drive strength see [DC Characteristics](#) on page 35.

## Programmable Slew Rate

Each I/O has programmable slew rate capability. The PolarPro GPIOs allow up to four different slew rate speeds (slow, fast, vfast, and wow). Slower slew rates can be used to reduce noise caused by I/O switching.

I/O interface standards are programmable on a per bank basis. **Table 26** illustrates the I/O bank configurations available. Each I/O bank is independent of other I/O banks and each I/O bank has its own VCCIO supply inputs. A mixture of different I/O standards can be used on a PolarPro device. However, there is a limitation as to which I/O standards can be supported within a given bank. Only standards that share a common VCCIO can be shared within the same bank (e.g., PCI and LVTTL).

Table 26: I/O Standards and Applications

| I/O Standard | VCCIO Voltage | Application          |
|--------------|---------------|----------------------|
| LVTTL        | 3.3 V         | General Purpose      |
| LVCMOS25     | 2.5 V         | General Purpose      |
| LVCMOS18     | 1.8 V         | General Purpose      |
| PCI          | 3.3 V         | PCI Bus Applications |

## DDRIO Cell Structure

QuickLogic PolarPro devices support DDRIOs, which allows clocking data on both the positive and negative clock edges. All PolarPro devices have one I/O bank (Bank D) that can be configured in either a GPIO bank or a DDRIO mode. When bank D is configured to DDRIO mode, it is further divided into DDRIO sets. Each set contains 12 I/Os, which include 8 DQs, 1 DQM, 1 DQS, 1 DQCK\_N and 1 DQCK\_P (for the differential clocks, refer to **Table 27**).

Figure 18: PolarPro DDRIO Block Diagram

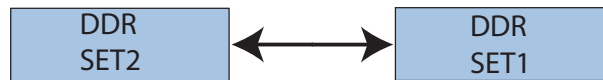


Table 27: Available DDR Sets

| PolarPro Device | Package | Number of DDR Sets |
|-----------------|---------|--------------------|
| QL1P075         | PU132   | 1                  |
|                 | PF144   | 2                  |
|                 | PT196   | 4                  |
|                 | PS256   | 4                  |
| QL1P100         | PU121   | 0                  |
|                 | PU132   | 1                  |
|                 | PF144   | 2                  |
|                 | PT196   | 4                  |
|                 | PS256   | 4                  |

Table 27: Available DDR Sets (Continued)

| PolarPro Device | Package | Number of DDR Sets |
|-----------------|---------|--------------------|
| QL1P200         | PU132   | 1                  |
|                 | PS256   | 4                  |
| QL1P300         | WU99    | 0                  |
|                 | PU132   | 1                  |
|                 | PS256   | 4                  |



Figure 20: DDRIO DQS Configuration

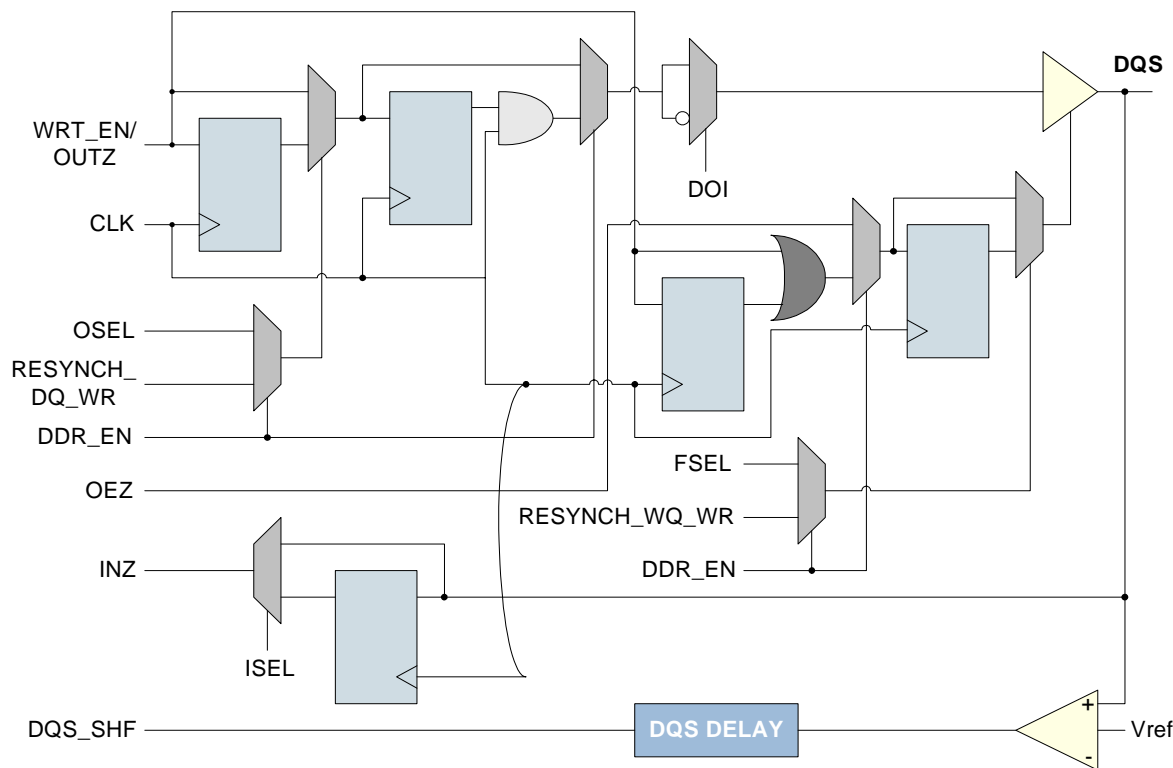


Table 28: DDR DQ Fabric Interface Signals

| Signal Name             | Direction | Function  |
|-------------------------|-----------|---|
| <b>Routable Signals</b> |           |   |
| DDR_EN                  | I         | Enable DDR function, otherwise function will be that of GPIO.   |
| CLK270                  | I         | Shifted clock used in center-aligning data with DQS in writing out data.  |
| PDB                     | I         | Used as control for differential power-down.  |
| CLK                     | I         | System clock signal from the programmable fabric.   |
| RST                     | I         | Reset signal for registers inside the I/O.  |
| INRZ_EN                 | I         | Enable for registered DQLI / INZ.   |
| DQH                     | I         | Higher bit DQ signal output from core.  |
| OUTRZ_EN                | I         | GPIO: enable for registered OUTZ signal.  |
| DQL / OUTZ              | I         | DDR(DQL): lower bit DQ signal output from core.<br>GPIO(OUTZ): data out from core with optional register.   |
| OEZ                     | I         | Tristate enable for the output signal with optional register.   |
| DQHI                    | O         | Higher bit DQ signal input to core with optional register for resynchronization.  |
| DQLI / INZ              | O         | DDR(DQLI): lower bit DQ signal input to core with optional register for resynchronization.<br>GPIO(INZ): data in signal to core with optional register. |

Table 28: DDR DQ Fabric Interface Signals (Continued)

| Signal Name           | Direction | Function   |
|-----------------------|-----------|--|
| <b>Static Signals</b> |           |  |
| resync_DQ_rd          | I         | Signal to enable resynching of DQ being read to avoid setup violations inside the programmable fabric. |
| resync_DQ_wr          | I         | Signal to enable resynching of DQ being written to avoid setup violations inside the I/O.              |
| SLEW[1:0]             | I         | 2-bit slew rate control.   |
| P[3:0]                | I         | Pull-up programmable drive strength.   |
| N[3:0]                | I         | Pull-down programmable drive strength.   |
| FIXHOLD               | I         | Enable control for I/O input delay for hold fixing.  |
| PBE                   | I         | Input signal for weak pull-up controller.  |
| DOI                   | I         | Used as control for data out inversion.  |
| ISEL                  | I         | Select signal for registered or flow through INZ.  |
| OSEL                  | I         | Select signal for registered or flow through OUTZ.   |
| ESEL                  | I         | Select signal for registered or flow through OEZ.  |

Table 29: DDR DQS Interface Signals

| Signal Name              | Direction | Function  |
|--------------------------|-----------|---|
| <b>Routeable Signals</b> |           |   |
| CLK_SYNC                 | I         | Optional resynchronization clock to sync incoming data with the programmable fabric system clock.                                   |
| PDB                      | I         | Control for differential power-down.  |
| CLK                      | I         | System clock signal from the programmable fabric.   |
| RST                      | I         | Reset signal for registers inside the I/O.  |
| INRZ_EN                  | I         | GPIO: enable for registered INZ.  |
| INZ                      | O         | GPIO: data in signal to core with optional register.  |
| DQS_BR_REL               | I         | A read burst signal used to mask the end of DQS pulses to avoid unnecessary glitches that will result in clocking-in unwanted data. |
| OEZ                      | I         | Tristate enable for the output signal with optional register.   |
| OUTRZ_EN                 | I         | Enable for registered or flow-through WRT_EN/OUTZ.  |
| WRT_EN                   | I         | DDR(WRT_EN): write enable signal.<br>GPIO(OUTZ): data out from core with optional register.   |
| <b>Static Signals</b>    |           |   |
| CLK_SYNC_DEL_CTRL[4:0]   | I         | Setting to program delay for CLK_SYNC.  |
| CLK_SYNC_INV             | I         | Option to invert CLK_SYNC.  |
| resync_DQ_wr             | I         | Signal to enable resynching of DQ being written to avoid setup violations inside I/O.   |
| DDR_EN                   | I         | Enable DDR function, otherwise function will be that of GPIO.   |
| FIXHOLD                  | I         | Enable control for I/O input delay for hold fixing.   |

Table 29: DDR DQS Interface Signals (Continued)

| Signal Name       | Direction | Function   |
|-------------------|-----------|--|
| PBE               | I         | Input signal for weak pull-up controller.  |
| SLEW[1:0]         | I         | Slew rate control setting.   |
| P[3:0]            | I         | Pull-up programmable drive strength.   |
| N[3:0]            | I         | Pull-down programmable drive strength.   |
| DOI               | I         | Control for data out inversion.  |
| ISEL              | I         | DDR: selects between VREF (ISEL=0) or PADI (ISEL=1), to connect to the inverting-input of a differential amplifier inside the DDR I/O driver.<br>GPIO: Select signal for registered or flow-through INZ. |
| OSEL              | I         | Select signal for registered or flow-through WRT_EN/OUTZ.  |
| ESEL              | I         | Select signal for registered or flow-through DQS_OE/OEZ.   |
| DQS_DEL_CTRL[3:0] | I         | Setting to program delay of DQS signal.  |

## DDRIO in GPIO Mode

DDR in GPIO mode features include programmable I/O standards via the VCCIO input pins (1.8V LVCMOS, 2.5V LVCMOS, and 3.3V LVTTTL).

**NOTE:** DDRIOs do not support PCI. For PCI support use the general purpose I/Os.

## Very Low Power (VLP) Mode

The QuickLogic PolarPro devices have a unique feature, referred to as VLP mode, which reduces power consumption by placing the device in standby. Specifically, VLP mode can bring the total standby current down to less than 10  $\mu$ A at room temperature when no incoming signals are toggled. VLP mode is controlled by the VLP pin. The VLP pin is active low, so VLP mode is activated by pulling the VLP pin to ground. Conversely, the VLP pin must be pulled to 3.3 V for normal operation.

When a PolarPro device goes into VLP mode, the following occurs:

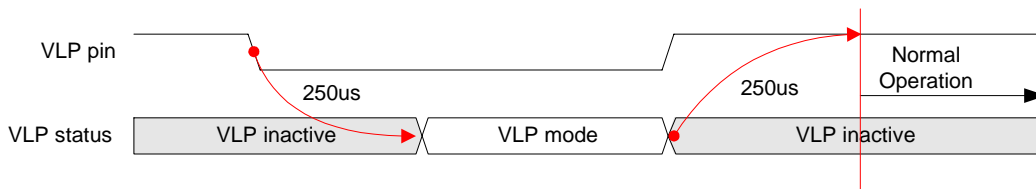
- All logic cell registers and GPIO registers values are held
- All RAM cell data is retained
- The outputs from all GPIO to the internal logic are tied to a weak '1'
- GPIO outputs drive the previous values
- GPIO output enables retain the previous values
- DDRIO outputs are pulled down through a weak pull down circuit
- Clock pad inputs are gated
- CCMs are held in the reset state



The entire operation from normal mode to VLP mode requires 250  $\mu$ s (300  $\mu$ s maximum). As mentioned in the VLP behavioral description above, the output of the GPIO to the internal logic is a weak '1'. Therefore, to preserve data retention GPIO should not be used for a set, reset, or clock signal. During the transition from VLP mode to normal operation, the VLP pin can draw up to 1.5 mA. Consequently, if using a pull-up resistor, use a pull-up resistor with a value that is less than 2 K $\Omega$ .

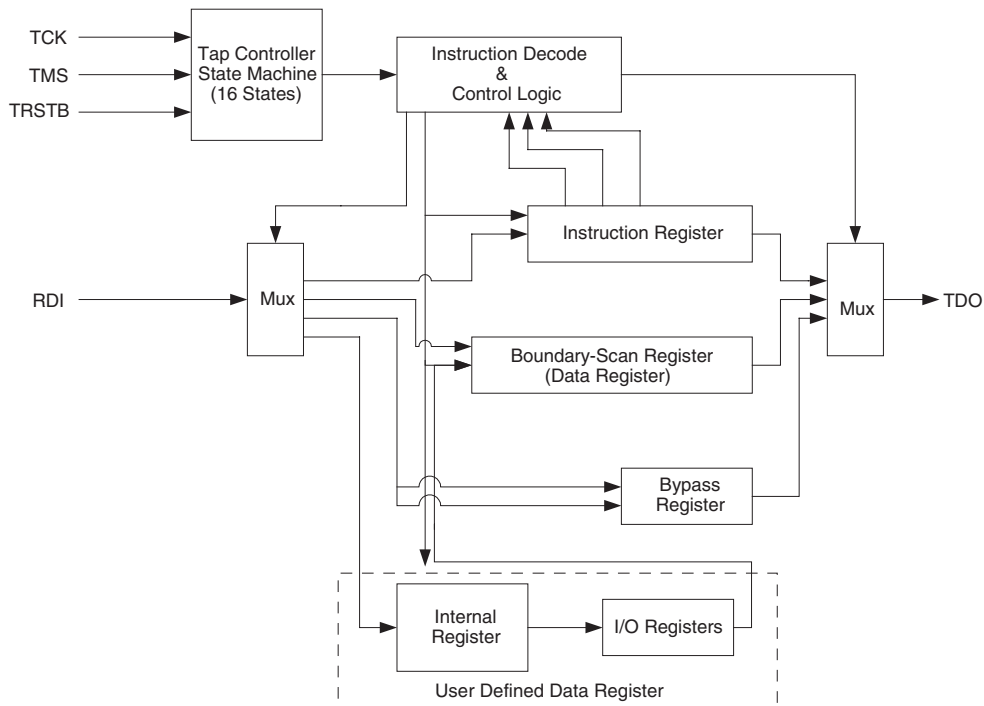
As the device exits out of VLP mode, the data from the registers, RAM, and GPIO will be used to recover the functionality of the device. Furthermore, since the CCMs were in a reset state during VLP mode, they will have to re-acquire the correct output signals before asserting lock\_out. The time required to go from VLP mode to normal operation is 250  $\mu$ s (300  $\mu$ s maximum). **Figure 21** displays the delays associated with entering and exiting VLP mode.

Figure 21: Typical VLP Mode Timing



## Joint Test Access Group (JTAG) Information

Figure 22: JTAG Block Diagram



QuickLogic's PolarPro devices comply with IEEE standard 1149.1, the Standard Test Access Port and Boundary Scan Architecture. The JTAG boundary scan test methodology allows complete observation and control of the boundary pins of a JTAG-compatible device through JTAG software. A Test Access Port (TAP) controller works in concert with the Instruction Register (IR), which allow users to run three required tests along with several user-defined tests. JTAG tests allow users to reduce system debug time, reuse test platforms and tools, and reuse subsystem tests for comprehensive verification of higher level system elements.

The 1149.1 standard requires the following three tests:

- **Extest Instruction.** The Extest Instruction performs a printed circuit board (PCB) interconnect test. This test places a device into an external boundary test mode, selecting the boundary scan register to be connected between the TAP Test Data In (TDI) and Test Data Out (TDO) pins. Boundary scan cells are preloaded with test patterns (through the Sample/Preload Instruction), and input boundary cells capture the input data for analysis.
- **Sample/Preload Instruction.** The Sample/Preload Instruction allows a device to remain in its functional mode, while selecting the boundary scan register to be connected between the TDI and TDO pins. For this test, the boundary scan register can be accessed through a data scan operation, allowing users to sample the functional data entering and leaving the device.
- **Bypass Instruction.** The Bypass Instruction allows data to skip a device boundary scan entirely, so the data passes through the bypass register. The Bypass instruction allows users to test a device without passing through other devices. The bypass register is connected between the TDI and TDO pins, allowing serial data to be transferred through a device without affecting the operation of the device.

## JTAG BSDL Support

- Boundary Scan Description Language (BSDL)
- Machine-readable data for test equipment to generate testing vectors and software
- BSDL files available for all device/package combinations from QuickLogic
- Extensive industry support available and ATVG (Automatic Test Vector Generation)

## Electrical Specifications

### DC Characteristics

The DC Specifications are provided in **Table 30** through **Table 33**.

Table 30: Absolute Maximum Ratings

| Parameter     | Value           | Parameter                                  | Value              |
|---------------|-----------------|--|--------------------|
| VCC Voltage   | -0.5 V to 2.2 V | Latch-up Immunity                          | ±100 mA            |
| VCCIO Voltage | -0.5 V to 4.0 V | ESD Pad Protection                         | 2 kV               |
| VREF Voltage  | -0.5 V to 2.0 V | Leaded Package Storage Temperature         | -65° C to + 150° C |
| Input Voltage | -0.5 V to 4.0 V | Laminate Package (BGA) Storage Temperature | -55° C to + 125° C |

Table 31: Recommended Operating Range

| Symbol | Parameter                   | Military |      | Industrial |      | Commercial |      | Unit |
|--------|-----------------------------|----------|------|------------|------|------------|------|------|
|        |                             | Min.     | Max. | Min.       | Max. | Min.       | Max. |      |
| VCC    | Supply Voltage              | 1.71     | 1.89 | 1.71       | 1.89 | 1.71       | 1.89 | V    |
| VCCIO  | I/O Input Tolerance Voltage | 1.71     | 3.60 | 1.71       | 3.60 | 1.71       | 3.60 | V    |
| TJ     | Junction Temperature        | -55      | 125  | -40        | 100  | 0          | 85   | °C   |

Table 32: DC Characteristics

| Symbol      | Parameter                         | Conditions              | Min. | Typ. | Max. | Units   |
|-------------|-----------------------------------|-------------------------|------|------|------|---------|
| $I_I$       | I or I/O Input Leakage Current    | $V_I = V_{CCIO}$ or GND | -    | -    | 1    | $\mu$ A |
| $I_{OZ}$    | 3-State Output Leakage Current    | $V_I = V_{CCIO}$ or GND | -    | -    | 1    | $\mu$ A |
| $C_I$       | I/O Input Capacitance             | $V_{CCIO} = 3.6$ V      | -    | -    | 10   | pF      |
| $C_{CLOCK}$ | Clock Input Capacitance           | $V_{CCIO} = 3.6$ V      | -    | -    | 10   | pF      |
| $I_{REF}$   | Quiescent Current on INREF        | -                       | -    | -    | 5    | $\mu$ A |
| $I_{PD}$    | Current on programmable pull-down | $V_{CCIO} = 3.6$ V      | -200 | -    | -50  | $\mu$ A |
|             |                                   | $V_{CCIO} = 2.75$ V     | -150 | -    | -25  | $\mu$ A |
|             |                                   | $V_{CCIO} = 1.89$ V     | -100 | -    | -10  | $\mu$ A |
| $I_{PU}$    | Current on programmable pull-up   | $V_{CCIO} = 3.6$ V      | 50   | -    | 200  | $\mu$ A |
|             |                                   | $V_{CCIO} = 2.75$ V     | 25   | -    | 150  | $\mu$ A |
|             |                                   | $V_{CCIO} = 1.89$ V     | 10   | -    | 100  | $\mu$ A |
| $I_{VLP}$   | Quiescent Current on VLP pin      | VLP=3.3                 | -    | 1    | 10   | $\mu$ A |
| $I_{CCM}$   | Quiescent Current on each CCMVCC  | VCC=1.89 V              | -    | 1    | 10   | $\mu$ A |
| $I_{VCC}$   | Quiescent Current <sup>a</sup>    | VLP=GND                 | -    | 2.2  | 40   | $\mu$ A |
|             |                                   | VLP=3.3V                | -    | 40   | 100  | $\mu$ A |
| $I_{VCCIO}$ | Quiescent Current on VCCIO        | $V_{CCIO} = 3.6$ V      | -    | 2    | 10   | $\mu$ A |
|             |                                   | $V_{CCIO} = 2.75$ V     | -    | 2    | 10   | $\mu$ A |
|             |                                   | $V_{CCIO} = 1.89$ V     | -    | 2    | 10   | $\mu$ A |

a. Quiescent current values correspond to the QL1P100.

Table 33: DC Input and Output Levels<sup>a</sup>

| Symbol    | INREF            |                  | V <sub>IL</sub>  |                  | V <sub>IH</sub>  |                  | V <sub>OL</sub>  | V <sub>OH</sub>  | I <sub>OL</sub> | I <sub>OH</sub> |
|-----------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------|-----------------|
|           | V <sub>MIN</sub> | V <sub>MAX</sub> | V <sub>MIN</sub> | V <sub>MAX</sub> | V <sub>MIN</sub> | V <sub>MAX</sub> | V <sub>MAX</sub> | V <sub>MIN</sub> | mA              | mA              |
| LVTTTL    | n/a              | n/a              | -0.3             | 0.8              | 2.2              | VCCIO + 0.3      | 0.4              | 2.4              | 2.0             | -2.0            |
| LVC MOS2  | n/a              | n/a              | -0.3             | 0.7              | 1.7              | VCCIO + 0.3      | 0.7              | 1.7              | 2.0             | -2.0            |
| LVC MOS18 | n/a              | n/a              | -0.3             | 0.63             | 1.2              | VCCIO + 0.3      | 0.7              | 1.7              | 2.0             | -2.0            |
| GTL+      | 0.88             | 1.12             | -0.3             | INREF - 0.2      | INREF + 0.2      | VCCIO + 0.3      | 0.6              | n/a              | 40              | n/a             |
| PCI       | n/a              | n/a              | -0.3             | 0.3 x VCCIO      | 0.6 x VCCIO      | VCCIO + 0.5      | 0.1 x VCCIO      | 0.9 x VCCIO      | 1.5             | -0.5            |
| SSTL2     | 1.15             | 1.35             | -0.3             | INREF - 0.18     | INREF + 0.18     | VCCIO + 0.3      | 0.74             | 1.76             | 7.6             | -7.6            |
| SSTL3     | 1.3              | 1.7              | -0.3             | INREF - 0.2      | INREF + 0.2      | VCCIO + 0.3      | 1.10             | 1.90             | 8               | -8              |

a. The data provided in **Table 33** represents the JEDEC and PCI specification. QuickLogic devices either meet or exceed these requirements.

**Table 34** and **Table 35** lists the worst case process ( $T_j=125^\circ\text{C}$ ) output currents (in mA) across the output driver at three levels of I/O voltages. All drive strength data was measured at I/O voltages of 0.4 V and VCCIO - 0.4 V.

Table 34: GPIO Programmable Drive Strength

| Drive Strength | IOH (mA) |      |      | IOL (mA) |      |      |
|----------------|----------|------|------|----------|------|------|
|                | 1.8V     | 2.5V | 3.3V | 1.8V     | 2.5V | 3.3V |
| 1              | 2.2      | 2.8  | 3.2  | 1.7      | 2.3  | 2.7  |
| 2              | 4.1      | 5.2  | 5.9  | 3.4      | 4.4  | 5    |
| 3              | 6.2      | 7.8  | 8.8  | 5.1      | 6.7  | 7.6  |
| 4              | 8        | 10   | 11.2 | 6.6      | 8.6  | 9.7  |
| 5              | 10       | 12.4 | 13.9 | 8.3      | 10.7 | 12.1 |
| 6              | 11.8     | 14.6 | 16.3 | 9.8      | 12.7 | 14.2 |
| 7              | 13.7     | 16.9 | 18.9 | 11.5     | 14.7 | 16.6 |
| 8              | 15.3     | 18.9 | 21   | 12.9     | 16.5 | 18.5 |
| 9              | 17.1     | 21.1 | 23.4 | 14.5     | 18.5 | 20.7 |
| 10             | 18.8     | 23   | 25.5 | 15.9     | 20.2 | 22.6 |
| 11             | 20       | 25   | 27.6 | 17.4     | 22   | 24.6 |
| 12             | 21.7     | 26.4 | 29.1 | 18.6     | 23.5 | 26.1 |
| N/A            | Reserved |      |      |          |      |      |

Table 35: DDRIO Programmable Drive Strength

| Drive Strength | IOH      |      |      | IOL  |      |      |
|----------------|----------|------|------|------|------|------|
|                | 1.8V     | 2.5V | 3.3V | 1.8V | 2.5V | 3.3V |
| 1              | 1.9      | 2.7  | 3.1  | 2.1  | 2.8  | 3.3  |
| 2              | 3.4      | 4.4  | 4.9  | 2.9  | 3.8  | 4.4  |
| 3              | 5.4      | 7    | 7.9  | 4.9  | 6.5  | 7.4  |
| 4              | 6.8      | 8.6  | 9.6  | 5.7  | 7.3  | 8.2  |
| 5              | 8.6      | 11   | 12.4 | 7.6  | 9.9  | 11.2 |
| 6              | 9.9      | 12.5 | 14   | 8.3  | 10.7 | 12   |
| 7              | 11.8     | 14.8 | 16.6 | 10.2 | 13.2 | 14.9 |
| 8              | 11.6     | 14.6 | 16.3 | 10.2 | 13.2 | 14.9 |
| 9              | 12.9     | 16   | 17.7 | 10.9 | 14   | 15.7 |
| 10             | 14.7     | 18.2 | 20.2 | 12.7 | 16.3 | 18.3 |
| 11             | 15.9     | 19.5 | 21.6 | 13.4 | 17.1 | 19   |
| 12             | 17.4     | 21.6 | 23.9 | 15.1 | 19.2 | 21.3 |
| 13             | 19.2     | 23.7 | 26.2 | 16.3 | 20.9 | 23.5 |
| 14             | 21.5     | 26.3 | 28.9 | 18.2 | 23   | 25.6 |
| 15             | 22       | 27.1 | 29.8 | 18.7 | 23.9 | 26.8 |
| N/A            | Reserved |      |      |      |      |      |

Figure 23 and Figure 24 illustrate quiescent current for QL1P075 and QL1P100 with VLP = 0 V and 3.3 V.

Figure 23: Quiescent Current for QL1P075 and QL1P100 with VLP = 0 V

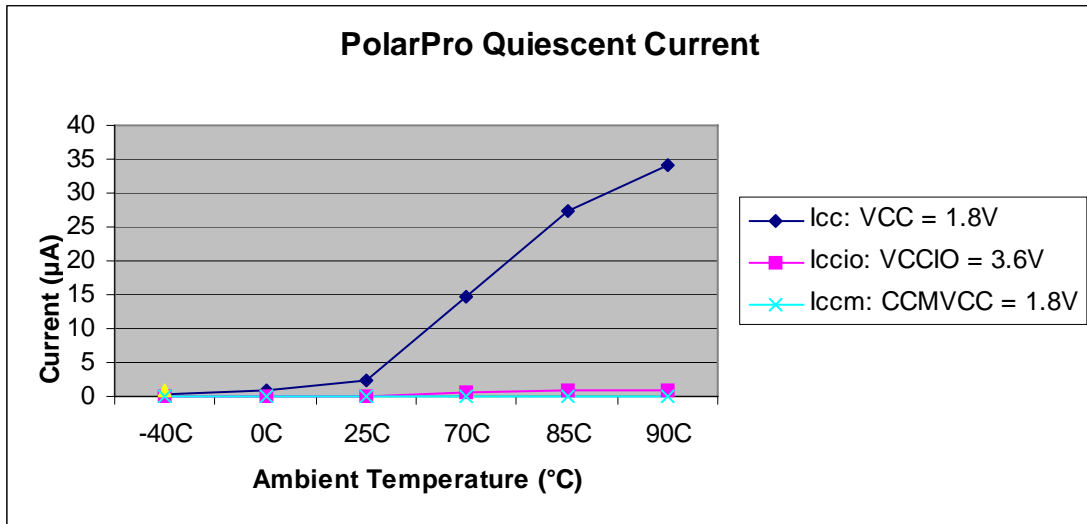


Figure 24: Quiescent Current for QL1P075 and QL1P100 with VLP = 3.3 V

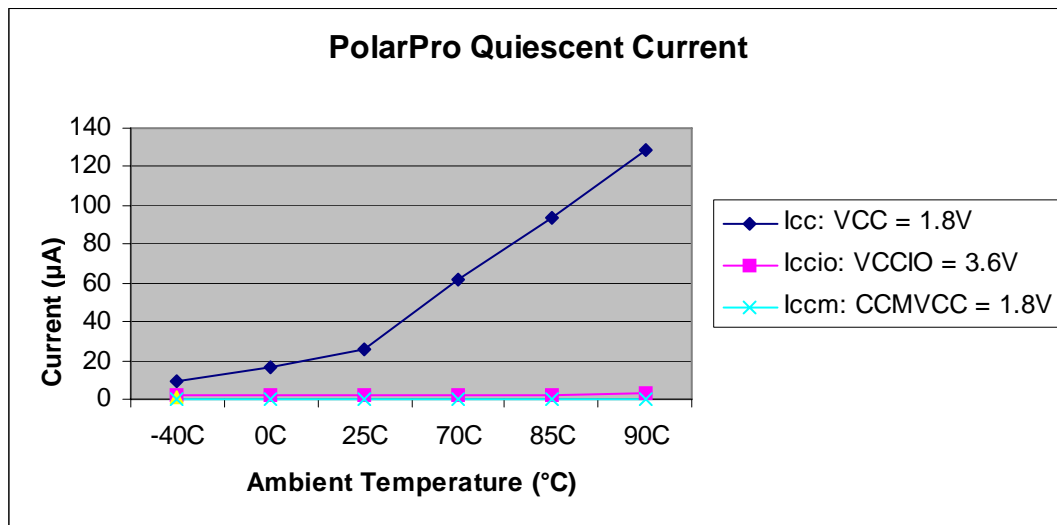


Figure 25 and Figure 26 illustrate quiescent current for QL1P200 and QL1P300 with VLP = 0 V and 3.3 V.

Figure 25: Quiescent Current for QL1P200 and QL1P300 with VLP = 0 V

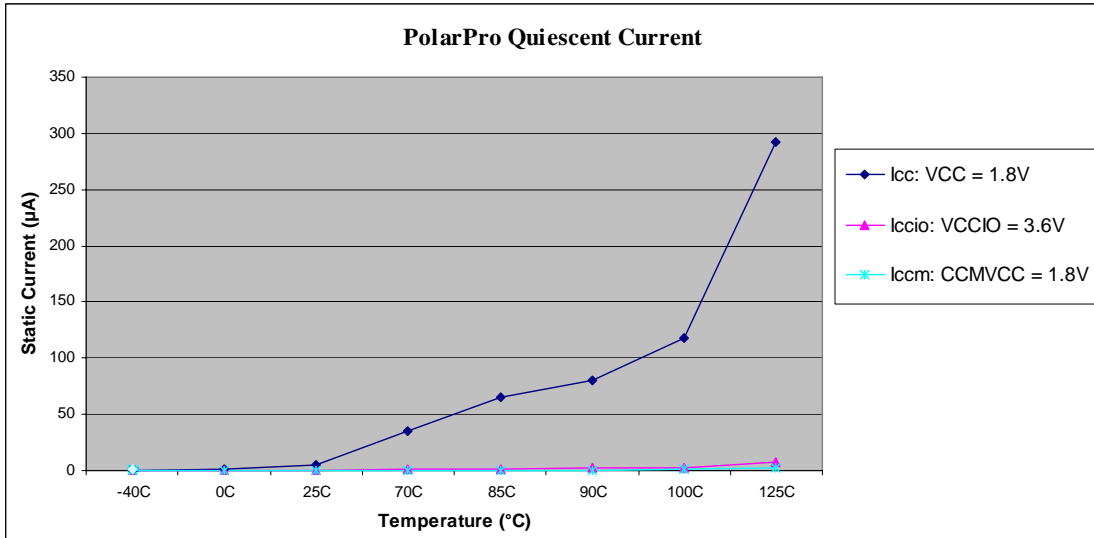
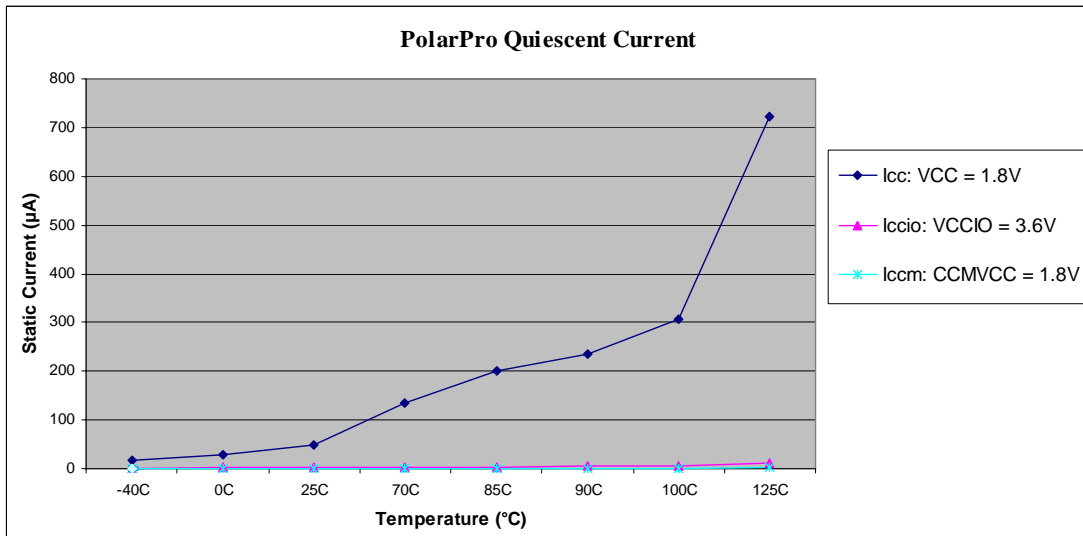


Figure 26: Quiescent Current for QL1P200 and QL1P300 with VLP = 3.3 V



## AC Characteristics

AC specifications are provided in **Table 36** through **Table 48**. Logic cell diagrams and waveforms are provided in **Figure 27** through **Figure 40**. All of the following AC timing numbers are for worst case Commercial (T = 85°C Junction, V= 1.71V), and worst case Industrial (T = 100°C Junction, V=1.71V) conditions.

Figure 27: PolarPro Logic Cell

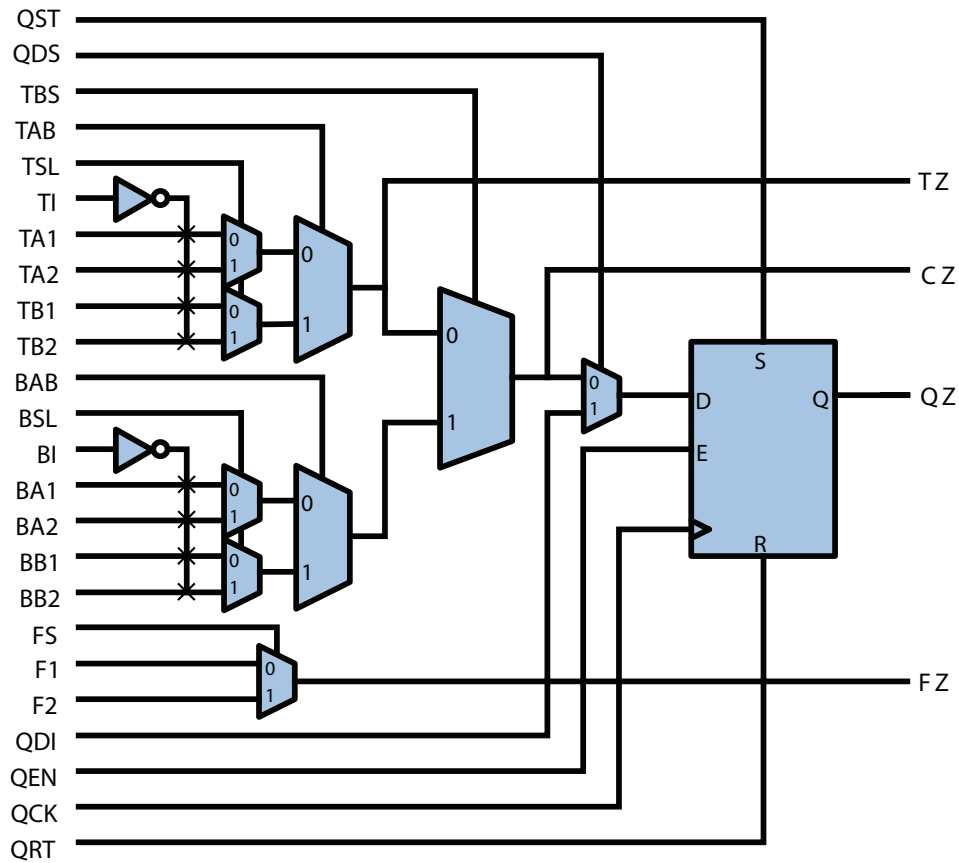




Table 36: Logic Cell Delays

| Symbol      | Parameter   | Commercial |         | Industrial |         |
|-------------|---|------------|---------|------------|---------|
|             |   | Min.       | Max.    | Min.       | Max.    |
| $t_{PD}$    | Combinatorial delay of the longest path: time taken by the combinatorial circuit to output                      | 0.32 ns    | 0.59 ns | 0.34 ns    | 0.62 ns |
| $t_{SU}$    | Setup time: time the synchronous input of the flip-flop must be stable before the active clock edge             | 0.23 ns    | 0.56 ns | 0.24 ns    | 0.58 ns |
| $t_{HL}$    | Hold time: time the synchronous input of the flip-flop must be stable after the active clock edge               | 0 ns       | N/A     | 0 ns       | N/A     |
| $t_{ESU}$   | Enable setup time: time the enable input of the flip-flop must be stable before the active clock edge           | 0.23 ns    | 0.85 ns | 0.89 ns    | 0.24 ns |
| $t_{EHL}$   | Enable hold time: time the enable input of the flip-flop must be stable after the active clock edge             | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{CO}$    | Clock-to-out delay: the amount of time taken by the flip-flop to output after the active clock edge.            | 0.48 ns    | 0.52 ns | 0.50 ns    | 0.55 ns |
| $t_{CWHI}$  | Clock high time: required minimum time the clock stays high   | 0.46 ns    | 0.46 ns | 0.46 ns    | 0.46 ns |
| $t_{CWLO}$  | Clock low time: required minimum time that the clock stays low  | 0.46 ns    | 0.46 ns | 0.46 ns    | 0.46 ns |
| $t_{SET}$   | Set delay: time between when the flip-flop is “set” (high) and when the output is consequently “set” (high)     | 0.60 ns    | 0.60 ns | 0.61 ns    | 0.61 ns |
| $t_{RESET}$ | Reset delay: time between when the flip-flop is “reset” (low) and when the output is consequently “reset” (low) | 0.68 ns    | 0.68 ns | 0.71 ns    | 0.71 ns |
| $t_{SW}$    | Set width: time that the SET signal must remain high/low  | 0.30 ns    | 0.30 ns | 0.30 ns    | 0.30 ns |
| $t_{RW}$    | Reset width: time that the RESET signal must remain high/low  | 0.30 ns    | 0.30 ns | 0.30 ns    | 0.30 ns |

Figure 28: Logic Cell Flip-Flop Timings—First Waveform

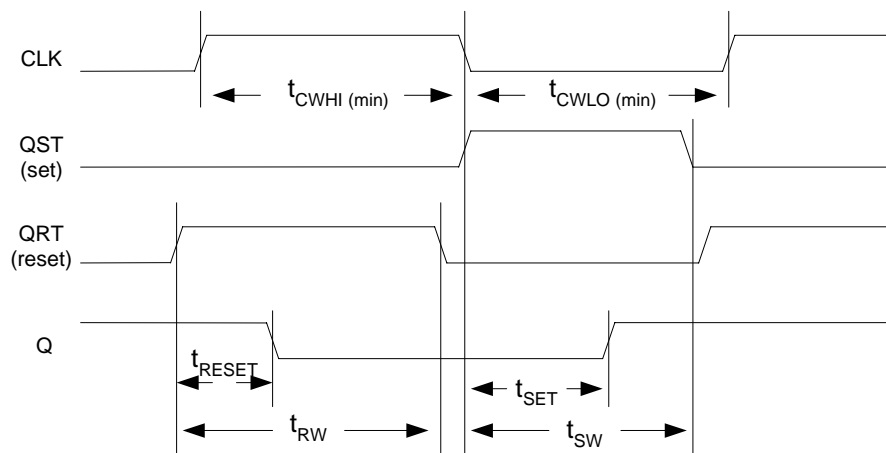


Figure 29: Logic Cell Flip-Flop Timings—Second Waveform

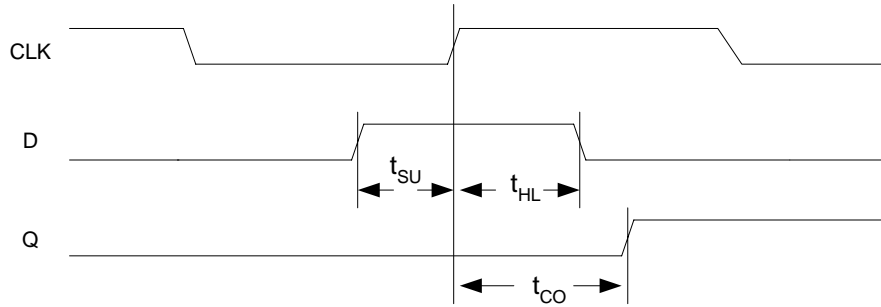


Figure 30: PolarPro Clock Network

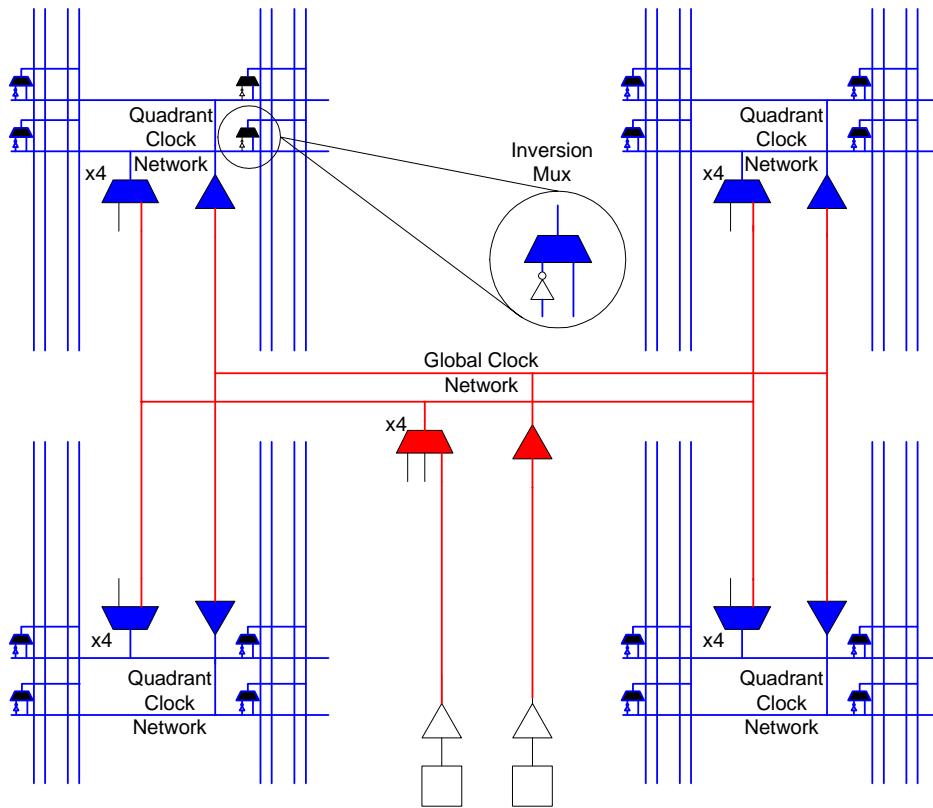


Table 37: PolarPro Tree Clock Delay

| Clock Segment | Parameter  | Commercial |         | Industrial |         |
|---------------|--|------------|---------|------------|---------|
|               |  | Min.       | Max.    | Min.       | Max.    |
| $t_{PGCK}$    | Delay from global clock pad input to quadrant network    | 1.54 ns    | 1.86 ns | 1.56 ns    | 1.88 ns |
| $t_{PDCK}$    | Delay from dedicated clock pad input to quadrant network | 1.4 ns     | 1.66 ns | 1.42 ns    | 1.68 ns |
| $t_{BGCK}$    | Global clock tree delay (quad net to flip-flop)          | 20 ps      | 200 ps  | 30 ps      | 220 ps  |
| $t_{GSKEW}$   | Global delay clock skew                                  | 30 ps      | 190 ps  | 40 ps      | 200 ps  |
| $t_{DSKEW}$   | Dedicated clock skew                                     | 30 ps      | 190 ps  | 40 ps      | 200 ps  |

## RAM Timing

Figure 31: RAM Module

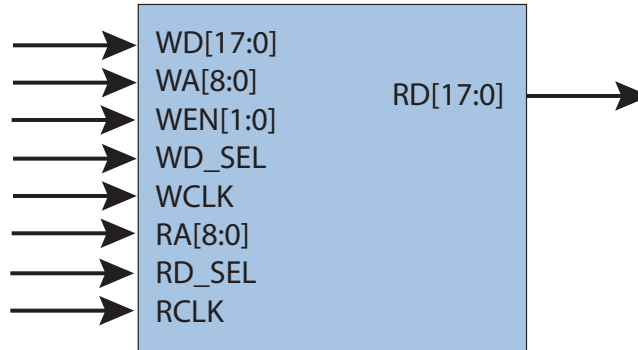


Table 38: RAM Cell Synchronous Write Timing

| Symbol    | Parameter  | Commercial |         | Industrial |         |
|-----------|--|------------|---------|------------|---------|
|           |  | Min.       | Max.    | Min.       | Max.    |
| $t_{SWA}$ | WA setup time to WCLK: time the WRITE ADDRESS must be stable before the active edge of the WRITE CLOCK     | 0.29 ns    | 1.10 ns | 0.31 ns    | 1.28 ns |
| $t_{HWA}$ | WA hold time to WCLK: time the WRITE ADDRESS must be stable after the active edge of the WRITE CLOCK       | 0 ns       | 0.21 ns | 0 ns       | 0.20 ns |
| $t_{SWD}$ | WD setup time to WCLK: time the WRITE DATA must be stable before the active edge of the WRITE CLOCK        | 0.31 ns    | 1.74 ns | 0.40 ns    | 2.21 ns |
| $t_{HWD}$ | WD hold time to WCLK: time the WRITE DATA must be stable after the active edge of the WRITE CLOCK          | 0 ns       | 0.22 ns | 0 ns       | 0.17 ns |
| $t_{SWS}$ | WD_SEL setup time to WCLK: time WRITE CHIP SELECT must be stable before the active edge of the WRITE CLOCK | 0.42 ns    | 1.10 ns | 0.49 ns    | 1.28 ns |
| $t_{HWS}$ | WD_SEL hold time to WCLK: time WRITE CHIP SELECT must be stable after the active edge of the WRITE CLOCK   | 0 ns       | 0.04 ns | 0 ns       | 0.04 ns |
| $t_{SWE}$ | WEN setup time to WCLK: time the WRITE ENABLE must be stable before the active edge of the WRITE CLOCK     | 0.63 ns    | 1.10 ns | 0.74 ns    | 1.28 ns |
| $t_{HWE}$ | WEN hold time to WCLK: time the WRITE ENABLE must be stable after the active edge of the WRITE CLOCK       | 0 ns       | 0 ns    | 0 ns       | 0 ns    |

Figure 32: RAM Cell Write Timing

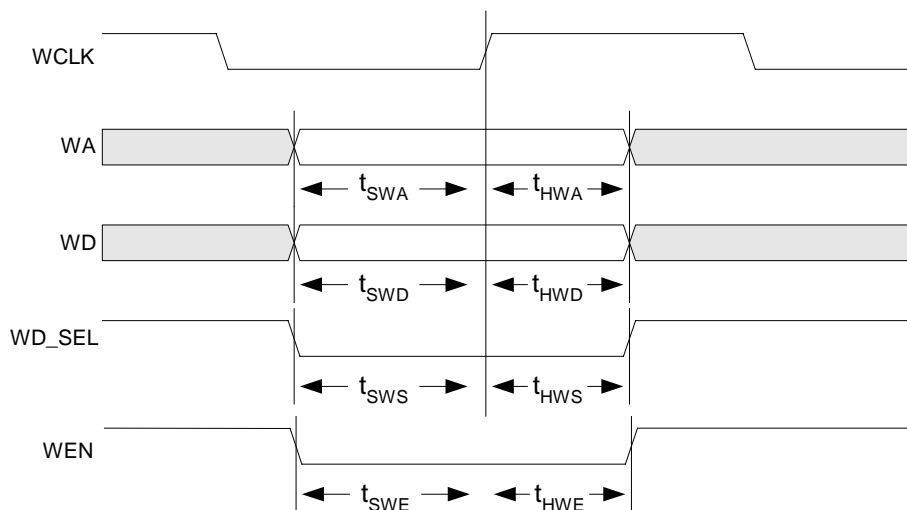
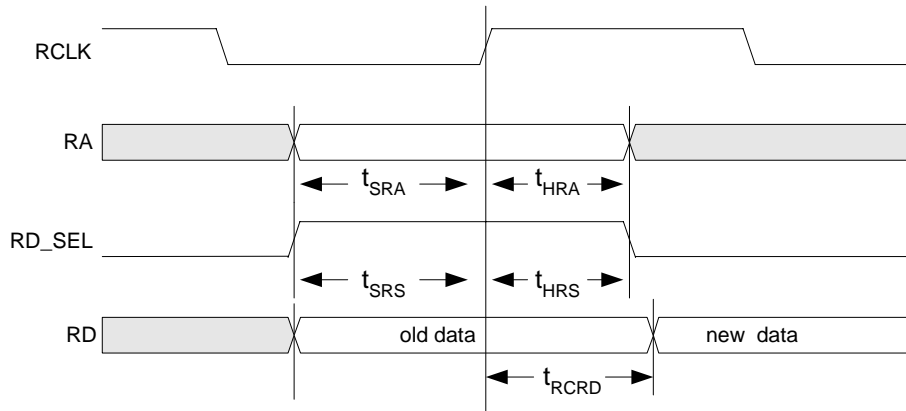


Table 39: RAM Cell Synchronous Read Timing

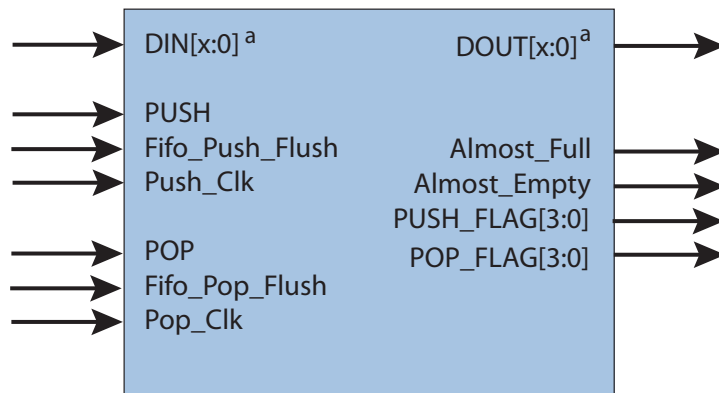
| Symbol           | Parameter  | Commercial |         | Industrial |         |
|------------------|--|------------|---------|------------|---------|
|                  |  | Min.       | Max.    | Min.       | Max.    |
| t <sub>SRA</sub> | RA setup time to RCLK: time the READ ADDRESS must be stable before the active edge of the READ CLOCK         | 0.29 ns    | 1.10 ns | 0.31 ns    | 1.28 ns |
| t <sub>HRA</sub> | RA hold time to RCLK: time the READ ADDRESS must be stable after the active edge of the READ CLOCK           | 0 ns       | 0.21 ns | 0 ns       | 0.20 ns |
| t <sub>SRS</sub> | RD_SEL setup time to RCLK: time the READ CHIP SELECT must be stable before the active edge of the READ CLOCK | 0.42 ns    | 1.10 ns | 0.49 ns    | 1.28 ns |
| t <sub>HRS</sub> | RD_SEL hold time to RCLK: time the READ CHIP SELECT must be stable after the active edge of the READ CLOCK   | 0 ns       | 0.04 ns | 0 ns       | 0.04 ns |
| t <sub>RCD</sub> | RCLK to RD: time between the active READ CLOCK edge and the time when the data is available at RD            | 2.62 ns    | 5.67 ns | 2.69 ns    | 5.88 ns |

Figure 33: RAM Cell Read Timing



## FIFO Timing

Figure 34: FIFO Module



a.  $x = \{1,2,3,\dots,35\}$ .

Table 40: FIFO PUSH Timing

| Symbol           | Parameter   | Commercial |         | Industrial |         |
|------------------|---|------------|---------|------------|---------|
|                  |   | Min.       | Max.    | Min.       | Max.    |
| $t_{SPUSHD}$     | DIN setup time to Push_Clk: time DIN must be stable before the active edge of the FIFO Push clock               | 0.31 ns    | 1.74 ns | 0.40 ns    | 2.21 ns |
| $t_{HPUSHD}$     | DIN hold time to Push_Clk: time DIN must be stable after the active edge of the FIFO Push clock                 | 0 ns       | 0.22 ns | 0 ns       | 0.17 ns |
| $t_{SPUSHEN}$    | PUSH setup time to Push_Clk: time PUSH must be stable before the active edge of the FIFO Push clock             | 1.07 ns    | 1.57 ns | 1.38 ns    | 2.0 ns  |
| $t_{HPUSHEN}$    | PUSH hold time to Push_Clk: time PUSH must be stable after the active edge of the FIFO Push clock               | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{SPUSHFLUSH}$ | FLUSH setup time to Push_Clk: time Fifo_Push_Flush must be stable before the active edge of the FIFO Push clock | 1.11 ns    | 1.74 ns | 1.43 ns    | 2.21 ns |
| $t_{HPUSHFLUSH}$ | FLUSH hold time to Push_Clk: time Fifo_Push_Flush must be stable after the active edge of the FIFO Push clock   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{COAF}$       | Clock-to-out of Almost Full   | 2.66 ns    | 3.34 ns | 2.72 ns    | 3.42 ns |
| $t_{COPUSHFLAG}$ | Clock-to-out of FIFO Push level indicator   | 2.36 ns    | 4.20 ns | 2.41 ns    | 4.32 ns |

Figure 35: FIFO PUSH Timing

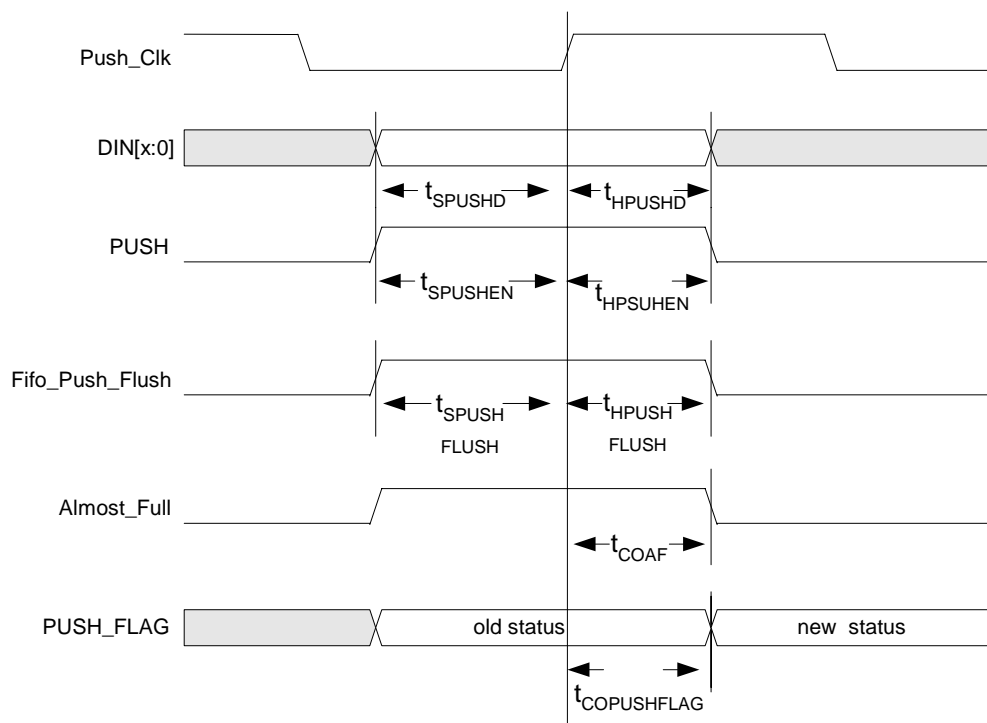
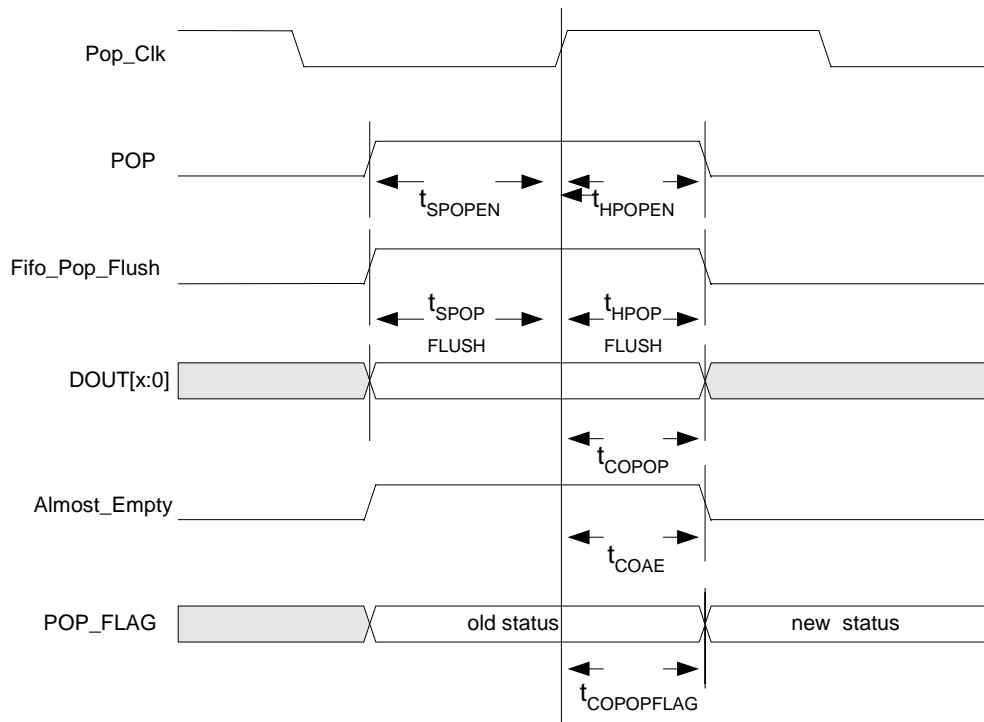


Table 41: FIFO POP Timing

| Symbol          | Parameter   | Commercial |         | Industrial |         |
|-----------------|---|------------|---------|------------|---------|
|                 |   | Min.       | Max.    | Min.       | Max.    |
| $t_{SPOPEN}$    | POP setup time to Pop_Clk: time POP must be stable before the active edge of the FIFO Pop clock                         | 1.01 ns    | 1.13 ns | 1.19 ns    | 1.32 ns |
| $t_{HPOPEN}$    | POP hold time to Pop_Clk: time POP must be stable after the active edge of the FIFO Pop clock                           | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{SPOPFLUSH}$ | FLUSH setup time to Pop_Clk: time Fifo_Pop_Flush must be stable before the active edge of the FIFO Pop clock            | 1.11 ns    | 1.74 ns | 1.43 ns    | 2.21 ns |
| $t_{HPOPFLUSH}$ | FLUSH hold time to Pop_Clk: time Fifo_Pop_Flush must be stable after the active edge of the FIFO Pop clock              | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{FPOP}$      | Pop_Clk to Pop: Clock-to-out from the active FIFO CLOCK edge and the time when the data is popped from the FIFO at DOUT | 2.32 ns    | 5.61 ns | 2.37 ns    | 5.88 ns |
| $t_{COAE}$      | Clock-to-out of Almost Empty  | 2.64 ns    | 3.58 ns | 2.70 ns    | 3.66 ns |
| $t_{COPOPFLAG}$ | Clock-to-out of FIFO Pop level indicator  | 2.32 ns    | 3.93 ns | 2.38 ns    | 4.03 ns |

Figure 36: FIFO POP Timing



## GPIO Cell Timing

Figure 37: PolarPro I/O Cell Output Path

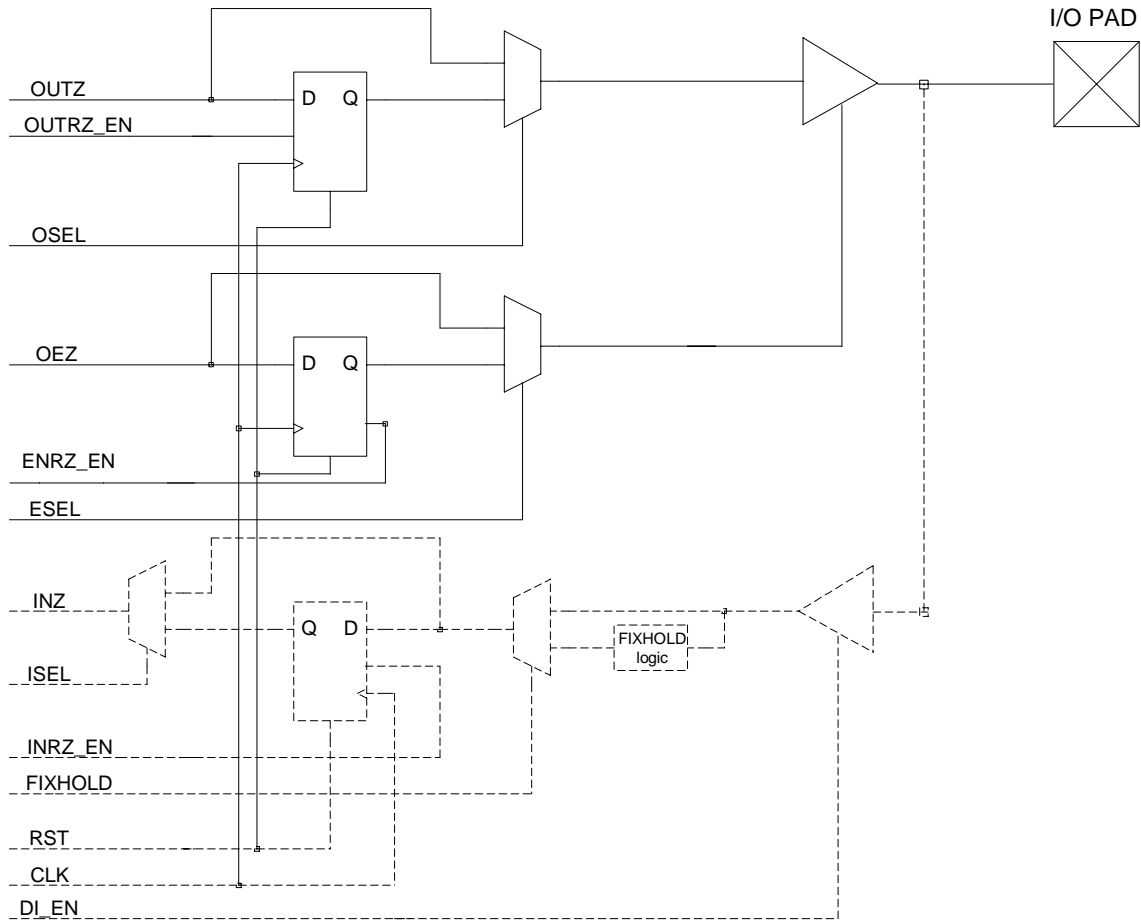


Figure 38: PolarPro I/O Cell Output Enable Timing

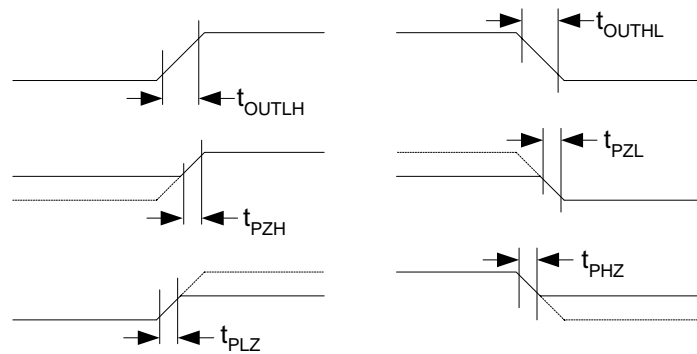




Table 42: Output Timing Characteristics @ VCCIO = 3.3 V, T = 25° C

| Symbol             | Parameter                                 | Value (ns)        |                   |
|--------------------|---|-------------------|-------------------|
|                    |   | Slowest Slew Max. | Fastest Slew Max. |
| t <sub>OUTLH</sub> | Output Delay low to high (90% of H)       | 8.10              | 1.00              |
| t <sub>OUTH</sub>  | Output Delay high to low (10% of L)       | 9.60              | 0.90              |
| t <sub>PZH</sub>   | Output Delay tri-state to high (90% of H) | 3.40              | 0.30              |
| t <sub>PZL</sub>   | Output Delay tri-state to low (10% of L)  | 3.90              | 0.30              |
| t <sub>PHZ</sub>   | Output Delay high to tri-state            | 3.60              | 0.36              |
| t <sub>PLZ</sub>   | Output Delay low to tri-state             | 4.1               | 0.41              |

Table 43: Output Timing Characteristics @ VCCIO = 2.5 V, T = 25° C

| Symbol             | Parameter                                 | Value (ns)        |                   |
|--------------------|---|-------------------|-------------------|
|                    |   | Slowest Slew Max. | Fastest Slew Max. |
| t <sub>OUTLH</sub> | Output Delay low to high (90% of H)       | 12.20             | 1.10              |
| t <sub>OUTH</sub>  | Output Delay high to low (10% of L)       | 18.80             | 1.00              |
| t <sub>PZH</sub>   | Output Delay tri-state to high (90% of H) | 4.50              | 0.45              |
| t <sub>PZL</sub>   | Output Delay tri-state to low (10% of L)  | 8.40              | 0.52              |
| t <sub>PHZ</sub>   | Output Delay high to tri-state            | 8.10              | 0.52              |
| t <sub>PLZ</sub>   | Output Delay low to tri-state             | 5.30              | 0.53              |

Table 44: Output Timing Characteristics @ VCCIO = 1.8 V, T = 25° C

| Symbol             | Parameter                                 | Value (ns)        |                   |
|--------------------|---|-------------------|-------------------|
|                    |   | Slowest Slew Max. | Fastest Slew Max. |
| t <sub>OUTLH</sub> | Output Delay low to high (90% of H)       | 2.50              | 2.20              |
| t <sub>OUTH</sub>  | Output Delay high to low (10% of L)       | 1.70              | 1.40              |
| t <sub>PZH</sub>   | Output Delay tri-state to high (90% of H) | 8.30              | 0.70              |
| t <sub>PZL</sub>   | Output Delay tri-state to low (10% of L)  | 24.70             | 1.05              |
| t <sub>PHZ</sub>   | Output Delay high to tri-state            | 23.50             | 1.25              |
| t <sub>PLZ</sub>   | Output Delay low to tri-state             | 10.80             | 0.78              |

Table 45 lists the typical output slew rates (in V/ns) across three levels of output voltages, with a drive strength of 4, and a load capacitor of 10 pF.

Table 45: GPIO Output Slew Rate

| Slew  | Output Slew Rate (V/ns) at VCCIO = |       |       |
|-------|------------------------------------|-------|-------|
|       | 1.8 V                              | 2.5 V | 3.3 V |
| slow  | n/a                                | 0.20  | 0.36  |
| fast  | n/a                                | 0.31  | 0.66  |
| vfast | 0.17                               | 0.61  | 1.32  |
| wow   | 0.25                               | 1.18  | 2.03  |

Table 46: I/O Output Register Cell Timing

| Symbol      | Parameter   | Commercial |         | Industrial |         |
|-------------|---|------------|---------|------------|---------|
|             |   | Min.       | Max.    | Min.       | Max.    |
| $t_{OSU}$   | Output register setup time: time the synchronous OUTZ input of the flip-flop must be stable before the active clock edge        | 0.33 ns    | 0.38 ns | 0.34 ns    | 0.36 ns |
| $t_{OHL}$   | Output register hold time: time the synchronous OUTZ input of the flip-flop must be stable after the active clock edge          | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OCO}$   | Output register clock-to-out: time taken by the flip-flop to output after the active clock edge                                 | 5.25 ns    | 5.99 ns | 5.46 ns    | 6.29 ns |
| $t_{ORST}$  | Output register reset delay: time between when the flip-flop is “reset” (low) and when the output is consequently “reset” (low) | 5.85 ns    | 5.85 ns | 6.03 ns    | 6.03 ns |
| $t_{OESU}$  | Output register clock enable setup time: time OUTRZ_EN must be stable before the active clock edge                              | 0.33 ns    | 0.51 ns | 0.30 ns    | 0.54 ns |
| $t_{OEH}$   | Output register clock enable hold time: time OUTRZ_EN must be stable after the active clock edge                                | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OEZSU}$ | Output register clock enable setup time: time OEZ must be stable before the active clock edge                                   | 0.14 ns    | 0.20 ns | 0.15 ns    | 0.18 ns |
| $t_{OEZH}$  | Output register clock enable hold time: time OEZ must be stable after the active clock edge                                     | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OPD}$   | Output signal propagation delay: propagation delay of OUTZ to the output pad  | 4.82 ns    | 5.44 ns | 5.03 ns    | 5.72 ns |

Figure 39: PolarPro I/O Cell Input Path

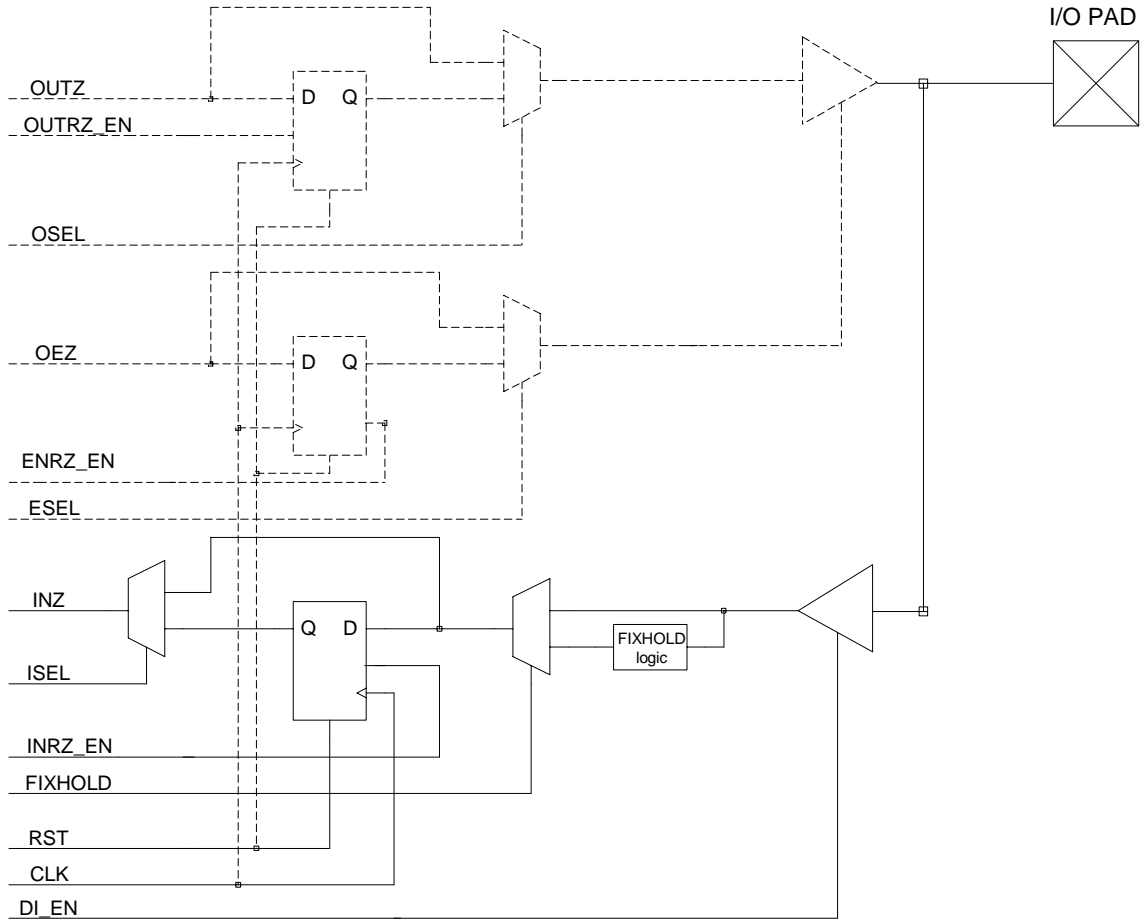


Figure 40: PolarPro Input Register Cell Timing

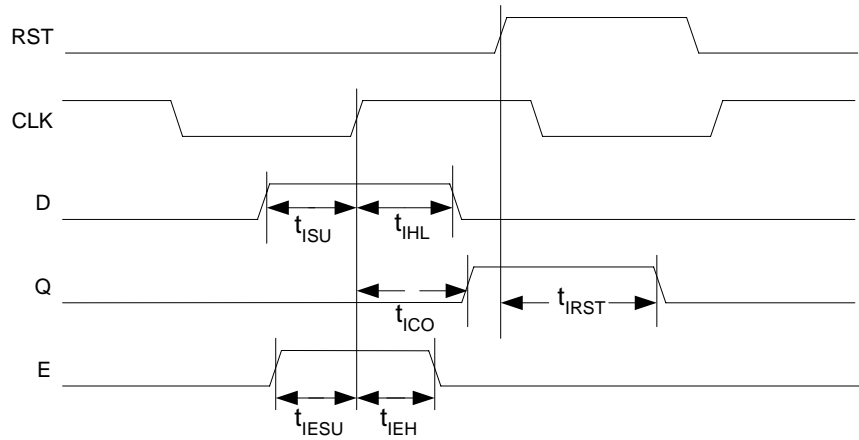


Table 47: I/O Input Register Cell Timing

| Symbol       | Parameter  | Commercial |         | Industrial |         |
|--------------|--|------------|---------|------------|---------|
|              |  | Min.       | Max.    | Min.       | Max.    |
| $t_{ISU}$    | Input register setup time: time the synchronous input of the flip-flop must be stable before the active clock edge             | 2.51 ns    | 2.85 ns | 2.80 ns    | 2.82 ns |
| $t_{IHL}$    | Input register hold time: time the synchronous input of the flip-flop must be stable after the active clock edge               | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{ICO}$    | Input register clock-to-out: time taken by the flip-flop to output after the active clock edge                                 | 1.68 ns    | 2.66 ns | 1.58 ns    | 2.70 ns |
| $t_{IRST}$   | Input register reset delay: time between when the flip-flop is “reset” (low) and when the output is consequently “reset” (low) | 1.59 ns    | 1.59 ns | 1.53 ns    | 1.53 ns |
| $t_{IESU}$   | Input register clock enable setup time: time INRZ_EN must be stable before the active clock edge                               | 0.25 ns    | 0.40 ns | 0.23 ns    | 0.43 ns |
| $t_{IEH}$    | Input register clock enable hold time: time INRZ_EN must be stable after the active clock edge                                 | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{DIENSU}$ | Input data enable setup time: time DI_EN must be stable before the active clock edge   | 2.39 ns    | 5.38 ns | 2.28 ns    | 5.63 ns |
| $t_{DIENH}$  | Input data enable hold time: time DI_EN must be stable after the active clock edge   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{IFHSU}$  | Input fixhold setup time: time FIXHOLD must be stable before the active clock edge   | 2.39 ns    | 5.38 ns | 2.28 ns    | 5.63 ns |
| $t_{IFHH}$   | Input fixhold hold time: time FIXHOLD must be stable after the active clock edge   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |

Table 48: I/O Input Buffer Delays

| Symbol               | Parameter  | Value |      |
|----------------------|--|-------|------|
|                      |  | Min.  | Max. |
| $t_{SID}$ (LVTTTL)   | LVTTTL input delay: Low Voltage TTL for 3.3 V applications             | TBD   | TBD  |
| $t_{SID}$ (LVCMOS2)  | LVCMOS2 input delay: Low Voltage CMOS for 2.5 V and lower applications | TBD   | TBD  |
| $t_{SID}$ (LVCMOS18) | LVCMOS18 input delay: Low Voltage CMOS for 1.8 V applications          | TBD   | TBD  |
| $t_{SID}$ (GTL+)     | GTL+ input delay: Gunning Transceiver Logic                            | TBD   | TBD  |
| $t_{SID}$ (SSTL3)    | SSTL3 input delay: Stub Series Terminated Logic for 3.3 V              | TBD   | TBD  |
| $t_{SID}$ (SSTL2)    | SSTL2 input delay: Stub Series Terminated Logic for 2.5 V              | TBD   | TBD  |
| $t_{SID}$ (PCI)      | PCI input delay: Peripheral Component Interconnect for 3.3 V           | TBD   | TBD  |

## DDR Cell Timing

Figure 41: DDRIO DQ Configuration

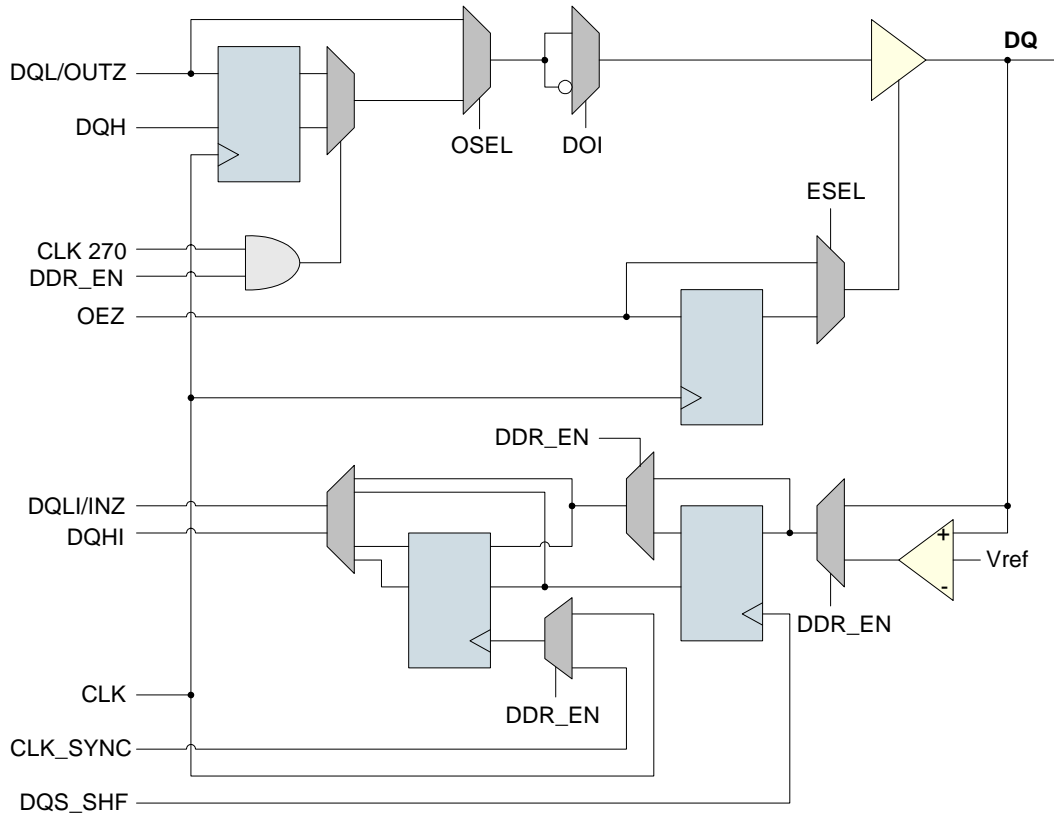


Table 49: DQ Cell Timing

| Symbol       | Parameter   | Commercial |         | Industrial |         |
|--------------|---|------------|---------|------------|---------|
|              |   | Min.       | Max.    | Min.       | Max.    |
| $t_{DQLSU}$  | Output register setup time: time the synchronous DQL input of the flip-flop must be stable before the active clock edge | 0.37 ns    | 0.38 ns | 0.35 ns    | 0.39 ns |
| $t_{DQLH}$   | Output register hold time: time the synchronous DQL input of the flip-flop must be stable after the active clock edge   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OCO}$    | Output register clock-to-out: time taken by the DQL flip-flop to output to the DQ pad after the active clock edge       | 4.13 ns    | 4.39 ns | 4.48 ns    | 4.85 ns |
| $t_{ODQHSU}$ | Output higher bit register clock setup time: time DQH must be stable before the active clock edge                       | 0.32 ns    | 0.34 ns | 0.31 ns    | 0.35 ns |
| $t_{ODQHH}$  | Output higher bit register clock hold time: time DQH must be stable after the active clock edge                         | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OPD}$    | Output propagation delay: propagation time from DQL to the output pad   | 3.64 ns    | 3.92 ns | 4.17 ns    | 4.20 ns |

Table 49: DQ Cell Timing (Continued)

| Symbol     | Parameter  | Commercial |         | Industrial |         |
|------------|--|------------|---------|------------|---------|
|            |  | Min.       | Max.    | Min.       | Max.    |
| $t_{DQSU}$ | Input register setup time: time DQ must be stable before the active clock edge | 1.45 ns    | 1.48 ns | 1.24 ns    | 1.69 ns |
| $t_{DQH}$  | Input register hold time: time DQ must be stable after the active clock edge   | 0.62 ns    | 0.65 ns | 0.47 ns    | 0.83 ns |
| $t_{IPD}$  | Input propagation delay: propagation time from DQ to DQLI                      | 2.35 ns    | 2.63 ns | 2.19 ns    | 2.75 ns |

Table 50: DQ Cell Configured as a GPIO Timing

| Symbol     | Parameter  | Commercial |         | Industrial |         |
|------------|--|------------|---------|------------|---------|
|            |  | Min.       | Max.    | Min.       | Max.    |
| $t_{OSU}$  | Output register setup time: time the synchronous OUTZ input of the flip-flop must be stable before the active clock edge | 0.37 ns    | 0.38 ns | 0.35 ns    | 0.39 ns |
| $t_{OH}$   | Output register hold time: time the synchronous OUTZ input of the flip-flop must be stable after the active clock edge   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OCO}$  | Output register clock-to-out: time taken by the OUTZ flip-flop to output to the output pad after the active clock edge   | 4.17 ns    | 4.43 ns | 4.61 ns    | 4.80 ns |
| $t_{OESU}$ | Output data enable setup time: time OENZ must be stable before the active clock edge                                     | 0.43 ns    | 0.54 ns | 0.42 ns    | 0.55 ns |
| $t_{OEH}$  | Output data enable hold time: time OENZ must be stable after the active clock edge                                       | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OESU}$ | Output register clock enable setup time: time OUTRZ_EN must be stable before the active clock edge                       | 0.38 ns    | 0.64 ns | 0.35 ns    | 0.67 ns |
| $t_{OEH}$  | Output register clock enable hold time: time OUTRZ_EN must be stable after the active clock edge                         | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OPD}$  | Output propagation delay: propagation time from OUTZ to the output pad   | 3.65 ns    | 3.87 ns | 4.06 ns    | 4.24 ns |
| $t_{ISU}$  | Input register setup time: time the synchronous input of the flip-flop must be stable before the active clock edge       | 2.54 ns    | 2.63 ns | 2.46 ns    | 2.62 ns |
| $t_{IHL}$  | Input register hold time: time the synchronous input of the flip-flop must be stable after the active clock edge         | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{ICO}$  | Input register clock-to-out: time taken by the flip-flop to output to INZ after the active clock edge                    | 2.88 ns    | 3.12 ns | 2.73 ns    | 3.21 ns |
| $t_{IESU}$ | Input register clock enable setup time: time INRZ_EN must be stable before the active clock edge                         | 0.26 ns    | 0.55 ns | 0.23 ns    | 0.58 ns |
| $t_{IEH}$  | Input register clock enable hold time: time INRZ_EN must be stable after the active clock edge                           | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{IPD}$  | Input propagation delay: propagation time from the input pad to INZ  | 2.35 ns    | 3.12 ns | 2.19 ns    | 3.21 ns |

Figure 42: DDRIO DQS Configuration

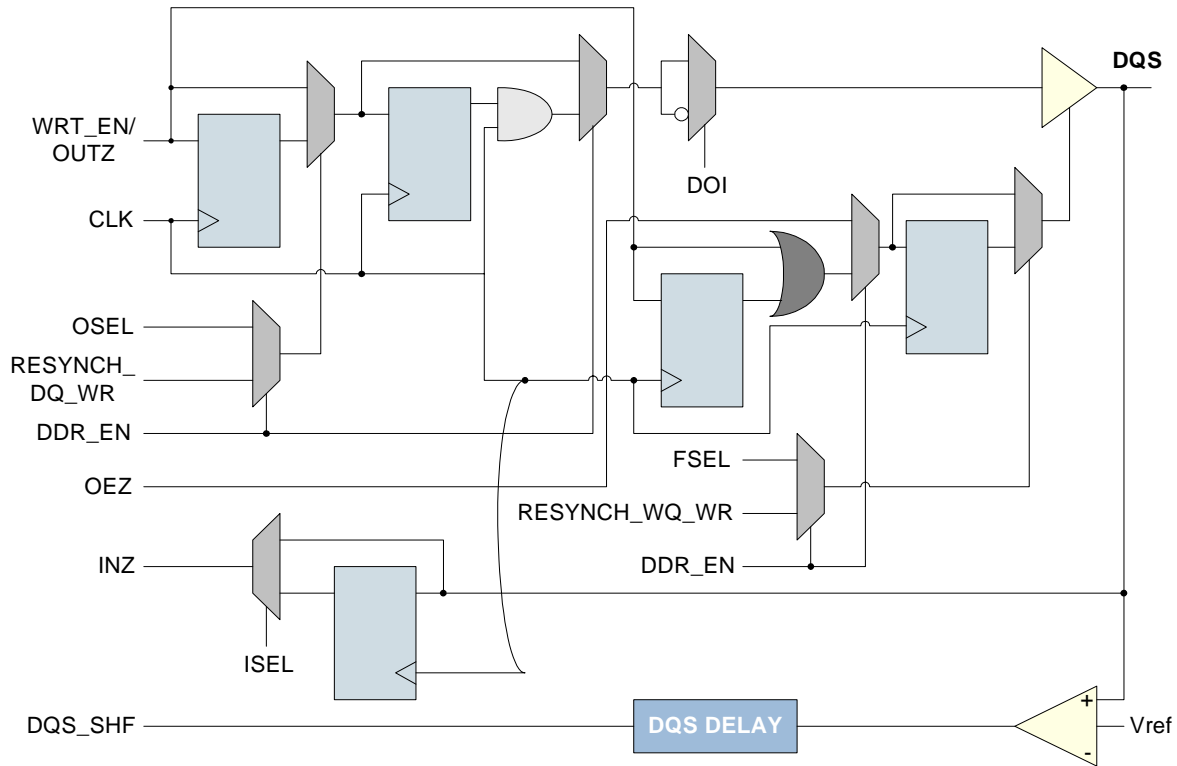


Table 51: DQS Cell Timing

| Symbol       | Parameter  | Commercial |         | Industrial |         |
|--------------|--|------------|---------|------------|---------|
|              |  | Min.       | Max.    | Min.       | Max.    |
| $t_{WESU}$   | Output register setup time: time the synchronous WRT_EN input of the flip-flop must be stable before the active clock edge | 0.61 ns    | 0.64 ns | 0.61 ns    | 0.64 ns |
| $t_{WEH}$    | Output register hold time: time the synchronous WRT_EN input of the flip-flop must be stable after the active clock edge   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{WEPD}$   | Output propagation delay: propagation time from WRT_EN to the output pad   | 3.56 ns    | 3.62 ns | 3.85 ns    | 3.99 ns |
| $t_{IDQSPD}$ | Input propagation delay: propagation time from DQS to DQS_SHF  | 1.58 ns    | 3.53 ns | 1.37 ns    | 3.77 ns |

Table 52: DQS Cell Configured as a GPIO Timing

| Symbol     | Parameter  | Commercial |         | Industrial |         |
|------------|--|------------|---------|------------|---------|
|            |  | Min.       | Max.    | Min.       | Max.    |
| $t_{OSU}$  | Output register setup time: time the synchronous OUTZ input of the flip-flop must be stable before the active clock edge | 0.47 ns    | 0.48 ns | 0.45 ns    | 0.50 ns |
| $t_{OH}$   | Output register hold time: time the synchronous OUTZ input of the flip-flop must be stable after the active clock edge   | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OCO}$  | Output register clock-to-out: time taken by the OUTZ flip-flop to output to the output pad after the active clock edge   | 4.14 ns    | 4.46 ns | 4.66 ns    | 4.77 ns |
| $t_{OESU}$ | Output data enable setup time: time OEZ must be stable before the active clock edge                                      | 0.47 ns    | 0.49 ns | 0.49 ns    | 0.49 ns |
| $t_{OEH}$  | Output data enable hold time: time OEZ must be stable after the active clock edge  | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OESU}$ | Output register clock enable setup time: time OUTRZ_EN must be stable before the active clock edge                       | 0.35 ns    | 0.66 ns | 0.33 ns    | 0.77 ns |
| $t_{OEH}$  | Output register clock enable hold time: time OUTRZ_EN must be stable after the active clock edge                         | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{OPD}$  | Output propagation delay: propagation time from OUTZ to the output pad   | 3.88 ns    | 4.13 ns | 4.41 ns    | 4.42 ns |
| $t_{ISU}$  | Input register setup time: time the synchronous input of the flip-flop must be stable before the active clock edge       | 2.38 ns    | 2.45 ns | 2.47 ns    | 2.29 ns |
| $t_{IHL}$  | Input register hold time: time the synchronous input of the flip-flop must be stable after the active clock edge         | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{ICO}$  | Input register clock-to-out: time taken by the flip-flop to output to INZ after the active clock edge                    | 2.76 ns    | 2.78 ns | 2.73 ns    | 3.21 ns |
| $t_{IESU}$ | Input register clock enable setup time: time INRZ_EN must be stable before the active clock edge                         | 0.40 ns    | 0.71 ns | 0.23 ns    | 0.58 ns |
| $t_{IEH}$  | Input register clock enable hold time: time INRZ_EN must be stable after the active clock edge                           | 0 ns       | 0 ns    | 0 ns       | 0 ns    |
| $t_{IPD}$  | Input propagation delay: propagation time from the input pad to INZ  | 2.25 ns    | 2.78 ns | 2.19 ns    | 3.21 ns |



## Package Thermal Characteristics

The PolarPro device is available for Commercial (0°C to 85°C Junction), Industrial (-40°C to 100°C Junction), and Military (-55°C to 125°C Junction) temperature ranges.

Thermal Resistance Equations:

$$\theta_{JA} = (T_J - T_A) / P$$

$$P_{MAX} = (T_{JMAX} - T_{AMAX}) / \theta_{JA}$$

Parameter Description:

$\theta_{JA}$ : Junction-to-ambient thermal resistance

$T_J$ : Junction temperature

$T_A$ : Ambient temperature

P: Power dissipated by the device while operating

$P_{MAX}$ : The maximum power dissipation for the device

$T_{JMAX}$ : Maximum junction temperature

$T_{AMAX}$ : Maximum ambient temperature

**NOTE:** Maximum junction temperature ( $T_{JMAX}$ ) is 125°C. To calculate the maximum power dissipation for a device package look up  $\theta_{JA}$  from **Table 53**, pick an appropriate  $T_{AMAX}$  and use:

$$P_{MAX} = (125^\circ\text{C} - T_{AMAX}) / \theta_{JA}$$

Table 53: Package Thermal Characteristics

| Package Description |              |                          |           | Theta-JA (° C/W) |         |         |
|---------------------|--------------|--------------------------|-----------|------------------|---------|---------|
| Device              | Package Code | Package Type             | Pin Count | 0 LFM            | 200 LFM | 400 LFM |
| QL1P075             | PU           | TFBGA                    | 132       | 55               | 48      | 46      |
|                     | PF           | TQFP                     | 144       | 50               | 44      | 42      |
|                     | PT           | TFBGA<br>(12 mm x 12 mm) | 196       | 42.0             | 35.0    | 33.5    |
|                     | PS           | LBGA                     | 256       | 48.2             | 41.7    | 40.2    |
| QL1P100             | PU           | TFBGA                    | 121       | 54               | 47      | 45      |
|                     | PU           | TFBGA                    | 132       | 55               | 48      | 46      |
|                     | PF           | TQFP                     | 144       | 50               | 44      | 42      |
|                     | PT           | TFBGA<br>(12 mm x 12 mm) | 196       | 42.0             | 35.0    | 33.5    |
|                     | PS           | LBGA                     | 256       | 48.2             | 41.7    | 40.2    |
| QL1P200             | PU           | TFBGA                    | 132       | 44               | 37      | 35      |
|                     | PS           | LBGA                     | 256       | 35.5             | 29.0    | 27.7    |
| QL1P300             | WU           | WLCSP                    | 99        | 31               | 27      | 25      |
|                     | PU           | TFBGA                    | 132       | 44               | 37      | 35      |
|                     | PS           | LBGA                     | 256       | 35.5             | 29.0    | 27.7    |

## Moisture Sensitivity Level

All PolarPro devices are Moisture Sensitivity Level 3.

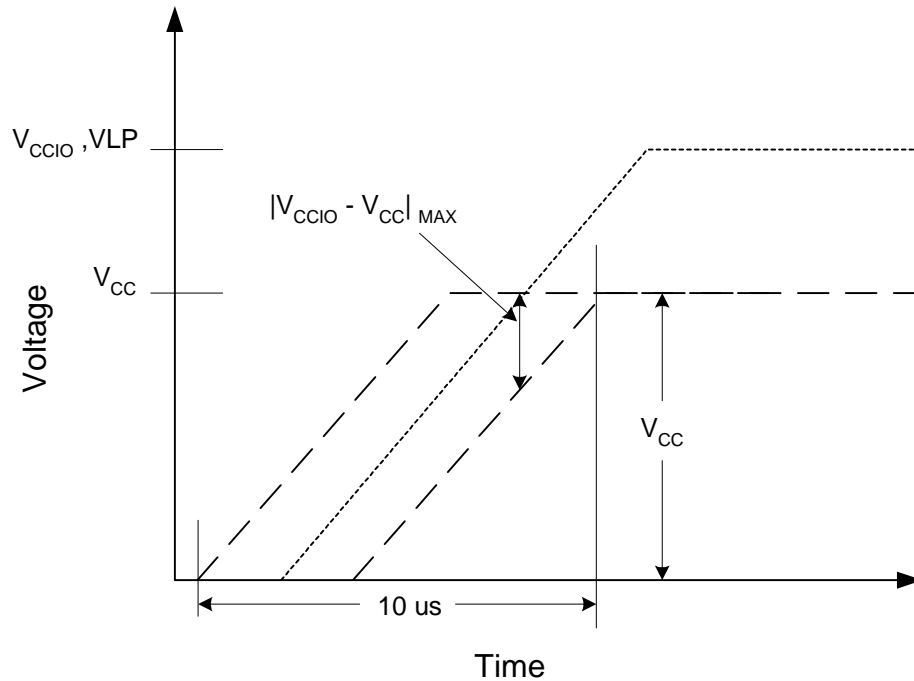
Table 54: Solder and Lead Finish Composition

|                 | Lead Included  | Lead-Free                    |
|-----------------|----------------|------------------------------|
| BGA Solder      | 63% Pb, 37% Sn | Sn3AgCu:Sn4AgCu <sup>a</sup> |
| QFP Lead Finish | 85% Pb, 15% Sn | Sn (matte)                   |

a. Sn3AgCu:Sn4AgCu means that Ag can range from 3% to 4%. Cu is always 0.5%.

## Power-Up Sequencing

Figure 43: Power-Up Sequencing



**Figure 43** shows an example where all  $V_{CCIO} = 3.3$  V. When powering up a PolarPro device,  $V_{CC}$ ,  $V_{CCIO}$  rails must take 10  $\mu s$  or longer to reach the maximum value (refer to **Figure 43**). Ramping  $V_{CC}$  and  $V_{CCIO}$  faster than 10  $\mu s$  can cause the device to behave improperly.

It is also important to ensure  $V_{CCIO}$  and  $V_{LP}$  are within 500 mV of  $V_{CC}$  when ramping up the power supplies. In the case where  $V_{CCIO}$  or  $V_{LP}$  are greater than  $V_{CC}$  by more than 500 mV an additional current draw can occur as  $V_{CC}$  passes its threshold voltage. In a case where  $V_{CC}$  is greater than  $V_{CCIO}$  by more than 500 mV the protection diodes between the power supplies become forward biased. If this occurs then there will be an additional current load on the power supply. Having the diodes on can cause a reliability problem, since it can wear out the diodes and subsequently damage the internal transistors. As noted in the  $V_{LP}$  section, during the transition from  $V_{LP}$  mode to normal operation, the  $V_{LP}$  pin can draw up to 1.5 mA. Consequently, if using a pull-up resistor, use a pull-up resistor with a value that is less than 2  $K\Omega$ .

## Programming Stipulation

For PolarPro devices to correctly program, there must not be any race conditions or internally generated free-running oscillators in the design. This will cause an ICC programming failure during the programming process. QuickLogic cannot guarantee the operation of any device that fails programming. Therefore, race conditions and free-running oscillators must be removed from designs so that PolarPro devices can correctly pass programming.

## Pin Descriptions

Table 55: Pin Descriptions

| Pin                               | Direction | Function   | Description  |
|-----------------------------------|-----------|--|--|
| <b>Dedicated Pin Descriptions</b> |           |  |  |
| GPIO(C:A)                         | I/O       | General purpose input/output pin   | The I/O pin is a bi-directional pin, configurable to either an input-only, output-only, or bi-directional pin. The letter inside the parenthesis means that the I/O is located in the bank with that letter. If an I/O is not used, the development software provides the option of tying that pin to GND, VCCIO, or Hi-Z.   |
| CLK(C:A)                          | I         | Global clock network pin low skew global clock                                     | This pin provides access to a distributed network capable of driving the CLOCK, SET, RESET, all inputs to the Logic Cell, READ and WRITE CLOCKS, Read and Write Enables of the Embedded RAM Blocks, and I/O inputs. The voltage tolerance of this pin is specified by VCCIO(C:A).  |
| DEDCLK(D)                         | I         | Dedicated clock network pin low skew clock   | This pin provides access to a distributed network capable of driving the CLOCK, SET, RESET, all inputs to the Logic Cell, READ and WRITE CLOCKS, Read and Write Enables of the Embedded RAM Blocks, and I/O inputs. The voltage tolerance of this pin is specified by VCCIO(D).  |
| CCMIN(1:0)                        | I         | CCM clock input  | Input clock for CCM. The voltage tolerance for this pin is specified by the VCCIO of the same bank.  |
| CCMVCC (1:0)                      | I         | Power supply pin for CCM   | CCM input voltage level. Configurable as 1.8 V only.   |
| CCMGND(1:0)                       | I         | Ground pin for CCM   | Connect to ground.   |
| VLP                               | I         | Voltage low power  | Active low. Therefore, when VLP pin is low, the device will go into low power mode. Tie VLP to 3.3 V to disable low power mode.  |
| VCC                               | I         | Power supply pin   | Connect to 1.8 V supply.   |
| VCCIO(D:A)                        | I         | Input voltage tolerance pin  | This pin provides the flexibility to interface the device with either a 3.3 V, 2.5 V, or 1.8 V device. The letter inside the parenthesis means that the VCCIO is located in the bank with that letter. Every I/O pin in the same bank will be tolerant of the same VCCIO input signals and will drive VCCIO level output signals. This pin must be connected to either 3.3 V, 2.5 V, or 1.8 V. |
| GND                               | I         | Ground pin   | Connect to ground.   |
| DQ <sup>a</sup> /<br>GPIO(D)      | I/O       | Configurable pin can be declared as either a DDRIO DQ or as a general purpose I/O  | The D inside the parenthesis means that the I/O is located in Bank D. If an I/O is not used, the development software provides the option of tying that pin to GND, VCCIO, or Hi-Z.  |
| DQS <sup>a</sup> /<br>GPIO(D)     | I/O       | Configurable pin can be declared as either a DDRIO DQS or as a general purpose I/O | The D inside the parenthesis means that the I/O is located in Bank D. If an I/O is not used, the development software provides the option of tying that pin to GND, VCCIO, or Hi-Z.  |

Table 55: Pin Descriptions (Continued)

| Pin                              | Direction | Function  | Description   |
|----------------------------------|-----------|---|---|
| DQCK_N <sup>a</sup> /<br>GPIO(D) | I/O       | Configurable pin can be declared as either a DDRIO DQ, DDR negative clock, or as a general purpose I/O. | The D inside the parenthesis means that the I/O is located in Bank D. If an I/O is not used, the development software provides the option of tying that pin to GND, VCCIO, or Hi-Z.                               |
| DQCK_P <sup>a</sup> /<br>GPIO(D) | I/O       | Configurable pin can be declared as either a DDRIO DQ, DDR positive clock, or as a general purpose I/O. | The D inside the parenthesis means that the I/O is located in Bank D. If an I/O is not used, the development software provides the option of tying that pin to GND, VCCIO, or Hi-Z.                               |
| VREF(D)                          | I         | Differential reference voltage  | The INREF is the reference voltage pin for the SSTL1.8 and SSTL2 standards. The D inside the parenthesis means that INREF is located in Bank D. Tie this pin to GND if voltage referenced standards are not used. |
| JTAG Pin Descriptions            |           |   |   |
| TDI/RSI                          | I         | Test data in for JTAG/RAM init. serial data in  | Hold HIGH during normal operation. Connect to VCCIO(B) if unused.   |
| TRSTB                            | I         | Active low reset for JTAG   | Hold LOW during normal operation. Connect to GND if unused. During JTAG, a high voltage is based on VCCIO(B).   |
| TMS                              | I         | Test mode select for JTAG   | Hold HIGH during normal operation. Connect to VCCIO(B) if not used for JTAG.  |
| TCK                              | I         | Test clock for JTAG   | Hold HIGH or LOW during normal operation. Connect to VCCIO(B) or GND if not used for JTAG.  |
| TDO                              | O         | Test data out for JTAG  | Must be left unconnected if not used for JTAG. The output voltage drive is specified by VCCIO(B).   |

a. The number following the DDRIO signal names in the pinout tables indicates the DDRIO set the pin corresponds to.

## Recommended Unused Pin Terminations for PolarPro Devices

All unused, general purpose I/O pins can be tied to VCCIO, GND, or Hi-Z (high impedance) internally. By default, QuickLogic QuickWorks software ties unused I/Os to GND.

Terminate the rest of the pins at the board level as recommended in **Table 56**.

Table 56: Recommended Unused Pin Terminations

| Signal Name          | Recommended Termination  |
|----------------------|--|
| VREF                 | If an I/O bank does not require the use of the INREF signal, connect the pin to GND.   |
| CLK <x> <sup>a</sup> | Connect to GND or VCCIO(x) if unused.  |
| VLP                  | Tie VLP to 3.3 V to disable low power mode.  |
| CCMVCC(1:0)          | If a CCM is not used, the corresponding CCMVCC may be tied to GND to reduce power consumption. If a CCM is used, do not try to disable the CCM by tying the CCMVCC to GND. |
| TDI                  | Connect to VCCIO(B) if not used for JTAG.  |
| TRSTB                | Connect to GND if not used for JTAG.   |
| TMS                  | Connect to VCCIO(B) if not used for JTAG   |
| TCK                  | Connect to VCCIO(B) or GND if not used for JTAG.   |
| TDO                  | Must be left unconnected if not used for JTAG.   |

a. x represents A, B, C or D.

## Packaging Pinout Tables

### PolarPro QL1P075 - 132 TFBA Pinout Table

Table 57: QL1P075 – 132 TFBA Pinout Table

| Pin | Function        | Pin | Function    | Pin | Function        | Pin | Function |
|-----|-----------------|-----|-------------|-----|-----------------|-----|----------|
| A1  | VCC             | D7  | DQ3/GPIO(D) | H1  | CLK(C)          | L9  | GPIO(B)  |
| A2  | VCCIO(D)        | D8  | DQ3/GPIO(D) | H3  | TCK             | L10 | GPIO(B)  |
| A3  | DQS2/GPIO(D)    | D9  | DQ3/GPIO(D) | H4  | GPIO(C)         | L11 | GPIO(A)  |
| A4  | DQCK_P2/GPIO(D) | D10 | DQ3/GPIO(D) | H6  | GND             | L12 | GPIO(A)  |
| A5  | DQCK_N2/GPIO(D) | D11 | GPIO(A)     | H7  | GND             | L14 | GPIO(A)  |
| A6  | DQ2/GPIO(D)     | D12 | GPIO(A)     | H8  | GND             | M1  | VCC      |
| A7  | DEDCLK(D)       | D14 | VCCIO(A)    | H9  | GND             | M3  | GPIO(B)  |
| A8  | DQ3/GPIO(D)     | E1  | VCCIO(C)    | H11 | GPIO(A)         | M4  | GPIO(B)  |
| A9  | DQS3/GPIO(D)    | E3  | GPIO(C)     | H12 | GPIO(A)         | M5  | GPIO(B)  |
| A10 | DQCK_P3/GPIO(D) | E4  | DQ2/GPIO(D) | H14 | VCC             | M6  | GPIO(B)  |
| A11 | DQCK_N3/GPIO(D) | E11 | GPIO(A)     | J1  | GPIO(C)         | M7  | GPIO(B)  |
| A12 | VCCIO(D)        | E12 | GPIO(A)     | J3  | GPIO(C)         | M8  | VCC      |
| A13 | GND             | E14 | GPIO(A)     | J4  | GPIO(C)         | M9  | GPIO(B)  |
| A14 | VCC             | F1  | VCC         | J6  | GPIO(C)         | M10 | GPIO(B)  |
| B1  | VREF            | F3  | GPIO(C)     | J7  | GPIO(B)         | M11 | GPIO(B)  |
| B14 | CCMGND(1)       | F4  | GND         | J8  | GND             | M12 | GPIO(A)  |
| C1  | GPIO(C)         | F6  | TMS         | J9  | GPIO(A)         | M14 | VCCIO(A) |
| C3  | GPIO(C)         | F7  | GND         | J11 | GPIO(A)         | N1  | GND      |
| C4  | DQ2/GPIO(D)     | F8  | GND         | J12 | GPIO(A)         | N14 | VCC      |
| C5  | DQ2/GPIO(D)     | F9  | GPIO(A)     | J14 | CLK(A)/CCMIN(1) | P1  | VCCIO(B) |
| C6  | VCC             | F11 | GPIO(A)     | K1  | VCCIO(C)        | P2  | GPIO(B)  |
| C7  | DQ3/GPIO(D)     | F12 | GPIO(A)     | K3  | GPIO(C)         | P3  | TDO      |
| C8  | VCCIO(D)        | F14 | VCCIO(A)    | K4  | VCCIO(B)        | P4  | GPIO(B)  |
| C9  | DQ3/GPIO(D)     | G1  | VCC         | K11 | GPIO(A)         | P5  | VCCIO(B) |
| C10 | DQ3/GPIO(D)     | G3  | GPIO(C)     | K12 | TRSTB           | P6  | GPIO(B)  |
| C11 | VREF            | G4  | GPIO(C)     | K14 | VCCIO(B)        | P7  | CLK(B)   |
| C12 | CCMVCC(1)       | G6  | GND         | L1  | GPIO(C)         | P8  | CLK(B)   |
| C14 | GPIO(A)         | G7  | GND         | L3  | GPIO(C)         | P9  | VCC      |
| D1  | GPIO(C)         | G8  | GND         | L4  | GPIO(C)         | P10 | VCCIO(B) |
| D3  | GPIO(C)         | G9  | GND         | L5  | GPIO(C)         | P11 | GPIO(B)  |
| D4  | VCCIO(D)        | G11 | GPIO(A)     | L6  | GPIO(C)         | P12 | GPIO(B)  |
| D5  | DQ2/GPIO(D)     | G12 | GPIO(A)     | L7  | GPIO(B)         | P13 | VLP      |
| D6  | DQ3/GPIO(D)     | G14 | VCC         | L8  | TDI             | P14 | GND      |

## PolarPro QL1P075 - 144 TQFP Pinout Table

Table 58: QL1P075 – 144 TQFP Pinout Table

| Pin | Function | Pin | Function | Pin | Function        | Pin | Function        |
|-----|----------|-----|----------|-----|-----------------|-----|-----------------|
| 1   | VCCIO(C) | 37  | GND      | 73  | VCCIO(A)        | 109 | VCCIO(D)        |
| 2   | GPIO(C)  | 38  | GPIO(B)  | 74  | GPIO(A)         | 110 | VREF(D)         |
| 3   | GPIO(C)  | 39  | GPIO(B)  | 75  | GPIO(A)         | 111 | DQ3/GPIO(D)     |
| 4   | GPIO(C)  | 40  | TDO      | 76  | GPIO(A)         | 112 | DQ3/GPIO(D)     |
| 5   | GPIO(C)  | 41  | VCCIO(B) | 77  | GPIO(A)         | 113 | DQ3/GPIO(D)     |
| 6   | GPIO(C)  | 42  | GPIO(B)  | 78  | GPIO(A)         | 114 | DQ3/GPIO(D)     |
| 7   | GPIO(C)  | 43  | GPIO(B)  | 79  | VCCIO(B)        | 115 | DQCK_P3/GPIO(D) |
| 8   | GPIO(C)  | 44  | GPIO(B)  | 80  | GPIO(A)         | 116 | DQCK_N3/GPIO(D) |
| 9   | GPIO(C)  | 45  | GPIO(B)  | 81  | TRSTB           | 117 | DQS3/GPIO(D)    |
| 10  | GPIO(C)  | 46  | GPIO(B)  | 82  | GPIO(A)         | 118 | DQ3/GPIO(D)     |
| 11  | GPIO(C)  | 47  | GPIO(B)  | 83  | GPIO(A)         | 119 | DQ3/GPIO(D)     |
| 12  | GPIO(C)  | 48  | GPIO(B)  | 84  | CLK(A)/CCMIN(1) | 120 | DQ3/GPIO(D)     |
| 13  | VCC      | 49  | GPIO(B)  | 85  | GPIO(A)         | 121 | TMS             |
| 14  | GPIO(C)  | 50  | GPIO(B)  | 86  | VCCIO(A)        | 122 | DQ3/GPIO(D)     |
| 15  | GPIO(C)  | 51  | GPIO(B)  | 87  | GPIO(A)         | 123 | DQ3/GPIO(D)     |
| 16  | VCC      | 52  | TDI      | 88  | GPIO(A)         | 124 | VCC             |
| 17  | GPIO(C)  | 53  | CLK(B)   | 89  | GPIO(A)         | 125 | DEDCLK(D)       |
| 18  | GPIO(C)  | 54  | VCCIO(B) | 90  | VCC             | 126 | VCCIO(D)        |
| 19  | VCCIO(C) | 55  | VCC      | 91  | GPIO(A)         | 127 | DQ2/GPIO(D)     |
| 20  | GPIO(C)  | 56  | CLK(B)   | 92  | GPIO(A)         | 128 | DQ2/GPIO(D)     |
| 21  | GPIO(C)  | 57  | GPIO(B)  | 93  | VCC             | 129 | DQ2/GPIO(D)     |
| 22  | GPIO(C)  | 58  | VCC      | 94  | GPIO(A)         | 130 | DQ2/GPIO(D)     |
| 23  | CLK(C)   | 59  | GPIO(B)  | 95  | GPIO(A)         | 131 | DQCK_N2/GPIO(D) |
| 24  | TCK      | 60  | GPIO(B)  | 96  | GPIO(A)         | 132 | DQCK_P2/GPIO(D) |
| 25  | GPIO(C)  | 61  | GPIO(B)  | 97  | GPIO(A)         | 133 | DQS2/GPIO(D)    |
| 26  | GPIO(C)  | 62  | GPIO(B)  | 98  | GPIO(A)         | 134 | DQ2/GPIO(D)     |
| 27  | VCCIO(B) | 63  | GPIO(B)  | 99  | GPIO(A)         | 135 | DQ2/GPIO(D)     |
| 28  | GPIO(C)  | 64  | GPIO(B)  | 100 | GPIO(A)         | 136 | DQ2/GPIO(D)     |
| 29  | GPIO(C)  | 65  | GPIO(B)  | 101 | GPIO(A)         | 137 | DQ2/GPIO(D)     |
| 30  | GPIO(C)  | 66  | GPIO(B)  | 102 | GPIO(A)         | 138 | VREF(D)         |
| 31  | GPIO(C)  | 67  | GPIO(B)  | 103 | GPIO(A)         | 139 | DQ2/GPIO(D)     |
| 32  | GPIO(C)  | 68  | GPIO(B)  | 104 | CCMVCC(1)       | 140 | VCCIO(D)        |
| 33  | GPIO(C)  | 69  | VCCIO(B) | 105 | VCCIO(A)        | 141 | VCC             |
| 34  | VCCIO(C) | 70  | VLP      | 106 | CCMGND(1)       | 142 | VCCIO(D)        |
| 35  | GND      | 71  | GND      | 107 | GND             | 143 | GND             |
| 36  | GND      | 72  | GND      | 108 | GND             | 144 | GND             |



## PolarPro QL1P075 - 196 TFBGA (12 mm x 12 mm) Pinout Table

Table 59: QL1P075 – 196 TFBGA (12 mm x 12 mm) Pinout Table

| Pin | Function        | Pin | Function     | Pin | Function        | Pin | Function | Pin | Function |
|-----|-----------------|-----|--------------|-----|-----------------|-----|----------|-----|----------|
| A1  | DQS1/GPIO(D)    | C13 | DQ4/GPIO(D)  | F11 | GPIO(A)         | J9  | GND      | M7  | GPIO(B)  |
| A2  | DQCK_P1/GPIO(D) | C14 | DQ4/GPIO(D)  | F12 | GPIO(A)         | J10 | VCC      | M8  | GPIO(B)  |
| A3  | DQCK_N1/GPIO(D) | D1  | GPIO(C)      | F13 | GPIO(A)         | J11 | VCCIO(B) | M9  | GPIO(B)  |
| A4  | DQ2/GPIO(D)     | D2  | GND          | F14 | GPIO(A)         | J12 | GPIO(A)  | M10 | GPIO(B)  |
| A5  | DQ2/GPIO(D)     | D3  | DQ1/GPIO(D)  | G1  | GPIO(C)         | J13 | GPIO(A)  | M11 | GPIO(B)  |
| A6  | DQCK_P2/GPIO(D) | D4  | DQ1/GPIO(D)  | G2  | GPIO(C)         | J14 | GPIO(A)  | M12 | GPIO(A)  |
| A7  | DQCK_N2/GPIO(D) | D5  | DQ1/GPIO(D)  | G3  | GPIO(C)         | K1  | GPIO(C)  | M13 | GPIO(A)  |
| A8  | DQ3/GPIO(D)     | D6  | DQ2/GPIO(D)  | G4  | TCK             | K2  | GPIO(C)  | M14 | GPIO(A)  |
| A9  | DQCK_P3/GPIO(D) | D7  | DQ2/GPIO(D)  | G5  | VCC             | K3  | GPIO(C)  | N1  | GPIO(C)  |
| A10 | DQCK_N3/GPIO(D) | D8  | DQ2/GPIO(D)  | G6  | GND             | K4  | GND      | N2  | GPIO(C)  |
| A11 | DQ4/GPIO(D)     | D9  | DQ3/GPIO(D)  | G7  | GND             | K5  | VCCIO(B) | N3  | GPIO(B)  |
| A12 | DQ4/GPIO(D)     | D10 | DQ3/GPIO(D)  | G8  | GND             | K6  | VCCIO(B) | N4  | GPIO(B)  |
| A13 | DQCK_P4/GPIO(D) | D11 | DQS3/GPIO(D) | G9  | GND             | K7  | VCC      | N5  | GPIO(B)  |
| A14 | DQCK_N4/GPIO(D) | D12 | DQ3/GPIO(D)  | G10 | VCC             | K8  | VCCIO(B) | N6  | GPIO(B)  |
| B1  | DQ1/GPIO(D)     | D13 | DQ4/GPIO(D)  | G11 | GPIO(A)         | K9  | VCCIO(B) | N7  | CLK(B)   |
| B2  | DQ1/GPIO(D)     | D14 | GND          | G12 | GPIO(A)         | K10 | VCCIO(A) | N8  | GPIO(B)  |
| B3  | DQ1/GPIO(D)     | E1  | GPIO(C)      | G13 | GPIO(A)         | K11 | GPIO(A)  | N9  | GPIO(B)  |
| B4  | VREF(D)         | E2  | GPIO(C)      | G14 | GPIO(A)         | K12 | GPIO(A)  | N10 | GPIO(B)  |
| B5  | DQ2/GPIO(D)     | E3  | GPIO(C)      | H1  | CLK(C)/CCMIN(0) | K13 | GPIO(A)  | N11 | GPIO(B)  |
| B6  | DQ2/GPIO(D)     | E4  | CCMGND(0)    | H2  | GPIO(C)         | K14 | GPIO(A)  | N12 | GPIO(B)  |
| B7  | DEDCLK(D)       | E5  | VCCIO(C)     | H3  | GPIO(C)         | L1  | GPIO(C)  | N13 | VLP      |
| B8  | TMS             | E6  | VCCIO(D)     | H4  | VCCIO(B)        | L2  | GPIO(C)  | N14 | GPIO(A)  |
| B9  | VREF(D)         | E7  | VCCIO(D)     | H5  | VCC             | L3  | GPIO(C)  | P1  | GPIO(C)  |
| B10 | DQ3/GPIO(D)     | E8  | VCC          | H6  | GND             | L4  | GPIO(B)  | P2  | GPIO(B)  |
| B11 | DQ3/GPIO(D)     | E9  | VCCIO(D)     | H7  | GND             | L5  | GPIO(B)  | P3  | GPIO(B)  |
| B12 | DQS4/GPIO(D)    | E10 | VCCIO(D)     | H8  | GND             | L6  | GPIO(B)  | P4  | GPIO(B)  |
| B13 | DQ4/GPIO(D)     | E11 | CCMGND(1)    | H9  | GND             | L7  | TDO      | P5  | GPIO(B)  |
| B14 | DQ4/GPIO(D)     | E12 | CCMVCC(1)    | H10 | VCC             | L8  | TDI      | P6  | CLK(B)   |
| C1  | GPIO(C)         | E13 | GPIO(A)      | H11 | GPIO(A)         | L9  | GPIO(B)  | P7  | GPIO(B)  |
| C2  | DQ1/GPIO(D)     | E14 | GPIO(A)      | H12 | GPIO(A)         | L10 | GND      | P8  | GPIO(B)  |
| C3  | DQ1/GPIO(D)     | F1  | GPIO(C)      | H13 | GPIO(A)         | L11 | GPIO(A)  | P9  | GPIO(B)  |
| C4  | DQ1/GPIO(D)     | F2  | GPIO(C)      | H14 | CLK(A)/CCMIN(1) | L12 | GPIO(A)  | P10 | GPIO(B)  |
| C5  | DQ2/GPIO(D)     | F3  | GPIO(C)      | J1  | GPIO(C)         | L13 | GPIO(A)  | P11 | GPIO(B)  |
| C6  | DQS2/GPIO(D)    | F4  | CCMVCC(0)    | J2  | GPIO(C)         | L14 | TRSTB    | P12 | GPIO(B)  |
| C7  | DQ2/GPIO(D)     | F5  | VCC          | J3  | GPIO(C)         | M1  | GPIO(C)  | P13 | GPIO(A)  |
| C8  | DQ3/GPIO(D)     | F6  | GND          | J4  | GND             | M2  | GPIO(C)  | P14 | GPIO(A)  |
| C9  | DQ3/GPIO(D)     | F7  | GND          | J5  | VCCIO(C)        | M3  | GPIO(C)  |     |          |
| C10 | DQ3/GPIO(D)     | F8  | GND          | J6  | GND             | M4  | GPIO(B)  |     |          |
| C11 | DQ4/GPIO(D)     | F9  | GND          | J7  | GND             | M5  | GPIO(B)  |     |          |
| C12 | DQ4/GPIO(D)     | F10 | VCCIO(A)     | J8  | GND             | M6  | GPIO(B)  |     |          |

## PolarPro QL1P075 - 256 LPGA Pinout Table

Table 60: QL1P075 – 256 LPGA Pinout Table

| Pin | Function        | Pin | Function        | Pin | Function        | Pin | Function            | Pin | Function | Pin | Function |
|-----|-----------------|-----|-----------------|-----|-----------------|-----|---------------------|-----|----------|-----|----------|
| A1  | GND             | C12 | DQCK_P4/GPIO(D) | F7  | VCC             | J2  | GPIO(C)             | L13 | NC       | P8  | GPIO(B)  |
| A2  | DQ1/GPIO(D)     | C13 | DQCK_N4/GPIO(D) | F8  | GND             | J3  | GPIO(C)             | L14 | GPIO(A)  | P9  | GPIO(B)  |
| A3  | DQ1/GPIO(D)     | C14 | GND             | F9  | TMS             | J4  | GPIO(C)             | L15 | GPIO(A)  | P10 | GPIO(B)  |
| A4  | DQ1/GPIO(D)     | C15 | DQ4/GPIO(D)     | F10 | VCC             | J5  | VCCIO(C)            | L16 | GPIO(A)  | P11 | GPIO(B)  |
| A5  | DQ2/GPIO(D)     | C16 | DQ4/GPIO(D)     | F11 | DQ4/GPIO(D)     | J6  | GND                 | M1  | NC       | P12 | GPIO(B)  |
| A6  | DQ2/GPIO(D)     | D1  | GPIO(C)         | F12 | CCMVCC(1)       | J7  | GND                 | M2  | NC       | P13 | GPIO(B)  |
| A7  | DQS2/GPIO(D)    | D2  | NC              | F13 | GPIO(A)         | J8  | VCC                 | M3  | GPIO(B)  | P14 | GND      |
| A8  | DQ2/GPIO(D)     | D3  | NC              | F14 | GPIO(A)         | J9  | VCC                 | M4  | GPIO(B)  | P15 | GPIO(B)  |
| A9  | DEDCLK(D)       | D4  | NC              | F15 | GPIO(A)         | J10 | GND                 | M5  | GPIO(B)  | P16 | GPIO(B)  |
| A10 | DQ3/GPIO(D)     | D5  | VREF(D)         | F16 | GPIO(A)         | J11 | TRSTB               | M6  | VCCIO(B) | R1  | GPIO(B)  |
| A11 | DQ3/GPIO(D)     | D6  | DQS1/GPIO(D)    | G1  | GPIO(C)         | J12 | VCCIO(A)            | M7  | VCCIO(B) | R2  | GPIO(B)  |
| A12 | DQ3/GPIO(D)     | D7  | DQ2/GPIO(D)     | G2  | GPIO(C)         | J13 | GPIO(A)             | M8  | VCCIO(B) | R3  | GPIO(B)  |
| A13 | DQ3/GPIO(D)     | D8  | DQ2/GPIO(D)     | G3  | GPIO(C)         | J14 | GPIO(A)             | M9  | VCCIO(B) | R4  | GPIO(B)  |
| A14 | DQ4/GPIO(D)     | D9  | DQS3/GPIO(D)    | G4  | GPIO(C)         | J15 | GPIO(A)             | M10 | VCCIO(B) | R5  | TDO      |
| A15 | NC              | D10 | DQCK_P3/GPIO(D) | G5  | GPIO(C)         | J16 | CLK(A)/<br>CCMIN(1) | M11 | VCCIO(B) | R6  | GPIO(B)  |
| A16 | GND             | D11 | DQ4/GPIO(D)     | G6  | VCC             | K1  | GPIO(C)             | M12 | GPIO(B)  | R7  | GPIO(B)  |
| B1  | DQ1/GPIO(D)     | D12 | VREF(D)         | G7  | GND             | K2  | GPIO(C)             | M13 | NC       | R8  | GPIO(B)  |
| B2  | DQ1/GPIO(D)     | D13 | DQ4/GPIO(D)     | G8  | GND             | K3  | GPIO(C)             | M14 | GPIO(A)  | R9  | GPIO(B)  |
| B3  | DQ1/GPIO(D)     | D14 | NC              | G9  | GND             | K4  | GPIO(C)             | M15 | GPIO(A)  | R10 | GPIO(B)  |
| B4  | DQ1/GPIO(D)     | D15 | NC              | G10 | GND             | K5  | GPIO(C)             | M16 | NC       | R11 | GPIO(B)  |
| B5  | DQ1/GPIO(D)     | D16 | NC              | G11 | VCC             | K6  | VCC                 | N1  | GPIO(B)  | R12 | GPIO(B)  |
| B6  | DQ2/GPIO(D)     | E1  | GPIO(C)         | G12 | GPIO(A)         | K7  | GND                 | N2  | GPIO(B)  | R13 | GPIO(B)  |
| B7  | DQCK_P2/GPIO(D) | E2  | GPIO(C)         | G13 | GPIO(A)         | K8  | GND                 | N3  | GPIO(B)  | R14 | GPIO(B)  |
| B8  | DQCK_N2/GPIO(D) | E3  | GPIO(C)         | G14 | GPIO(A)         | K9  | GND                 | N4  | GPIO(B)  | R15 | GPIO(B)  |
| B9  | DQ2/GPIO(D)     | E4  | GPIO(C)         | G15 | GPIO(A)         | K10 | GND                 | N5  | GPIO(B)  | R16 | GPIO(B)  |
| B10 | DQ3/GPIO(D)     | E5  | CCMGND(0)       | G16 | GPIO(A)         | K11 | VCC                 | N6  | GPIO(B)  | T1  | GND      |
| B11 | DQ3/GPIO(D)     | E6  | VCCIO(D)        | H1  | CLK(C)/CCMIN(0) | K12 | GPIO(A)             | N7  | GPIO(B)  | T2  | GPIO(B)  |
| B12 | DQ3/GPIO(D)     | E7  | VCCIO(D)        | H2  | GPIO(C)         | K13 | GPIO(A)             | N8  | GPIO(B)  | T3  | GPIO(B)  |
| B13 | DQ4/GPIO(D)     | E8  | VCCIO(D)        | H3  | GPIO(C)         | K14 | GPIO(A)             | N9  | GPIO(B)  | T4  | GPIO(B)  |
| B14 | DQ4/GPIO(D)     | E9  | VCCIO(D)        | H4  | GPIO(C)         | K15 | GPIO(A)             | N10 | GPIO(B)  | T5  | GPIO(B)  |
| B15 | DQ4/GPIO(D)     | E10 | VCCIO(D)        | H5  | VCCIO(C)        | K16 | GPIO(A)             | N11 | GPIO(B)  | T6  | GPIO(B)  |
| B16 | DQS4/GPIO(D)    | E11 | VCCIO(D)        | H6  | TCK             | L1  | GPIO(C)             | N12 | GPIO(B)  | T7  | CLK(B)   |
| C1  | NC              | E12 | CCMGND(1)       | H7  | GND             | L2  | GPIO(C)             | N13 | GPIO(B)  | T8  | GPIO(B)  |
| C2  | GPIO(C)         | E13 | GPIO(A)         | H8  | VCC             | L3  | GPIO(C)             | N14 | GPIO(B)  | T9  | CLK(B)   |
| C3  | GND             | E14 | GPIO(A)         | H9  | VCC             | L4  | NC                  | N15 | NC       | T10 | GPIO(B)  |
| C4  | DQ1/GPIO(D)     | E15 | GPIO(A)         | H10 | GND             | L5  | NC                  | N16 | GPIO(B)  | T11 | GPIO(B)  |
| C5  | DQCK_P1/GPIO(D) | E16 | GPIO(A)         | H11 | GND             | L6  | GND                 | P1  | GPIO(B)  | T12 | GPIO(B)  |
| C6  | DQCK_N1/GPIO(D) | F1  | GPIO(C)         | H12 | VCCIO(A)        | L7  | VCC                 | P2  | GPIO(B)  | T13 | GPIO(B)  |
| C7  | DQ2/GPIO(D)     | F2  | GPIO(C)         | H13 | GPIO(A)         | L8  | TDI                 | P3  | GND      | T14 | GPIO(B)  |
| C8  | DQ/GPIO(D)      | F3  | GPIO(C)         | H14 | GPIO(A)         | L9  | GND                 | P4  | GPIO(B)  | T15 | GPIO(B)  |
| C9  | DQ3/GPIO(D)     | F4  | GPIO(C)         | H15 | GPIO(A)         | L10 | VCC                 | P5  | GPIO(B)  | T16 | GND      |
| C10 | DQCK_N3/GPIO(D) | F5  | CCMVCC(0)       | H16 | GPIO(A)         | L11 | VCCIO(B)            | P6  | GPIO(B)  |     |          |
| C11 | DQ3/GPIO(D)     | F6  | VCCIO(B)        | J1  | GPIO(C)         | L12 | VLP                 | P7  | GPIO(B)  |     |          |

## PolarPro QL1P100 - 121 TFBGA Pinout Table

Table 61: QL1P100 - 121 TFBGA Pinout Table

| Pin | Function        | Pin | Function        | Pin | Function        | Pin | Function |
|-----|-----------------|-----|-----------------|-----|-----------------|-----|----------|
| A1  | VCC             | C10 | GPIO(A)         | F8  | VCC             | J6  | GND      |
| A2  | DQ1/GPIO(D)     | C11 | GPIO(A)         | F9  | GPIO(A)         | J7  | GPIO(B)  |
| A3  | DQCK_N1/GPIO(D) | D1  | GPIO(C)         | F10 | GPIO(A)         | J8  | GPIO(B)  |
| A4  | DQ1/GPIO(D)     | D2  | GPIO(C)         | F11 | GPIO(A)         | J9  | GPIO(A)  |
| A5  | DQ2/GPIO(D)     | D3  | GPIO(C)         | G1  | TCK             | J10 | GPIO(A)  |
| A6  | DEDCLK(D)       | D4  | VCCIO(D)        | G2  | VCCIO(B)        | J11 | GPIO(A)  |
| A7  | DQCK_N3/GPIO(D) | D5  | VCC             | G3  | GPIO(C)         | K1  | GND      |
| A8  | DQ3/GPIO(D)     | D6  | DQ3/GPIO(D)     | G4  | VCC             | K2  | GPIO(B)  |
| A9  | DQCK_P4/GPIO(D) | D7  | DQ3/GPIO(D)     | G5  | VCCIO(C)        | K3  | GPIO(B)  |
| A10 | DQ4/GPIO(D)     | D8  | GPIO(A)         | G6  | GND             | K4  | GPIO(B)  |
| A11 | VCC             | D9  | GPIO(A)         | G7  | GND             | K5  | TDI      |
| B1  | GND             | D10 | GPIO(A)         | G8  | VCC             | K6  | GPIO(B)  |
| B2  | GPIO(C)         | D11 | GPIO(A)         | G9  | TRSTB           | K7  | GPIO(B)  |
| B3  | DQS1/GPIO(D)    | E1  | GPIO(C)         | G10 | GPIO(A)         | K8  | GPIO(B)  |
| B4  | DQ2/GPIO(D)     | E2  | GPIO(C)         | G11 | CLK(A)/CCMIN(1) | K9  | GPIO(B)  |
| B5  | DQ2/GPIO(D)     | E3  | GPIO(C)         | H1  | GPIO(C)         | K10 | GPIO(A)  |
| B6  | TMS             | E4  | GPIO(C)         | H2  | GPIO(C)         | K11 | GPIO(A)  |
| B7  | DQ3/GPIO(D)     | E5  | VCCIO(D)        | H3  | GPIO(C)         | L1  | VCC      |
| B8  | DQ4/GPIO(D)     | E6  | GND             | H4  | GPIO(C)         | L2  | GPIO(B)  |
| B9  | DQ4/GPIO(D)     | E7  | GND             | H5  | VCCIO(C)        | L3  | GPIO(B)  |
| B10 | CCMGND(1)       | E8  | VCCIO(A)        | H6  | GND             | L4  | TDO      |
| B11 | GND             | E9  | VCCIO(A)        | H7  | VCCIO(B)        | L5  | CLK(B)   |
| C1  | GPIO(C)         | E10 | GPIO(A)         | H8  | VCCIO(B)        | L6  | CLK(B)   |
| C2  | GPIO(C)         | E11 | GPIO(A)         | H9  | VCCIO(B)        | L7  | GPIO(B)  |
| C3  | GPIO(C)         | F1  | GPIO(C)         | H10 | GPIO(A)         | L8  | GPIO(B)  |
| C4  | DQ1/GPIO(D)     | F2  | GPIO(C)         | H11 | GPIO(A)         | L9  | VLP      |
| C5  | DQ2/GPIO(D)     | F3  | CLK(C)/CCMIN(0) | J1  | GPIO(C)         | L10 | GND      |
| C6  | DQS2/GPIO(D)    | F4  | GND             | J2  | GPIO(C)         | L11 | VCC      |
| C7  | DQS3/GPIO(D)    | F5  | GND             | J3  | GPIO(B)         |     |          |
| C8  | DQ4/GPIO(D)     | F6  | GND             | J4  | GPIO(B)         |     |          |
| C9  | CCMVCC(1)       | F7  | GND             | J5  | GPIO(B)         |     |          |

## PolarPro QL1P100 - 132 TFBGA Pinout Table

Table 62: QL1P100 – 132 TFBGA Pinout Table

| Pin | Function        | Pin | Function    | Pin | Function        | Pin | Function |
|-----|-----------------|-----|-------------|-----|-----------------|-----|----------|
| A1  | VCC             | D7  | DQ3/GPIO(D) | H1  | CLK(C)          | L9  | GPIO(B)  |
| A2  | VCCIO(D)        | D8  | DQ3/GPIO(D) | H3  | TCK             | L10 | GPIO(B)  |
| A3  | DQS2/GPIO(D)    | D9  | DQ3/GPIO(D) | H4  | GPIO(C)         | L11 | GPIO(A)  |
| A4  | DQCK_P2/GPIO(D) | D10 | DQ3/GPIO(D) | H6  | GND             | L12 | GPIO(A)  |
| A5  | DQCK_N2/GPIO(D) | D11 | GPIO(A)     | H7  | GND             | L14 | GPIO(A)  |
| A6  | DQ2/GPIO(D)     | D12 | GPIO(A)     | H8  | GND             | M1  | VCC      |
| A7  | DEDCLK(D)       | D14 | VCCIO(A)    | H9  | GND             | M3  | GPIO(B)  |
| A8  | DQ3/GPIO(D)     | E1  | VCCIO(C)    | H11 | GPIO(A)         | M4  | GPIO(B)  |
| A9  | DQS3/GPIO(D)    | E3  | GPIO(C)     | H12 | GPIO(A)         | M5  | GPIO(B)  |
| A10 | DQCK_P3/GPIO(D) | E4  | DQ2/GPIO(D) | H14 | VCC             | M6  | GPIO(B)  |
| A11 | DQCK_N3/GPIO(D) | E11 | GPIO(A)     | J1  | GPIO(C)         | M7  | GPIO(B)  |
| A12 | VCCIO(D)        | E12 | GPIO(A)     | J3  | GPIO(C)         | M8  | VCC      |
| A13 | GND             | E14 | GPIO(A)     | J4  | GPIO(C)         | M9  | GPIO(B)  |
| A14 | VCC             | F1  | VCC         | J6  | GPIO(C)         | M10 | GPIO(B)  |
| B1  | VREF            | F3  | GPIO(C)     | J7  | GPIO(B)         | M11 | GPIO(B)  |
| B14 | CCMGND(1)       | F4  | GND         | J8  | GND             | M12 | GPIO(A)  |
| C1  | GPIO(C)         | F6  | TMS         | J9  | GPIO(A)         | M14 | VCCIO(A) |
| C3  | GPIO(C)         | F7  | GND         | J11 | GPIO(A)         | N1  | GND      |
| C4  | DQ2/GPIO(D)     | F8  | GND         | J12 | GPIO(A)         | N14 | VCC      |
| C5  | DQ2/GPIO(D)     | F9  | GPIO(A)     | J14 | CLK(A)/CCMIN(1) | P1  | VCCIO(B) |
| C6  | VCC             | F11 | GPIO(A)     | K1  | VCCIO(C)        | P2  | GPIO(B)  |
| C7  | DQ3/GPIO(D)     | F12 | GPIO(A)     | K3  | GPIO(C)         | P3  | TDO      |
| C8  | VCCIO(D)        | F14 | VCCIO(A)    | K4  | VCCIO(B)        | P4  | GPIO(B)  |
| C9  | DQ3/GPIO(D)     | G1  | VCC         | K11 | GPIO(A)         | P5  | VCCIO(B) |
| C10 | DQ3/GPIO(D)     | G3  | GPIO(C)     | K12 | TRSTB           | P6  | GPIO(B)  |
| C11 | VREF            | G4  | GPIO(C)     | K14 | VCCIO(B)        | P7  | CLK(B)   |
| C12 | CCMVCC(1)       | G6  | GND         | L1  | GPIO(C)         | P8  | CLK(B)   |
| C14 | GPIO(A)         | G7  | GND         | L3  | GPIO(C)         | P9  | VCC      |
| D1  | GPIO(C)         | G8  | GND         | L4  | GPIO(C)         | P10 | VCCIO(B) |
| D3  | GPIO(C)         | G9  | GND         | L5  | GPIO(C)         | P11 | GPIO(B)  |
| D4  | VCCIO(D)        | G11 | GPIO(A)     | L6  | GPIO(C)         | P12 | GPIO(B)  |
| D5  | DQ2/GPIO(D)     | G12 | GPIO(A)     | L7  | GPIO(B)         | P13 | VLP      |
| D6  | DQ3/GPIO(D)     | G14 | VCC         | L8  | TDI             | P14 | GND      |

## PolarPro QL1P100 - 144 TQFP Pinout Table

Table 63: QL1P100 – 144 TQFP Pinout Table

| Pin | Function | Pin | Function | Pin | Function        | Pin | Function        |
|-----|----------|-----|----------|-----|-----------------|-----|-----------------|
| 1   | VCCIO(C) | 37  | GND      | 73  | VCCIO(A)        | 109 | VCCIO(D)        |
| 2   | GPIO(C)  | 38  | GPIO(B)  | 74  | GPIO(A)         | 110 | VREF(D)         |
| 3   | GPIO(C)  | 39  | GPIO(B)  | 75  | GPIO(A)         | 111 | DQ3/GPIO(D)     |
| 4   | GPIO(C)  | 40  | TDO      | 76  | GPIO(A)         | 112 | DQ3/GPIO(D)     |
| 5   | GPIO(C)  | 41  | VCCIO(B) | 77  | GPIO(A)         | 113 | DQ3/GPIO(D)     |
| 6   | GPIO(C)  | 42  | GPIO(B)  | 78  | GPIO(A)         | 114 | DQ3/GPIO(D)     |
| 7   | GPIO(C)  | 43  | GPIO(B)  | 79  | VCCIO(B)        | 115 | DQCK_P3/GPIO(D) |
| 8   | GPIO(C)  | 44  | GPIO(B)  | 80  | GPIO(A)         | 116 | DQCK_N3/GPIO(D) |
| 9   | GPIO(C)  | 45  | GPIO(B)  | 81  | TRSTB           | 117 | DQS3/GPIO(D)    |
| 10  | GPIO(C)  | 46  | GPIO(B)  | 82  | GPIO(A)         | 118 | DQ3/GPIO(D)     |
| 11  | GPIO(C)  | 47  | GPIO(B)  | 83  | GPIO(A)         | 119 | DQ3/GPIO(D)     |
| 12  | GPIO(C)  | 48  | GPIO(B)  | 84  | CLK(A)/CCMIN(1) | 120 | DQ3/GPIO(D)     |
| 13  | VCC      | 49  | GPIO(B)  | 85  | GPIO(A)         | 121 | TMS             |
| 14  | GPIO(C)  | 50  | GPIO(B)  | 86  | VCCIO(A)        | 122 | DQ3/GPIO(D)     |
| 15  | GPIO(C)  | 51  | GPIO(B)  | 87  | GPIO(A)         | 123 | DQ3/GPIO(D)     |
| 16  | VCC      | 52  | TDI      | 88  | GPIO(A)         | 124 | VCC             |
| 17  | GPIO(C)  | 53  | CLK(B)   | 89  | GPIO(A)         | 125 | DEDCLK(D)       |
| 18  | GPIO(C)  | 54  | VCCIO(B) | 90  | VCC             | 126 | VCCIO(D)        |
| 19  | VCCIO(C) | 55  | VCC      | 91  | GPIO(A)         | 127 | DQ2/GPIO(D)     |
| 20  | GPIO(C)  | 56  | CLK(B)   | 92  | GPIO(A)         | 128 | DQ2/GPIO(D)     |
| 21  | GPIO(C)  | 57  | GPIO(B)  | 93  | VCC             | 129 | DQ2/GPIO(D)     |
| 22  | GPIO(C)  | 58  | VCC      | 94  | GPIO(A)         | 130 | DQ2/GPIO(D)     |
| 23  | CLK(C)   | 59  | GPIO(B)  | 95  | GPIO(A)         | 131 | DQCK_N2/GPIO(D) |
| 24  | TCK      | 60  | GPIO(B)  | 96  | GPIO(A)         | 132 | DQCK_P2/GPIO(D) |
| 25  | GPIO(C)  | 61  | GPIO(B)  | 97  | GPIO(A)         | 133 | DQS2/GPIO(D)    |
| 26  | GPIO(C)  | 62  | GPIO(B)  | 98  | GPIO(A)         | 134 | DQ2/GPIO(D)     |
| 27  | VCCIO(B) | 63  | GPIO(B)  | 99  | GPIO(A)         | 135 | DQ2/GPIO(D)     |
| 28  | GPIO(C)  | 64  | GPIO(B)  | 100 | GPIO(A)         | 136 | DQ2/GPIO(D)     |
| 29  | GPIO(C)  | 65  | GPIO(B)  | 101 | GPIO(A)         | 137 | DQ2/GPIO(D)     |
| 30  | GPIO(C)  | 66  | GPIO(B)  | 102 | GPIO(A)         | 138 | VREF(D)         |
| 31  | GPIO(C)  | 67  | GPIO(B)  | 103 | GPIO(A)         | 139 | DQ2/GPIO(D)     |
| 32  | GPIO(C)  | 68  | GPIO(B)  | 104 | CCMVCC(1)       | 140 | VCCIO(D)        |
| 33  | GPIO(C)  | 69  | VCCIO(B) | 105 | VCCIO(A)        | 141 | VCC             |
| 34  | VCCIO(C) | 70  | VLP      | 106 | CCMGND(1)       | 142 | VCCIO(D)        |
| 35  | GND      | 71  | GND      | 107 | GND             | 143 | GND             |
| 36  | GND      | 72  | GND      | 108 | GND             | 144 | GND             |

## PolarPro QL1P100 - 196 TFBGA (12 mm x 12 mm) Pinout Table

Table 64: QL1P100 – 196 TFBGA (12 mm x 12 mm) Pinout Table

| Pin | Function        | Pin | Function     | Pin | Function        | Pin | Function | Pin | Function |
|-----|-----------------|-----|--------------|-----|-----------------|-----|----------|-----|----------|
| A1  | DQS1/GPIO(D)    | C13 | DQ4/GPIO(D)  | F11 | GPIO(A)         | J9  | GND      | M7  | GPIO(B)  |
| A2  | DQCK_P1/GPIO(D) | C14 | DQ4/GPIO(D)  | F12 | GPIO(A)         | J10 | VCC      | M8  | GPIO(B)  |
| A3  | DQCK_N1/GPIO(D) | D1  | GPIO(C)      | F13 | GPIO(A)         | J11 | VCCIO(B) | M9  | GPIO(B)  |
| A4  | DQ2/GPIO(D)     | D2  | GND          | F14 | GPIO(A)         | J12 | GPIO(A)  | M10 | GPIO(B)  |
| A5  | DQ2/GPIO(D)     | D3  | DQ1/GPIO(D)  | G1  | GPIO(C)         | J13 | GPIO(A)  | M11 | GPIO(B)  |
| A6  | DQCK_P2/GPIO(D) | D4  | DQ1/GPIO(D)  | G2  | GPIO(C)         | J14 | GPIO(A)  | M12 | GPIO(A)  |
| A7  | DQCK_N2/GPIO(D) | D5  | DQ1/GPIO(D)  | G3  | GPIO(C)         | K1  | GPIO(C)  | M13 | GPIO(A)  |
| A8  | DQ3/GPIO(D)     | D6  | DQ2/GPIO(D)  | G4  | TCK             | K2  | GPIO(C)  | M14 | GPIO(A)  |
| A9  | DQCK_P3/GPIO(D) | D7  | DQ2/GPIO(D)  | G5  | VCC             | K3  | GPIO(C)  | N1  | GPIO(C)  |
| A10 | DQCK_N3/GPIO(D) | D8  | DQ2/GPIO(D)  | G6  | GND             | K4  | GND      | N2  | GPIO(C)  |
| A11 | DQ4/GPIO(D)     | D9  | DQ3/GPIO(D)  | G7  | GND             | K5  | VCCIO(B) | N3  | GPIO(B)  |
| A12 | DQ4/GPIO(D)     | D10 | DQ3/GPIO(D)  | G8  | GND             | K6  | VCCIO(B) | N4  | GPIO(B)  |
| A13 | DQCK_P4/GPIO(D) | D11 | DQS3/GPIO(D) | G9  | GND             | K7  | VCC      | N5  | GPIO(B)  |
| A14 | DQCK_N4/GPIO(D) | D12 | DQ3/GPIO(D)  | G10 | VCC             | K8  | VCCIO(B) | N6  | GPIO(B)  |
| B1  | DQ1/GPIO(D)     | D13 | DQ4/GPIO(D)  | G11 | GPIO(A)         | K9  | VCCIO(B) | N7  | CLK(B)   |
| B2  | DQ1/GPIO(D)     | D14 | GND          | G12 | GPIO(A)         | K10 | VCCIO(A) | N8  | GPIO(B)  |
| B3  | DQ1/GPIO(D)     | E1  | GPIO(C)      | G13 | GPIO(A)         | K11 | GPIO(A)  | N9  | GPIO(B)  |
| B4  | VREF(D)         | E2  | GPIO(C)      | G14 | GPIO(A)         | K12 | GPIO(A)  | N10 | GPIO(B)  |
| B5  | DQ2/GPIO(D)     | E3  | GPIO(C)      | H1  | CLK(C)/CCMIN(0) | K13 | GPIO(A)  | N11 | GPIO(B)  |
| B6  | DQ2/GPIO(D)     | E4  | CCMGND(0)    | H2  | GPIO(C)         | K14 | GPIO(A)  | N12 | GPIO(B)  |
| B7  | DEDCLK(D)       | E5  | VCCIO(C)     | H3  | GPIO(C)         | L1  | GPIO(C)  | N13 | VLP      |
| B8  | TMS             | E6  | VCCIO(D)     | H4  | VCCIO(B)        | L2  | GPIO(C)  | N14 | GPIO(A)  |
| B9  | VREF(D)         | E7  | VCCIO(D)     | H5  | VCC             | L3  | GPIO(C)  | P1  | GPIO(C)  |
| B10 | DQ3/GPIO(D)     | E8  | VCC          | H6  | GND             | L4  | GPIO(B)  | P2  | GPIO(B)  |
| B11 | DQ3/GPIO(D)     | E9  | VCCIO(D)     | H7  | GND             | L5  | GPIO(B)  | P3  | GPIO(B)  |
| B12 | DQS4/GPIO(D)    | E10 | VCCIO(D)     | H8  | GND             | L6  | GPIO(B)  | P4  | GPIO(B)  |
| B13 | DQ4/GPIO(D)     | E11 | CCMGND(1)    | H9  | GND             | L7  | TDO      | P5  | GPIO(B)  |
| B14 | DQ4/GPIO(D)     | E12 | CCMVCC(1)    | H10 | VCC             | L8  | TDI      | P6  | CLK(B)   |
| C1  | GPIO(C)         | E13 | GPIO(A)      | H11 | GPIO(A)         | L9  | GPIO(B)  | P7  | GPIO(B)  |
| C2  | DQ1/GPIO(D)     | E14 | GPIO(A)      | H12 | GPIO(A)         | L10 | GND      | P8  | GPIO(B)  |
| C3  | DQ1/GPIO(D)     | F1  | GPIO(C)      | H13 | GPIO(A)         | L11 | GPIO(A)  | P9  | GPIO(B)  |
| C4  | DQ1/GPIO(D)     | F2  | GPIO(C)      | H14 | CLK(A)/CCMIN(1) | L12 | GPIO(A)  | P10 | GPIO(B)  |
| C5  | DQ2/GPIO(D)     | F3  | GPIO(C)      | J1  | GPIO(C)         | L13 | GPIO(A)  | P11 | GPIO(B)  |
| C6  | DQS2/GPIO(D)    | F4  | CCMVCC(0)    | J2  | GPIO(C)         | L14 | TRSTB    | P12 | GPIO(B)  |
| C7  | DQ2/GPIO(D)     | F5  | VCC          | J3  | GPIO(C)         | M1  | GPIO(C)  | P13 | GPIO(A)  |
| C8  | DQ3/GPIO(D)     | F6  | GND          | J4  | GND             | M2  | GPIO(C)  | P14 | GPIO(A)  |
| C9  | DQ3/GPIO(D)     | F7  | GND          | J5  | VCCIO(C)        | M3  | GPIO(C)  |     |          |
| C10 | DQ3/GPIO(D)     | F8  | GND          | J6  | GND             | M4  | GPIO(B)  |     |          |
| C11 | DQ4/GPIO(D)     | F9  | GND          | J7  | GND             | M5  | GPIO(B)  |     |          |
| C12 | DQ4/GPIO(D)     | F10 | VCCIO(A)     | J8  | GND             | M6  | GPIO(B)  |     |          |

## PolarPro QL1P100 - 256 LPGA Pinout Table

Table 65: QL1P100 – 256 LPGA Pinout Table

| Pin | Function            | Pin | Function        | Pin | Function        | Pin | Function        | Pin | Function | Pin | Function |
|-----|---------------------|-----|-----------------|-----|-----------------|-----|-----------------|-----|----------|-----|----------|
| A1  | GND                 | C12 | DQCK_P4/GPIO(D) | F7  | VCC             | J2  | GPIO(C)         | L13 | GPIO(A)  | P8  | GPIO(B)  |
| A2  | DQ1/GPIO(D)         | C13 | DQCK_N4/GPIO(D) | F8  | GND             | J3  | GPIO(C)         | L14 | GPIO(A)  | P9  | GPIO(B)  |
| A3  | DQ1/GPIO(D)         | C14 | GND             | F9  | TMS             | J4  | GPIO(C)         | L15 | GPIO(A)  | P10 | GPIO(B)  |
| A4  | DQ1/GPIO(D)         | C15 | DQ4/GPIO(D)     | F10 | VCC             | J5  | VCCIO(C)        | L16 | GPIO(A)  | P11 | GPIO(B)  |
| A5  | DQ2/GPIO(D)         | C16 | DQ4/GPIO(D)     | F11 | DQ4/GPIO(D)     | J6  | GND             | M1  | GPIO(C)  | P12 | GPIO(B)  |
| A6  | DQ2/GPIO(D)         | D1  | GPIO(C)         | F12 | CCMVCC(1)       | J7  | GND             | M2  | GPIO(C)  | P13 | GPIO(B)  |
| A7  | DQS2/GPIO(D)        | D2  | GPIO(C)         | F13 | GPIO(A)         | J8  | VCC             | M3  | GPIO(B)  | P14 | GND      |
| A8  | DQ2/GPIO(D)         | D3  | GPIO(C)         | F14 | GPIO(A)         | J9  | VCC             | M4  | GPIO(B)  | P15 | GPIO(B)  |
| A9  | DEDCLK(D)           | D4  | GPIO(C)         | F15 | GPIO(A)         | J10 | GND             | M5  | GPIO(B)  | P16 | GPIO(B)  |
| A10 | DQ3/GPIO(D)         | D5  | VREF(D)         | F16 | GPIO(A)         | J11 | TRSTB           | M6  | VCCIO(B) | R1  | GPIO(B)  |
| A11 | DQ3/GPIO(D)         | D6  | DQS1/GPIO(D)    | G1  | GPIO(C)         | J12 | VCCIO(A)        | M7  | VCCIO(B) | R2  | GPIO(B)  |
| A12 | DQ3/GPIO(D)         | D7  | DQ2/GPIO(D)     | G2  | GPIO(C)         | J13 | GPIO(A)         | M8  | VCCIO(B) | R3  | GPIO(B)  |
| A13 | DQ3/GPIO(D)         | D8  | DQ2/GPIO(D)     | G3  | GPIO(C)         | J14 | GPIO(A)         | M9  | VCCIO(B) | R4  | GPIO(B)  |
| A14 | DQ4/GPIO(D)         | D9  | DQS3/GPIO(D)    | G4  | GPIO(C)         | J15 | GPIO(A)         | M10 | VCCIO(B) | R5  | TDO      |
| A15 | GPIO(A)             | D10 | DQCK_P3/GPIO(D) | G5  | GPIO(C)         | J16 | CLK(A)/CCMIN(1) | M11 | VCCIO(B) | R6  | GPIO(B)  |
| A16 | GND                 | D11 | DQ4/GPIO(D)     | G6  | VCC             | K1  | GPIO(C)         | M12 | GPIO(B)  | R7  | GPIO(B)  |
| B1  | DQ1/GPIO(D)         | D12 | VREF(D)         | G7  | GND             | K2  | GPIO(C)         | M13 | GPIO(A)  | R8  | GPIO(B)  |
| B2  | DQ1/GPIO(D)         | D13 | DQ4/GPIO(D)     | G8  | GND             | K3  | GPIO(C)         | M14 | GPIO(A)  | R9  | GPIO(B)  |
| B3  | DQ1/GPIO(D)         | D14 | GPIO(A)         | G9  | GND             | K4  | GPIO(C)         | M15 | GPIO(A)  | R10 | GPIO(B)  |
| B4  | DQ1/GPIO(D)         | D15 | GPIO(A)         | G10 | GND             | K5  | GPIO(C)         | M16 | GPIO(A)  | R11 | GPIO(B)  |
| B5  | DQ1/GPIO(D)         | D16 | GPIO(A)         | G11 | VCC             | K6  | VCC             | N1  | GPIO(B)  | R12 | GPIO(B)  |
| B6  | DQ2/GPIO(D)         | E1  | GPIO(C)         | G12 | GPIO(A)         | K7  | GND             | N2  | GPIO(B)  | R13 | GPIO(B)  |
| B7  | DQCK_P2/<br>GPIO(D) | E2  | GPIO(C)         | G13 | GPIO(A)         | K8  | GND             | N3  | GPIO(B)  | R14 | GPIO(B)  |
| B8  | DQCK_N2/<br>GPIO(D) | E3  | GPIO(C)         | G14 | GPIO(A)         | K9  | GND             | N4  | GPIO(B)  | R15 | GPIO(B)  |
| B9  | DQ2/GPIO(D)         | E4  | GPIO(C)         | G15 | GPIO(A)         | K10 | GND             | N5  | GPIO(B)  | R16 | GPIO(B)  |
| B10 | DQ3/GPIO(D)         | E5  | CCMGND(0)       | G16 | GPIO(A)         | K11 | VCC             | N6  | GPIO(B)  | T1  | GND      |
| B11 | DQ3/GPIO(D)         | E6  | VCCIO(D)        | H1  | CLK(C)/CCMIN(0) | K12 | GPIO(A)         | N7  | GPIO(B)  | T2  | GPIO(B)  |
| B12 | DQ3/GPIO(D)         | E7  | VCCIO(D)        | H2  | GPIO(C)         | K13 | GPIO(A)         | N8  | GPIO(B)  | T3  | GPIO(B)  |
| B13 | DQ4/GPIO(D)         | E8  | VCCIO(D)        | H3  | GPIO(C)         | K14 | GPIO(A)         | N9  | GPIO(B)  | T4  | GPIO(B)  |
| B14 | DQ4/GPIO(D)         | E9  | VCCIO(D)        | H4  | GPIO(C)         | K15 | GPIO(A)         | N10 | GPIO(B)  | T5  | GPIO(B)  |
| B15 | DQ4/GPIO(D)         | E10 | VCCIO(D)        | H5  | VCCIO(C)        | K16 | GPIO(A)         | N11 | GPIO(B)  | T6  | GPIO(B)  |
| B16 | DQS4/GPIO(D)        | E11 | VCCIO(D)        | H6  | TCK             | L1  | GPIO(C)         | N12 | GPIO(B)  | T7  | CLK(B)   |
| C1  | GPIO(C)             | E12 | CCMGND(1)       | H7  | GND             | L2  | GPIO(C)         | N13 | GPIO(B)  | T8  | GPIO(B)  |
| C2  | GPIO(C)             | E13 | GPIO(A)         | H8  | VCC             | L3  | GPIO(C)         | N14 | GPIO(B)  | T9  | CLK(B)   |
| C3  | GND                 | E14 | GPIO(A)         | H9  | VCC             | L4  | GPIO(C)         | N15 | GPIO(A)  | T10 | GPIO(B)  |
| C4  | DQ1/GPIO(D)         | E15 | GPIO(A)         | H10 | GND             | L5  | GPIO(C)         | N16 | GPIO(B)  | T11 | GPIO(B)  |
| C5  | DQCK_P1/<br>GPIO(D) | E16 | GPIO(A)         | H11 | GND             | L6  | GND             | P1  | GPIO(B)  | T12 | GPIO(B)  |
| C6  | DQCK_N1/<br>GPIO(D) | F1  | GPIO(C)         | H12 | VCCIO(A)        | L7  | VCC             | P2  | GPIO(B)  | T13 | GPIO(B)  |
| C7  | DQ2/GPIO(D)         | F2  | GPIO(C)         | H13 | GPIO(A)         | L8  | TDI             | P3  | GND      | T14 | GPIO(B)  |
| C8  | DQ/GPIO(D)          | F3  | GPIO(C)         | H14 | GPIO(A)         | L9  | GND             | P4  | GPIO(B)  | T15 | GPIO(B)  |
| C9  | DQ3/GPIO(D)         | F4  | GPIO(C)         | H15 | GPIO(A)         | L10 | VCC             | P5  | GPIO(B)  | T16 | GND      |
| C10 | DQCK_N3/<br>GPIO(D) | F5  | CCMVCC(0)       | H16 | GPIO(A)         | L11 | VCCIO(B)        | P6  | GPIO(B)  |     |          |
| C11 | DQ3/GPIO(D)         | F6  | VCCIO(B)        | J1  | GPIO(C)         | L12 | VLP             | P7  | GPIO(B)  |     |          |

## PolarPro QL1P200 - 132 TFBGA Pinout Table

Table 66: PolarPro QL1P200 – 132 TFBGA

| Pin | Function        | Pin | Function    | Pin | Function        | Pin | Function |
|-----|-----------------|-----|-------------|-----|-----------------|-----|----------|
| A1  | VCC             | D7  | DQ3/GPIO(D) | H1  | CLK(C)/CCMIN(0) | L9  | GPIO(B)  |
| A2  | VCC             | D8  | DQ3/GPIO(D) | H3  | VCCIO(C)        | L10 | GPIO(B)  |
| A3  | VREF            | D9  | DQ3/GPIO(D) | H4  | GPIO(C)         | L11 | GPIO(A)  |
| A4  | DQS2/GPIO(D)    | D10 | VCCIO(D)    | H6  | GND             | L12 | GPIO(A)  |
| A5  | DQCK_P2/GPIO(D) | D11 | GPIO(A)     | H7  | GND             | L14 | GPIO(A)  |
| A6  | DQCK_N2/GPIO(D) | D12 | VCCIO(A)    | H8  | GND             | M1  | VCC      |
| A7  | DEDCLK(D)       | D14 | GPIO(A)     | H9  | GND             | M3  | GND      |
| A8  | VCCIO(D)        | E1  | VCCIO(C)    | H11 | GPIO(A)         | M4  | GPIO(B)  |
| A9  | DQS3/GPIO(D)    | E3  | GPIO(C)     | H12 | GPIO(A)         | M5  | GPIO(B)  |
| A10 | DQCK_N3/GPIO(D) | E4  | GPIO(C)     | H14 | CLK(A)/CCMIN(1) | M6  | GPIO(B)  |
| A11 | DQCK_P3/GPIO(D) | E11 | GPIO(A)     | J1  | GPIO(C)         | M7  | GPIO(B)  |
| A12 | DQ3/GPIO(D)     | E12 | GPIO(A)     | J3  | TCK             | M8  | GPIO(B)  |
| A13 | VREF            | E14 | VCCIO(A)    | J4  | VCCIO(B)        | M9  | GPIO(B)  |
| A14 | VCC             | F1  | GPIO(C)     | J6  | GPIO(C)         | M10 | VCCIO(B) |
| B1  | CCMVCC(0)       | F3  | GPIO(C)     | J7  | TDI             | M11 | GPIO(B)  |
| B14 | CCMVCC(1)       | F4  | GPIO(C)     | J8  | GND             | M12 | GPIO(A)  |
| C1  | CCMGND(0)       | F6  | VCCIO(D)    | J9  | GPIO(A)         | M14 | VCCIO(A) |
| C3  | GND             | F7  | TMS         | J11 | GPIO(A)         | N1  | GND      |
| C4  | DQ2/GPIO(D)     | F8  | GND         | J12 | VCCIO(A)        | N14 | VLP      |
| C5  | VCC             | F9  | DQ3/GPIO(D) | J14 | VCCIO(B)        | P1  | VCC      |
| C6  | DQ2/GPIO(D)     | F11 | GPIO(A)     | K1  | VCCIO(C)        | P2  | TDO      |
| C7  | DQ3/GPIO(D)     | F12 | GPIO(A)     | K3  | GPIO(C)         | P3  | GPIO(B)  |
| C8  | DQ3/GPIO(D)     | F14 | GPIO(A)     | K4  | GPIO(C)         | P4  | VCCIO(B) |
| C9  | DQ3/GPIO(D)     | G1  | GPIO(C)     | K11 | TRSTB           | P5  | GPIO(B)  |
| C10 | DQ3/GPIO(D)     | G3  | GPIO(C)     | K12 | GPIO(A)         | P6  | CLK(B)   |
| C11 | GND             | G4  | GPIO(C)     | K14 | GPIO(A)         | P7  | CLK(B)   |
| C12 | CCMGND(1)       | G6  | GND         | L1  | VCC             | P8  | VCCIO(B) |
| C14 | VCC             | G7  | GND         | L3  | GPIO(C)         | P9  | GPIO(B)  |
| D1  | GPIO(C)         | G8  | GND         | L4  | GPIO(C)         | P10 | VCC      |
| D3  | GPIO(C)         | G9  | GND         | L5  | GPIO(B)         | P11 | VCC      |
| D4  | DQ2/GPIO(D)     | G11 | GPIO(A)     | L6  | GPIO(B)         | P12 | GPIO(A)  |
| D5  | DQ2/GPIO(D)     | G12 | GPIO(A)     | L7  | GPIO(B)         | P13 | GND      |
| D6  | DQ2/GPIO(D)     | G14 | GPIO(A)     | L8  | GPIO(B)         | P14 | VCC      |



## PolarPro QL1P200 - 256 LPGA Pinout Table

Table 67: PolarPro QL1P200 - 256 LPGA

| Pin | Function        | Pin | Function        | Pin | Function        | Pin | Function        | Pin | Function | Pin | Function |
|-----|-----------------|-----|-----------------|-----|-----------------|-----|-----------------|-----|----------|-----|----------|
| A1  | GND             | C12 | DQCK_P4/GPIO(D) | F7  | VCC             | J2  | GPIO(C)         | L13 | GPIO(A)  | P8  | GPIO(B)  |
| A2  | DQ1/GPIO(D)     | C13 | DQCK_N4/GPIO(D) | F8  | GND             | J3  | GPIO(C)         | L14 | GPIO(A)  | P9  | GPIO(B)  |
| A3  | DQ1/GPIO(D)     | C14 | GND             | F9  | TMS             | J4  | GPIO(C)         | L15 | GPIO(A)  | P10 | GPIO(B)  |
| A4  | DQ1/GPIO(D)     | C15 | DQ4/GPIO(D)     | F10 | VCC             | J5  | VCCIO(C)        | L16 | GPIO(A)  | P11 | GPIO(B)  |
| A5  | DQ2/GPIO(D)     | C16 | DQ4/GPIO(D)     | F11 | DQ4/GPIO(D)     | J6  | GND             | M1  | GPIO(C)  | P12 | GPIO(B)  |
| A6  | DQ2/GPIO(D)     | D1  | GPIO(C)         | F12 | CCMVCC(1)       | J7  | GND             | M2  | GPIO(C)  | P13 | GPIO(B)  |
| A7  | DQS2/GPIO(D)    | D2  | GPIO(C)         | F13 | GPIO(A)         | J8  | VCC             | M3  | GPIO(B)  | P14 | GND      |
| A8  | DQ2/GPIO(D)     | D3  | GPIO(C)         | F14 | GPIO(A)         | J9  | VCC             | M4  | GPIO(B)  | P15 | GPIO(B)  |
| A9  | DEDCLK(D)       | D4  | GPIO(C)         | F15 | GPIO(A)         | J10 | GND             | M5  | GPIO(B)  | P16 | GPIO(B)  |
| A10 | DQ3/GPIO(D)     | D5  | VREF(D)         | F16 | GPIO(A)         | J11 | TRSTB           | M6  | VCCIO(B) | R1  | GPIO(B)  |
| A11 | DQ3/GPIO(D)     | D6  | DQS1/GPIO(D)    | G1  | GPIO(C)         | J12 | VCCIO(A)        | M7  | VCCIO(B) | R2  | GPIO(B)  |
| A12 | DQ3/GPIO(D)     | D7  | DQ2/GPIO(D)     | G2  | GPIO(C)         | J13 | GPIO(A)         | M8  | VCCIO(B) | R3  | GPIO(B)  |
| A13 | DQ3/GPIO(D)     | D8  | DQ2/GPIO(D)     | G3  | GPIO(C)         | J14 | GPIO(A)         | M9  | VCCIO(B) | R4  | GPIO(B)  |
| A14 | DQ4/GPIO(D)     | D9  | DQS3/GPIO(D)    | G4  | GPIO(C)         | J15 | GPIO(A)         | M10 | VCCIO(B) | R5  | TDO      |
| A15 | GPIO(A)         | D10 | DQCK_P3/GPIO(D) | G5  | GPIO(C)         | J16 | CLK(A)/CCMIN(1) | M11 | VCCIO(B) | R6  | GPIO(B)  |
| A16 | GND             | D11 | DQ4/GPIO(D)     | G6  | VCC             | K1  | GPIO(C)         | M12 | GPIO(B)  | R7  | GPIO(B)  |
| B1  | DQ1/GPIO(D)     | D12 | VREF(D)         | G7  | GND             | K2  | GPIO(C)         | M13 | GPIO(A)  | R8  | GPIO(B)  |
| B2  | DQ1/GPIO(D)     | D13 | DQ4/GPIO(D)     | G8  | GND             | K3  | GPIO(C)         | M14 | GPIO(A)  | R9  | GPIO(B)  |
| B3  | DQ1/GPIO(D)     | D14 | GPIO(A)         | G9  | GND             | K4  | GPIO(C)         | M15 | GPIO(A)  | R10 | GPIO(B)  |
| B4  | DQ1/GPIO(D)     | D15 | GPIO(A)         | G10 | GND             | K5  | GPIO(C)         | M16 | GPIO(A)  | R11 | GPIO(B)  |
| B5  | DQ1/GPIO(D)     | D16 | GPIO(A)         | G11 | VCC             | K6  | VCC             | N1  | GPIO(B)  | R12 | GPIO(B)  |
| B6  | DQ2/GPIO(D)     | E1  | GPIO(C)         | G12 | GPIO(A)         | K7  | GND             | N2  | GPIO(B)  | R13 | GPIO(B)  |
| B7  | DQCK_P2/GPIO(D) | E2  | GPIO(C)         | G13 | GPIO(A)         | K8  | GND             | N3  | GPIO(B)  | R14 | GPIO(B)  |
| B8  | DQCK_N2/GPIO(D) | E3  | GPIO(C)         | G14 | GPIO(A)         | K9  | GND             | N4  | GPIO(B)  | R15 | GPIO(B)  |
| B9  | DQ2/GPIO(D)     | E4  | GPIO(C)         | G15 | GPIO(A)         | K10 | GND             | N5  | GPIO(B)  | R16 | GPIO(B)  |
| B10 | DQ3/GPIO(D)     | E5  | CCMGND(0)       | G16 | GPIO(A)         | K11 | VCC             | N6  | GPIO(B)  | T1  | GND      |
| B11 | DQ3/GPIO(D)     | E6  | VCCIO(D)        | H1  | CLK(C)/CCMIN(0) | K12 | GPIO(A)         | N7  | GPIO(B)  | T2  | GPIO(B)  |
| B12 | DQ3/GPIO(D)     | E7  | VCCIO(D)        | H2  | GPIO(C)         | K13 | GPIO(A)         | N8  | GPIO(B)  | T3  | GPIO(B)  |
| B13 | DQ4/GPIO(D)     | E8  | VCCIO(D)        | H3  | GPIO(C)         | K14 | GPIO(A)         | N9  | GPIO(B)  | T4  | GPIO(B)  |
| B14 | DQ4/GPIO(D)     | E9  | VCCIO(D)        | H4  | GPIO(C)         | K15 | GPIO(A)         | N10 | GPIO(B)  | T5  | GPIO(B)  |
| B15 | DQ4/GPIO(D)     | E10 | VCCIO(D)        | H5  | VCCIO(C)        | K16 | GPIO(A)         | N11 | GPIO(B)  | T6  | GPIO(B)  |
| B16 | DQS4/GPIO(D)    | E11 | VCCIO(D)        | H6  | TCK             | L1  | GPIO(C)         | N12 | GPIO(B)  | T7  | CLK(B)   |
| C1  | GPIO(C)         | E12 | CCMGND(1)       | H7  | GND             | L2  | GPIO(C)         | N13 | GPIO(B)  | T8  | GPIO(B)  |
| C2  | GPIO(C)         | E13 | GPIO(A)         | H8  | VCC             | L3  | GPIO(C)         | N14 | GPIO(B)  | T9  | CLK(B)   |
| C3  | GND             | E14 | GPIO(A)         | H9  | VCC             | L4  | GPIO(C)         | N15 | GPIO(A)  | T10 | GPIO(B)  |
| C4  | DQ1/GPIO(D)     | E15 | GPIO(A)         | H10 | GND             | L5  | GPIO(C)         | N16 | GPIO(B)  | T11 | GPIO(B)  |
| C5  | DQCK_P1/GPIO(D) | E16 | GPIO(A)         | H11 | GND             | L6  | GND             | P1  | GPIO(B)  | T12 | GPIO(B)  |
| C6  | DQCK_N1/GPIO(D) | F1  | GPIO(C)         | H12 | VCCIO(A)        | L7  | VCC             | P2  | GPIO(B)  | T13 | GPIO(B)  |
| C7  | DQ2/GPIO(D)     | F2  | GPIO(C)         | H13 | GPIO(A)         | L8  | TDI             | P3  | GND      | T14 | GPIO(B)  |
| C8  | DQ2/GPIO(D)     | F3  | GPIO(C)         | H14 | GPIO(A)         | L9  | GND             | P4  | GPIO(B)  | T15 | GPIO(B)  |
| C9  | DQ3/GPIO(D)     | F4  | GPIO(C)         | H15 | GPIO(A)         | L10 | VCC             | P5  | GPIO(B)  | T16 | GND      |
| C10 | DQCK_N3/GPIO(D) | F5  | CCMVCC(0)       | H16 | GPIO(A)         | L11 | VCCIO(B)        | P6  | GPIO(B)  |     |          |
| C11 | DQ3/GPIO(D)     | F6  | VCCIO(B)        | J1  | GPIO(C)         | L12 | VLP             | P7  | GPIO(B)  |     |          |

## PolarPro QL1P300 - 99 WLCSP Pinout Table

Table 68: PolarPro QL1P300 - 99 WLCSP Pinout Table

| Pin | Datasheet | Pin | Datasheet       | Pin | Datasheet       | Pin | Datasheet |
|-----|-----------|-----|-----------------|-----|-----------------|-----|-----------|
| A1  | GPIO(D)   | C8  | GPIO(D)         | F6  | VCC             | J4  | GPIO(B)   |
| A2  | GPIO(D)   | C9  | GPIO(C)         | F7  | GPIO(C)         | J5  | GPIO(B)   |
| A3  | GPIO(D)   | D1  | GPIO(A)         | F8  | GPIO(C)         | J6  | VCCIO(B)  |
| A4  | GPIO(D)   | D2  | GPIO(A)         | F9  | CLK(C)/CCMIN(0) | J7  | GPIO(B)   |
| A5  | DEDCLK(D) | D3  | GPIO(A)         | G1  | GPIO(A)         | J8  | GPIO(B)   |
| A6  | GPIO(D)   | D4  | VCCIO(A)        | G2  | GPIO(A)         | J9  | GPIO(B)   |
| A7  | GPIO(D)   | D5  | VCC             | G3  | TRSTB           | K1  | GPIO(A)   |
| A8  | GPIO(D)   | D6  | VCCIO(D)        | G4  | GND             | K2  | GPIO(A)   |
| A9  | GND       | D7  | VCC             | G5  | VCC             | K3  | GPIO(B)   |
| B1  | GPIO(D)   | D8  | GPIO(D)         | G6  | GND             | K4  | GPIO(B)   |
| B2  | GPIO(D)   | D9  | GPIO(C)         | G7  | VCCIO(C)        | K5  | GPIO(B)   |
| B3  | GPIO(D)   | E1  | GPIO(A)         | G8  | TCK             | K6  | GPIO(B)   |
| B4  | GPIO(D)   | E2  | GPIO(A)         | G9  | VCCIO(B)        | K7  | GPIO(B)   |
| B5  | GPIO(D)   | E3  | GPIO(A)         | H1  | GPIO(A)         | K8  | GPIO(B)   |
| B6  | GPIO(D)   | E4  | GND             | H2  | GPIO(A)         | K9  | GPIO(B)   |
| B7  | GPIO(D)   | E5  | VCC             | H3  | VCCIO(B)        | L1  | VLP       |
| B8  | GPIO(D)   | E6  | GND             | H4  | VCCIO(A)        | L2  | GPIO(B)   |
| B9  | GPIO(C)   | E7  | VCCIO(D)        | H5  | VCCIO(B)        | L3  | GPIO(B)   |
| C1  | GPIO(A)   | E8  | GPIO(C)         | H6  | TDI             | L4  | GPIO(B)   |
| C2  | GPIO(A)   | E9  | GPIO(C)         | H7  | VCC             | L5  | CLK(B)    |
| C3  | GPIO(A)   | F1  | CLK(A)/CCMIN(1) | H8  | GND             | L6  | CLK(B)    |
| C4  | TMS       | F2  | GPIO(A)         | H9  | VCC             | L7  | GPIO(B)   |
| C5  | GPIO(D)   | F3  | GPIO(A)         | J1  | GPIO(A)         | L8  | GPIO(B)   |
| C6  | GPIO(D)   | F4  | VCC             | J2  | GPIO(A)         | L9  | GPIO(B)   |
| C7  | VREF      | F5  | GND             | J3  | GND             |     |           |

## PolarPro QL1P300 - 132 TFBGA Pinout Table

Table 69: PolarPro QL1P300 - 132 TFBGA

| Pin | Function        | Pin | Function    | Pin | Function        | Pin | Function |
|-----|-----------------|-----|-------------|-----|-----------------|-----|----------|
| A1  | VCC             | D7  | DQ3/GPIO(D) | H1  | CLK(C)/CCMIN(0) | L9  | GPIO(B)  |
| A2  | VCC             | D8  | DQ3/GPIO(D) | H3  | VCCIO(C)        | L10 | GPIO(B)  |
| A3  | VREF            | D9  | DQ3/GPIO(D) | H4  | GPIO(C)         | L11 | GPIO(A)  |
| A4  | DQS2/GPIO(D)    | D10 | VCCIO(D)    | H6  | GND             | L12 | GPIO(A)  |
| A5  | DQCK_P2/GPIO(D) | D11 | GPIO(A)     | H7  | GND             | L14 | GPIO(A)  |
| A6  | DQCK_N2/GPIO(D) | D12 | VCCIO(A)    | H8  | GND             | M1  | VCC      |
| A7  | DEDCLK(D)       | D14 | GPIO(A)     | H9  | GND             | M3  | GND      |
| A8  | VCCIO(D)        | E1  | VCCIO(C)    | H11 | GPIO(A)         | M4  | GPIO(B)  |
| A9  | DQS3/GPIO(D)    | E3  | GPIO(C)     | H12 | GPIO(A)         | M5  | GPIO(B)  |
| A10 | DQCK_N3/GPIO(D) | E4  | GPIO(C)     | H14 | CLK(A)/CCMIN(1) | M6  | GPIO(B)  |
| A11 | DQCK_P3/GPIO(D) | E11 | GPIO(A)     | J1  | GPIO(C)         | M7  | GPIO(B)  |
| A12 | DQ3/GPIO(D)     | E12 | GPIO(A)     | J3  | TCK             | M8  | GPIO(B)  |
| A13 | VREF            | E14 | VCCIO(A)    | J4  | VCCIO(B)        | M9  | GPIO(B)  |
| A14 | VCC             | F1  | GPIO(C)     | J6  | GPIO(C)         | M10 | VCCIO(B) |
| B1  | CCMVCC(0)       | F3  | GPIO(C)     | J7  | TDI             | M11 | GPIO(B)  |
| B14 | CCMVCC(1)       | F4  | GPIO(C)     | J8  | GND             | M12 | GPIO(A)  |
| C1  | CCMGND(0)       | F6  | VCCIO(D)    | J9  | GPIO(A)         | M14 | VCCIO(A) |
| C3  | GND             | F7  | TMS         | J11 | GPIO(A)         | N1  | GND      |
| C4  | DQ2/GPIO(D)     | F8  | GND         | J12 | VCCIO(A)        | N14 | VLP      |
| C5  | VCC             | F9  | DQ3/GPIO(D) | J14 | VCCIO(B)        | P1  | VCC      |
| C6  | DQ2/GPIO(D)     | F11 | GPIO(A)     | K1  | VCCIO(C)        | P2  | TDO      |
| C7  | DQ3/GPIO(D)     | F12 | GPIO(A)     | K3  | GPIO(C)         | P3  | GPIO(B)  |
| C8  | DQ3/GPIO(D)     | F14 | GPIO(A)     | K4  | GPIO(C)         | P4  | VCCIO(B) |
| C9  | DQ3/GPIO(D)     | G1  | GPIO(C)     | K11 | TRSTB           | P5  | GPIO(B)  |
| C10 | DQ3/GPIO(D)     | G3  | GPIO(C)     | K12 | GPIO(A)         | P6  | CLK(B)   |
| C11 | GND             | G4  | GPIO(C)     | K14 | GPIO(A)         | P7  | CLK(B)   |
| C12 | CCMGND(1)       | G6  | GND         | L1  | VCC             | P8  | VCCIO(B) |
| C14 | VCC             | G7  | GND         | L3  | GPIO(C)         | P9  | GPIO(B)  |
| D1  | GPIO(C)         | G8  | GND         | L4  | GPIO(C)         | P10 | VCC      |
| D3  | GPIO(C)         | G9  | GND         | L5  | GPIO(B)         | P11 | VCC      |
| D4  | DQ2/GPIO(D)     | G11 | GPIO(A)     | L6  | GPIO(B)         | P12 | GPIO(A)  |
| D5  | DQ2/GPIO(D)     | G12 | GPIO(A)     | L7  | GPIO(B)         | P13 | GND      |
| D6  | DQ2/GPIO(D)     | G14 | GPIO(A)     | L8  | GPIO(B)         | P14 | VCC      |

## PolarPro QL1P300 - 256 LPGA Pinout Table

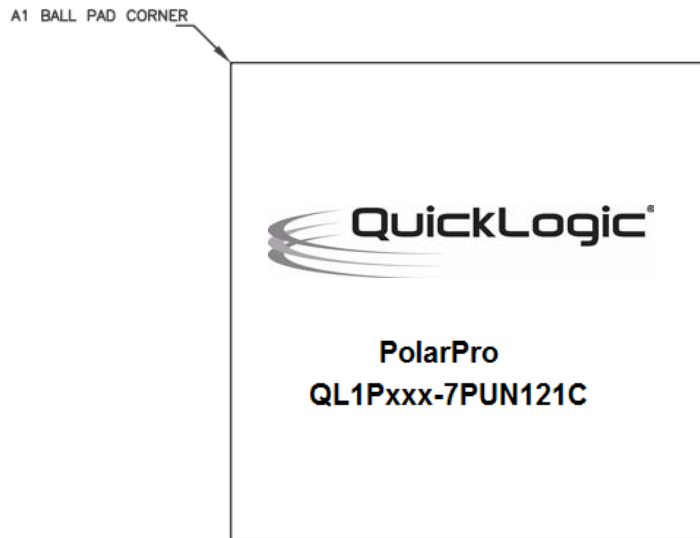
Table 70: QL1P300 – 256 LPGA Pinout Table

| Pin | Function        | Pin | Function        | Pin | Function            | Pin | Function            | Pin | Function | Pin | Function |
|-----|-----------------|-----|-----------------|-----|---------------------|-----|---------------------|-----|----------|-----|----------|
| A1  | GND             | C12 | DQCK_P4/GPIO(D) | F7  | VCC                 | J2  | GPIO(C)             | L13 | GPIO(A)  | P8  | GPIO(B)  |
| A2  | DQ1/GPIO(D)     | C13 | DQCK_N4/GPIO(D) | F8  | GND                 | J3  | GPIO(C)             | L14 | GPIO(A)  | P9  | GPIO(B)  |
| A3  | DQ1/GPIO(D)     | C14 | GND             | F9  | TMS                 | J4  | GPIO(C)             | L15 | GPIO(A)  | P10 | GPIO(B)  |
| A4  | DQ1/GPIO(D)     | C15 | DQ4/GPIO(D)     | F10 | VCC                 | J5  | VCCIO(C)            | L16 | GPIO(A)  | P11 | GPIO(B)  |
| A5  | DQ2/GPIO(D)     | C16 | DQ4/GPIO(D)     | F11 | DQ4/GPIO(D)         | J6  | GND                 | M1  | GPIO(C)  | P12 | GPIO(B)  |
| A6  | DQ2/GPIO(D)     | D1  | GPIO(C)         | F12 | CCMVCC(1)           | J7  | GND                 | M2  | GPIO(C)  | P13 | GPIO(B)  |
| A7  | DQS2/GPIO(D)    | D2  | GPIO(C)         | F13 | GPIO(A)             | J8  | VCC                 | M3  | GPIO(B)  | P14 | GND      |
| A8  | DQ2/GPIO(D)     | D3  | GPIO(C)         | F14 | GPIO(A)             | J9  | VCC                 | M4  | GPIO(B)  | P15 | GPIO(B)  |
| A9  | DEDCLK(D)       | D4  | GPIO(C)         | F15 | GPIO(A)             | J10 | GND                 | M5  | GPIO(B)  | P16 | GPIO(B)  |
| A10 | DQ3/GPIO(D)     | D5  | VREF(D)         | F16 | GPIO(A)             | J11 | TRSTB               | M6  | VCCIO(B) | R1  | GPIO(B)  |
| A11 | DQ3/GPIO(D)     | D6  | DQS1/GPIO(D)    | G1  | GPIO(C)             | J12 | VCCIO(A)            | M7  | VCCIO(B) | R2  | GPIO(B)  |
| A12 | DQ3/GPIO(D)     | D7  | DQ2/GPIO(D)     | G2  | GPIO(C)             | J13 | GPIO(A)             | M8  | VCCIO(B) | R3  | GPIO(B)  |
| A13 | DQ3/GPIO(D)     | D8  | DQ2/GPIO(D)     | G3  | GPIO(C)             | J14 | GPIO(A)             | M9  | VCCIO(B) | R4  | GPIO(B)  |
| A14 | DQ4/GPIO(D)     | D9  | DQS3/GPIO(D)    | G4  | GPIO(C)             | J15 | GPIO(A)             | M10 | VCCIO(B) | R5  | TDO      |
| A15 | GPIO(A)         | D10 | DQCK_P3/GPIO(D) | G5  | GPIO(C)             | J16 | CLK(A)/<br>CCMIN(1) | M11 | VCCIO(B) | R6  | GPIO(B)  |
| A16 | GND             | D11 | DQ4/GPIO(D)     | G6  | VCC                 | K1  | GPIO(C)             | M12 | GPIO(B)  | R7  | GPIO(B)  |
| B1  | DQ1/GPIO(D)     | D12 | VREF(D)         | G7  | GND                 | K2  | GPIO(C)             | M13 | GPIO(A)  | R8  | GPIO(B)  |
| B2  | DQ1/GPIO(D)     | D13 | DQ4/GPIO(D)     | G8  | GND                 | K3  | GPIO(C)             | M14 | GPIO(A)  | R9  | GPIO(B)  |
| B3  | DQ1/GPIO(D)     | D14 | GPIO(A)         | G9  | GND                 | K4  | GPIO(C)             | M15 | GPIO(A)  | R10 | GPIO(B)  |
| B4  | DQ1/GPIO(D)     | D15 | GPIO(A)         | G10 | GND                 | K5  | GPIO(C)             | M16 | GPIO(A)  | R11 | GPIO(B)  |
| B5  | DQ1/GPIO(D)     | D16 | GPIO(A)         | G11 | VCC                 | K6  | VCC                 | N1  | GPIO(B)  | R12 | GPIO(B)  |
| B6  | DQ2/GPIO(D)     | E1  | GPIO(C)         | G12 | GPIO(A)             | K7  | GND                 | N2  | GPIO(B)  | R13 | GPIO(B)  |
| B7  | DQCK_P2/GPIO(D) | E2  | GPIO(C)         | G13 | GPIO(A)             | K8  | GND                 | N3  | GPIO(B)  | R14 | GPIO(B)  |
| B8  | DQCK_N2/GPIO(D) | E3  | GPIO(C)         | G14 | GPIO(A)             | K9  | GND                 | N4  | GPIO(B)  | R15 | GPIO(B)  |
| B9  | DQ2/GPIO(D)     | E4  | GPIO(C)         | G15 | GPIO(A)             | K10 | GND                 | N5  | GPIO(B)  | R16 | GPIO(B)  |
| B10 | DQ3/GPIO(D)     | E5  | CCMGND(0)       | G16 | GPIO(A)             | K11 | VCC                 | N6  | GPIO(B)  | T1  | GND      |
| B11 | DQ3/GPIO(D)     | E6  | VCCIO(D)        | H1  | CLK(C)/<br>CCMIN(0) | K12 | GPIO(A)             | N7  | GPIO(B)  | T2  | GPIO(B)  |
| B12 | DQ3/GPIO(D)     | E7  | VCCIO(D)        | H2  | GPIO(C)             | K13 | GPIO(A)             | N8  | GPIO(B)  | T3  | GPIO(B)  |
| B13 | DQ4/GPIO(D)     | E8  | VCCIO(D)        | H3  | GPIO(C)             | K14 | GPIO(A)             | N9  | GPIO(B)  | T4  | GPIO(B)  |
| B14 | DQ4/GPIO(D)     | E9  | VCCIO(D)        | H4  | GPIO(C)             | K15 | GPIO(A)             | N10 | GPIO(B)  | T5  | GPIO(B)  |
| B15 | DQ4/GPIO(D)     | E10 | VCCIO(D)        | H5  | VCCIO(C)            | K16 | GPIO(A)             | N11 | GPIO(B)  | T6  | GPIO(B)  |
| B16 | DQS4/GPIO(D)    | E11 | VCCIO(D)        | H6  | TCK                 | L1  | GPIO(C)             | N12 | GPIO(B)  | T7  | CLK(B)   |
| C1  | GPIO(C)         | E12 | CCMGND(1)       | H7  | GND                 | L2  | GPIO(C)             | N13 | GPIO(B)  | T8  | GPIO(B)  |
| C2  | GPIO(C)         | E13 | GPIO(A)         | H8  | VCC                 | L3  | GPIO(C)             | N14 | GPIO(B)  | T9  | CLK(B)   |
| C3  | GND             | E14 | GPIO(A)         | H9  | VCC                 | L4  | GPIO(C)             | N15 | GPIO(A)  | T10 | GPIO(B)  |
| C4  | DQ1/GPIO(D)     | E15 | GPIO(A)         | H10 | GND                 | L5  | GPIO(C)             | N16 | GPIO(B)  | T11 | GPIO(B)  |
| C5  | DQCK_P1/GPIO(D) | E16 | GPIO(A)         | H11 | GND                 | L6  | GND                 | P1  | GPIO(B)  | T12 | GPIO(B)  |
| C6  | DQCK_N1/GPIO(D) | F1  | GPIO(C)         | H12 | VCCIO(A)            | L7  | VCC                 | P2  | GPIO(B)  | T13 | GPIO(B)  |
| C7  | DQ2/GPIO(D)     | F2  | GPIO(C)         | H13 | GPIO(A)             | L8  | TDI                 | P3  | GND      | T14 | GPIO(B)  |
| C8  | DQ2/GPIO(D)     | F3  | GPIO(C)         | H14 | GPIO(A)             | L9  | GND                 | P4  | GPIO(B)  | T15 | GPIO(B)  |
| C9  | DQ3/GPIO(D)     | F4  | GPIO(C)         | H15 | GPIO(A)             | L10 | VCC                 | P5  | GPIO(B)  | T16 | GND      |
| C10 | DQCK_N3/GPIO(D) | F5  | CCMVCC(0)       | H16 | GPIO(A)             | L11 | VCCIO(B)            | P6  | GPIO(B)  |     |          |
| C11 | DQ3/GPIO(D)     | F6  | VCCIO(B)        | J1  | GPIO(C)             | L12 | VLP                 | P7  | GPIO(B)  |     |          |

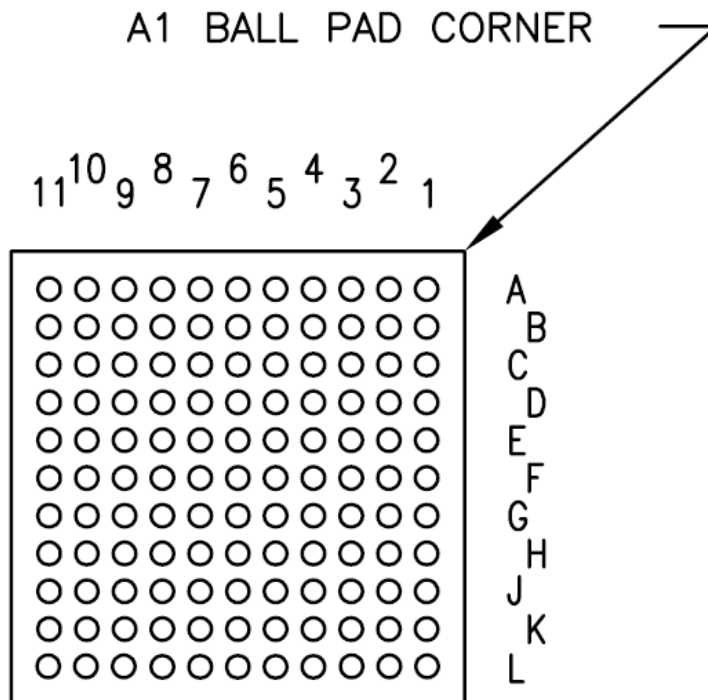
## Packaging Pinout Diagrams

### PolarPro QL1Pxxx - 121 TFBGA Pinout Diagram

Top

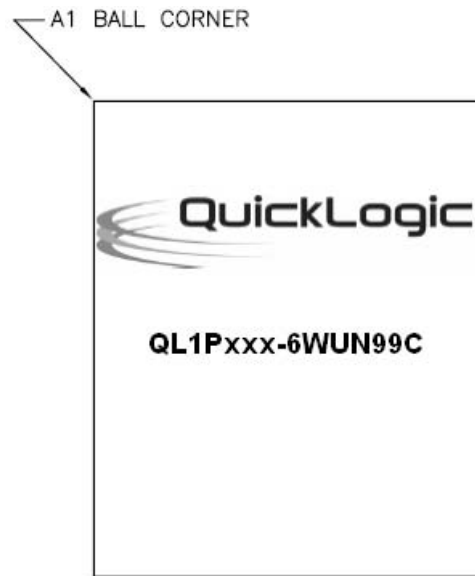


Bottom

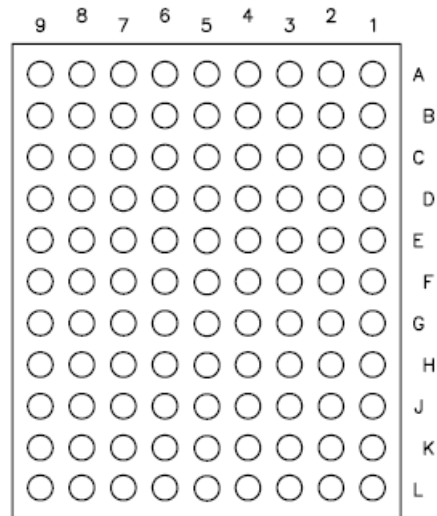


## PolarPro QL1Pxxx - 99 WLCSP Pinout Diagram

Top



Bottom

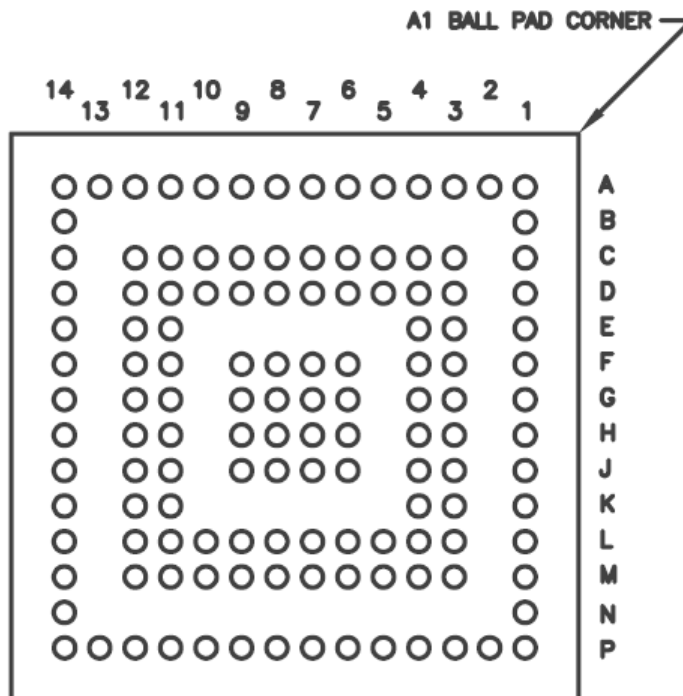


## PolarPro QL1Pxxx - 132 TFBGA (8 mm x 8 mm) Pinout Diagram

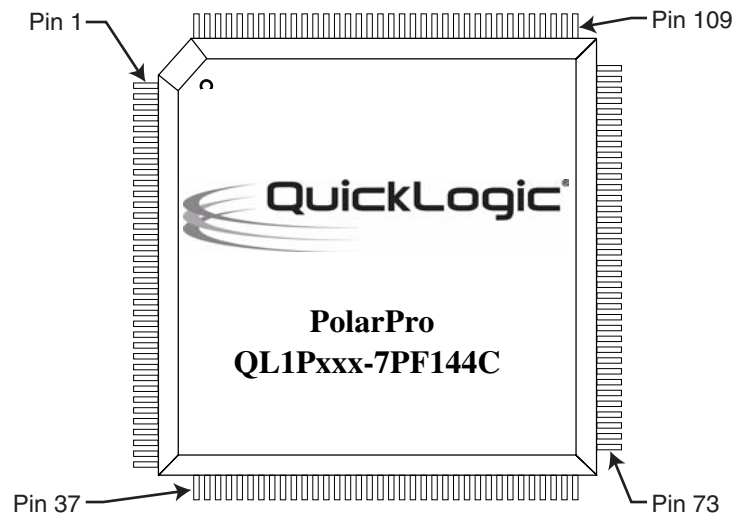
Top



Bottom



## PolarPro QL1Pxxx - 144 TQFP Pinout Diagram



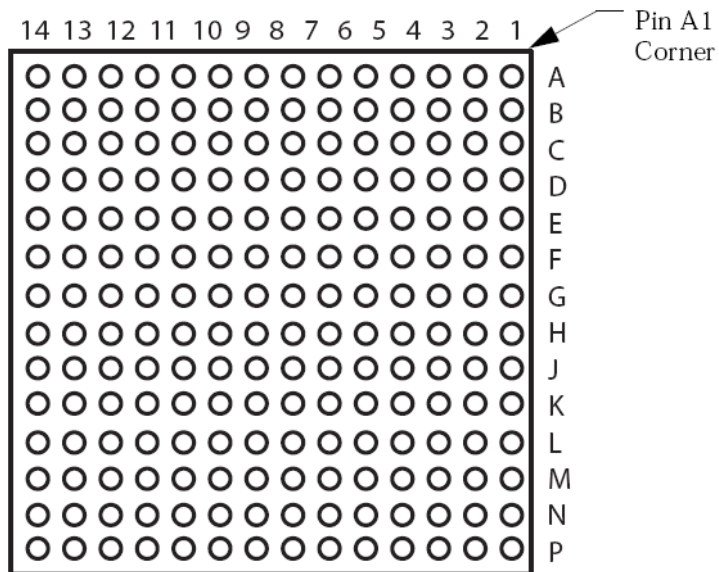


## PolarPro QL1Pxxx - 196 TFBGA (12 mm x 12 mm) Pinout Diagram

Top

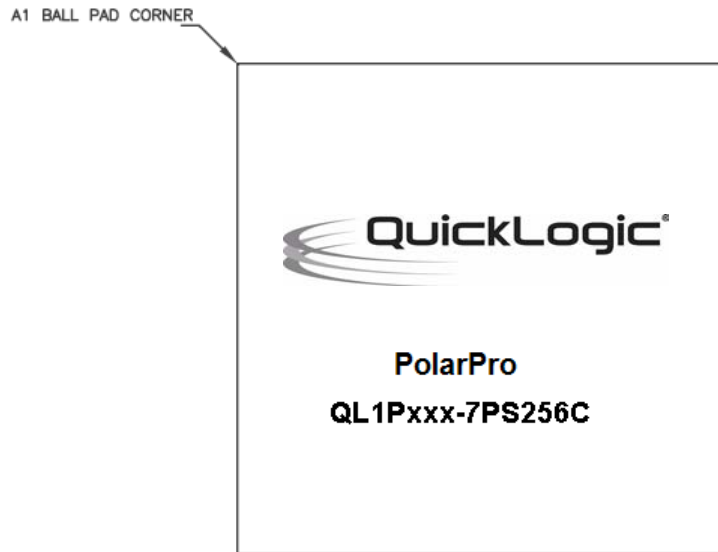


Bottom

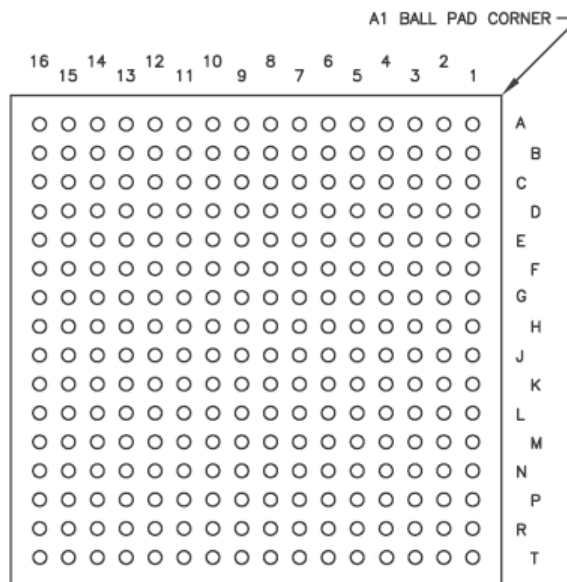


## PolarPro QL1Pxxx - 256 LBGAs Pinout Diagram

### Top



### Bottom



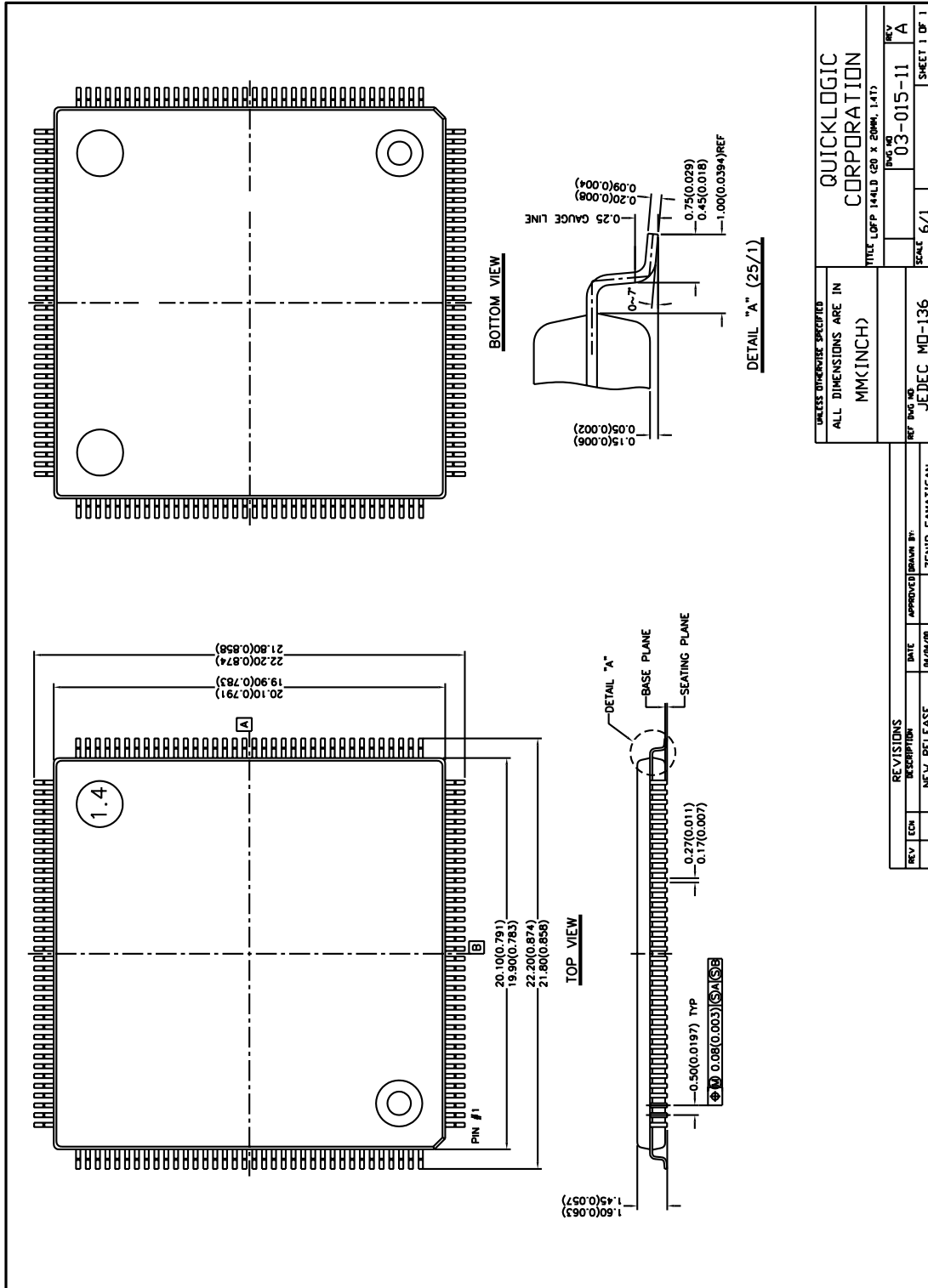
## Package Mechanical Drawings





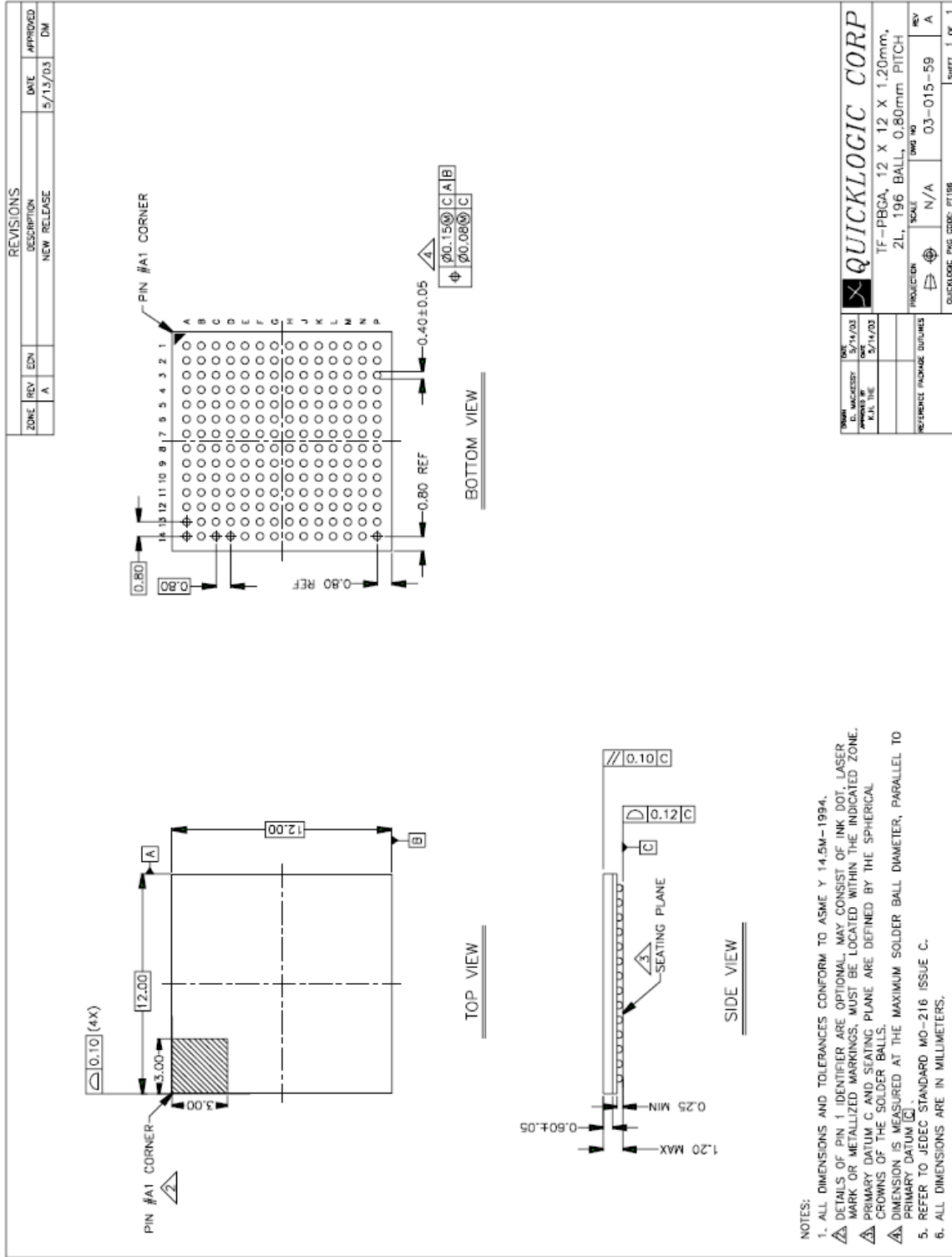


# 144 TQFP Packaging Drawing



|                                     |          |                                    |       |
|-------------------------------------|----------|------------------------------------|-------|
| UNLESS OTHERWISE SPECIFIED          |          | QUICKLOGIC CORPORATION             |       |
| ALL DIMENSIONS ARE IN MM(INCH)      |          | TITLE: LQFP 144LD QFP X 20MM, 1447 |       |
| REV                                 | ECN      | REV                                | REV   |
|                                     |          | 03-015-11                          | A     |
| REVISIONS                           |          | REF Pkg. NO.                       | SCALE |
| DESCRIPTION                         | DATE     | JEDEC MO-136                       | 6/1   |
| NEW RELEASE                         | 04/24/08 | SHEET 1 OF 1                       |       |
| APPROVED/DRAWN BY: ZENIR FAMA TIGAN |          |                                    |       |

# 196 TFBGA (12 mm x 12 mm) Package Drawing



|                             |          |                            |
|-----------------------------|----------|----------------------------|
| DATE                        | 3/14/03  | QUICKLOGIC CORP            |
| DESIGNED BY                 | N.A. THE | TF-PBGA, 12 X 12 X 1.20mm, |
| REFERENCE INCHES/DIMENSIONS | N/A      | 2L, 196 BALL, 0.80mm PITCH |
| PRODUCTION                  | N/A      | SCALE                      |
| SCALE                       | N/A      | DWG NO                     |
| PRODUCTION                  | N/A      | 03-015-59                  |
| OUTLOOK Pkg CODE: PTF196    |          | REV                        |
|                             |          | A                          |
|                             |          | SHEET 1 OF 1               |





## Packaging Information

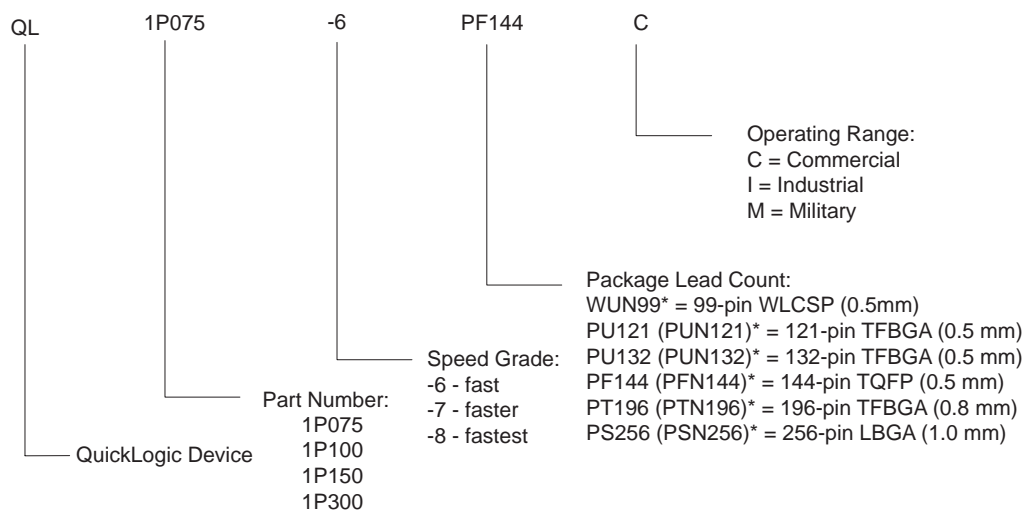
The PolarPro QL1P075, QL1P100, QL1P200 and QL1P300 device packaging information is presented in Table 71.

Table 71: QL1P075, QL1P100, QL1P200 and QL1P300 Packaging Options

| Device Information               | Device  |    |         |   |    |         |   |    |         |
|----------------------------------|---|----|---------|---|----|---------|---|----|---------|
|                                  | QL1P075   |    |         | QL1P100   |    |         | QL1P200 / QL1P300                             |    |         |
|                                  | Pin   | Pb | Pb-Free | Pin   | Pb | Pb-Free | Pin   | Pb | Pb-Free |
| Package Definitions <sup>a</sup> | 144 TQFP<br>(20 mm x 20 mm)<br>Pitch - 0.50 mm  | X  | X       | 121 TFBGA<br>(6 mm x 6 mm)<br>Pitch - 0.50 mm   |    | X       | 99 WLCSP<br>Pitch - 0.50 mm                   |    | X       |
|                                  | 196 TFBGA<br>(12 mm x 12 mm)<br>Pitch - 0.80 mm | X  | X       | 132 TFBGA<br>(8 mm x 8 mm)<br>Pitch - 0.50 mm   |    | X       | 132 TFBGA<br>(8 mm x 8 mm)<br>Pitch - 0.50 mm |    | X       |
|                                  | 256 LBGA<br>(17 mm x 17 mm)<br>Pitch - 1.0 mm   | X  | X       | 144 TQFP<br>(20 mm x 20 mm)<br>Pitch - 0.50 mm  | X  | X       | 256 LBGA<br>(17 mm x 17 mm)<br>Pitch - 1.0 mm | X  | X       |
|                                  |   |    |         | 196 TFBGA<br>(12 mm x 12 mm)<br>Pitch - 0.80 mm | X  | X       |   |    |         |
|                                  |   |    |         | 256 LBGA<br>(17 mm x 17 mm)<br>Pitch - 1.0 mm   | X  | X       |   |    |         |

- a. WLCSP = Wafer Level Chip Scale Package  
 TFBGA = Thin Profile Fine Pitch Ball Grid Array  
 LBGA = Low Profile Ball Grid Array  
 TQFP = Thin Quad Flat Pack

## Ordering Information



\* Lead-free packaging is denoted by the character 'N' preceding the number of pins.

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## Revision History

| Revision | Date          | Originator and Comments   |
|----------|---------------|---|
| A        | November 2007 | Jason Lew and Kathleen Murchek<br>- First release   |
| B        | January 2008  | Jason Lew and Kathleen Murchek<br>- Clock Dynamic Enable section changed clock2_dyn_en to CKPAD2_DYN_EN.<br>- Logic Cell Delays table change t <sub>HL</sub> Max. to N/A. |
| C        | July 2008     | Jason Lew and Kathleen Murchek<br>- Updated Copyright and Trademark Information.<br>- Updated Contact Information.<br>- Added Notice of Disclaimer                        |
| D        | January 2009  | Jason Lew and Kathleen Murchek<br>- Updated Thermal Characteristics.<br>- Added 99-pin WLCSP package information.   |

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