

# QuickLogic® PolarPro® 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)

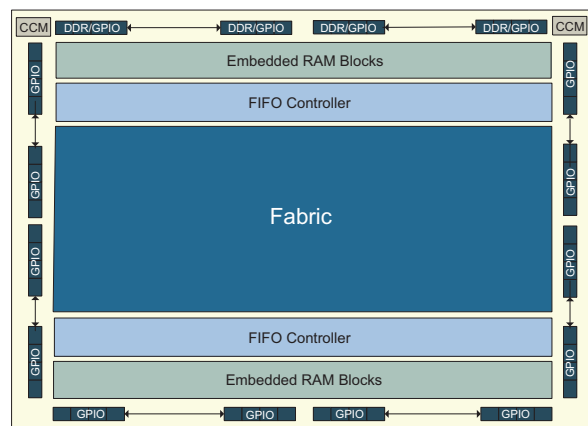
#### Very Low Power (VLP) Mode

- 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
CCM(s)		2 <sup>a</sup>	2 <sup>a</sup>	2	2 <sup>a</sup>
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	-	-
	LBGA (1.0 mm)	256	256	256, 324	256, 324

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

Table 2: Maximum Usable I/Os

Device	99 WLCSP	121 TFBGA (6 mm x 6 mm)	132 TFBGA (8 mm x 8 mm)	144 TQFP (20 mm x 20 mm)	196 TFBGA (12 mm x 12 mm)	256 LBGA (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.

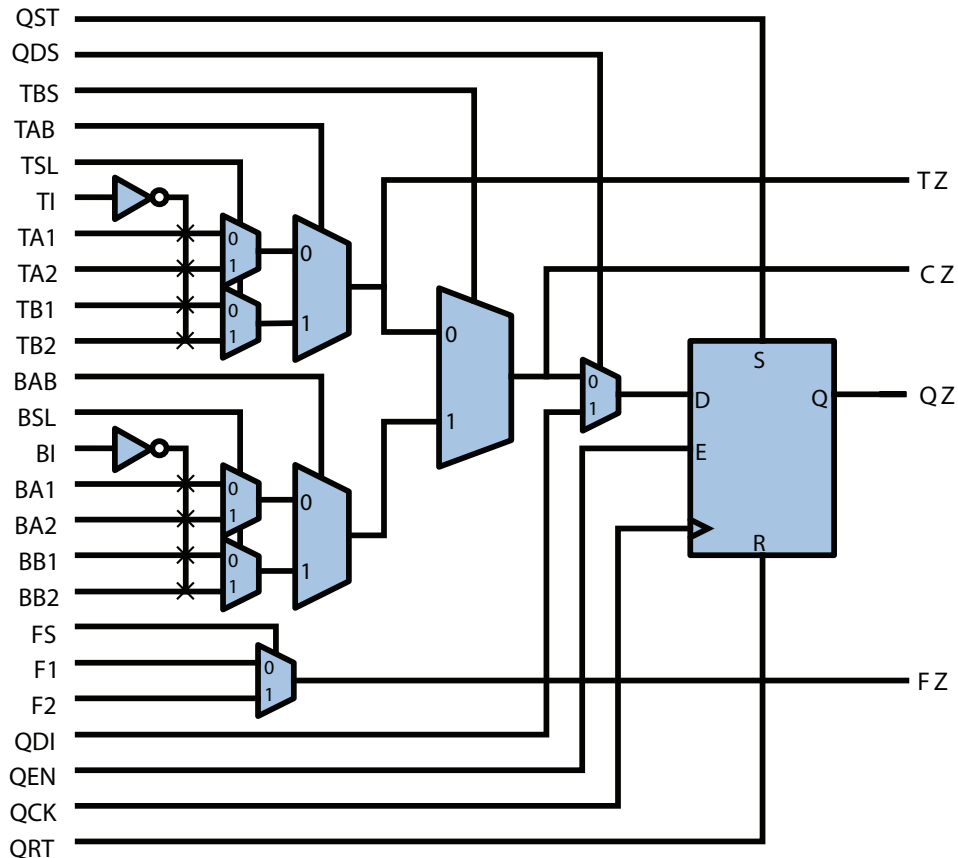
## Programmable Logic Architectural Overview

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

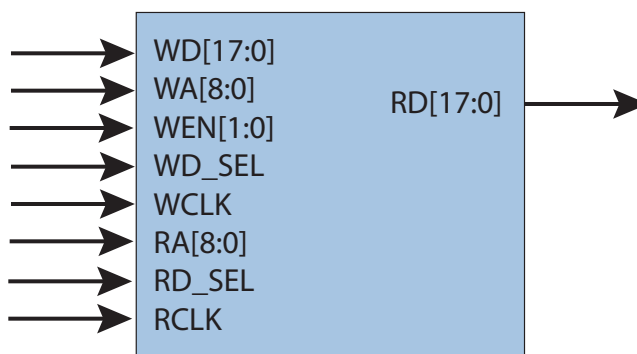


Table 3: RAM Interface Signals

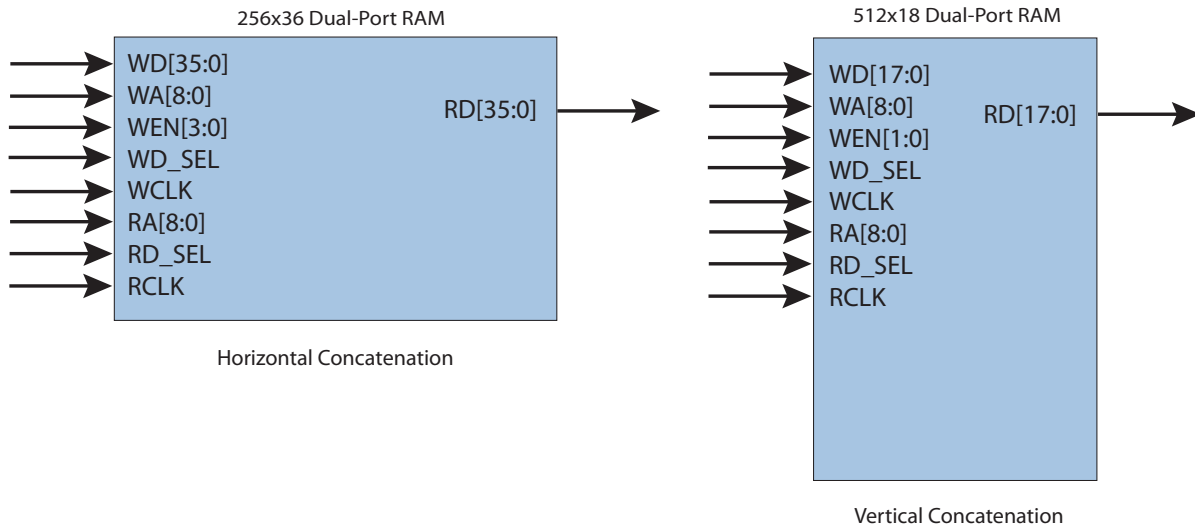
Signal Name	Function
<b>Inputs</b>	
WD [17:0]	Write Data
WA [8:0]	Write Address
WEN [1:0]	Write Enable (two 9-bit enables)
WD_SEL	Write Chip Select
WCLK	Write Clock
RA [8:0]	Read Address
RD_SEL	Read Chip Select
RCLK	Read Clock
<b>Output</b>	
RD [17:0]	Read Data

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

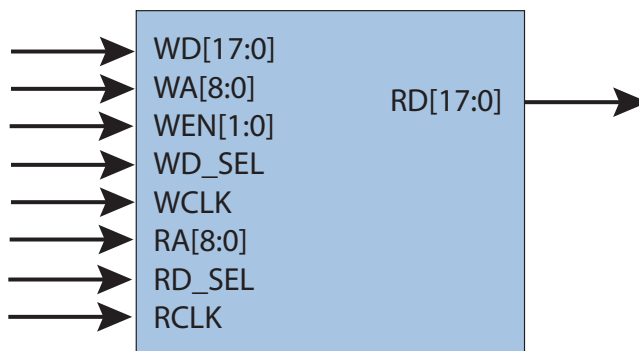


Table 6: True Dual-Port RAM Interface Signals

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 QL1P100	512	1-18
QL1P200 QL1P300	1024	1-9

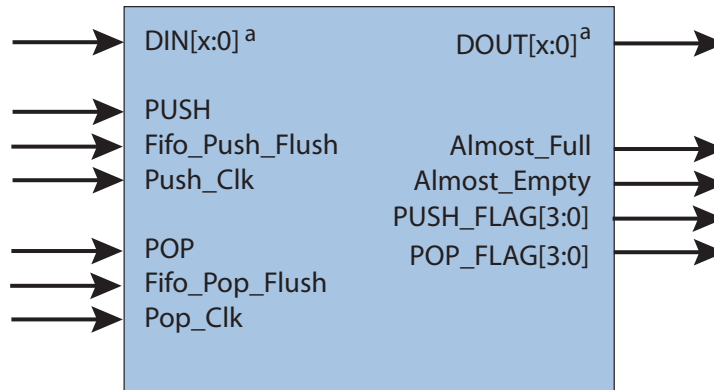
## Embedded FIFO Controllers

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 QL1P100 QL1P200 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

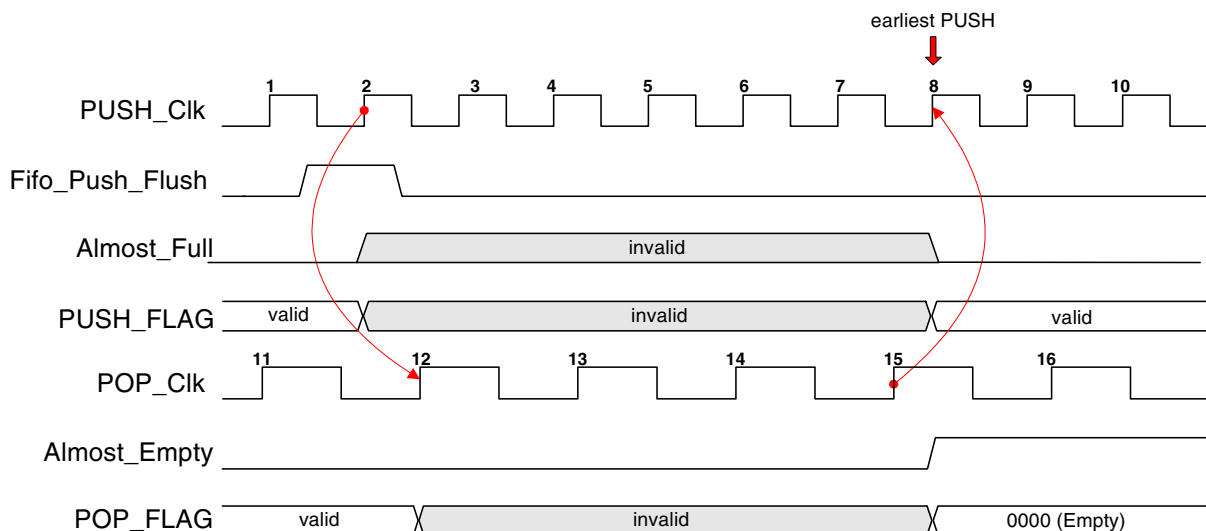
## FIFO Flush Procedure

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.

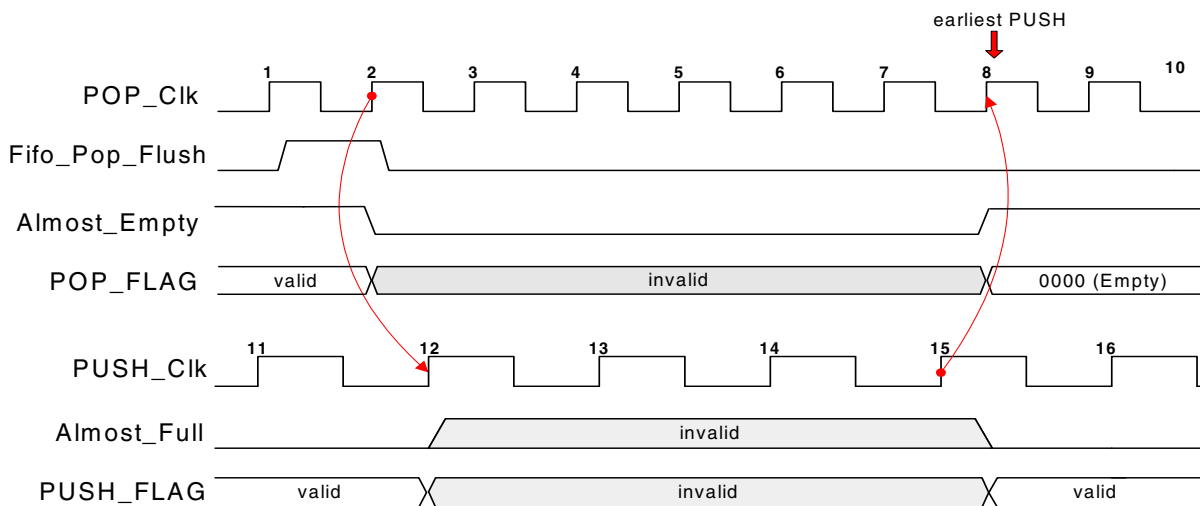
**Figure 7** illustrates a FIFO Flush operation. After the **Fifo\_Push\_Flush** is asserted at 2 (**PUSH\_Clk**), four POP clock cycles (12 through 15) are required to update the **POP\_FLAG**, and **PUSH\_FLAG** signals. The **Almost\_Empty** signal is asserted to indicate that the push flush operation 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



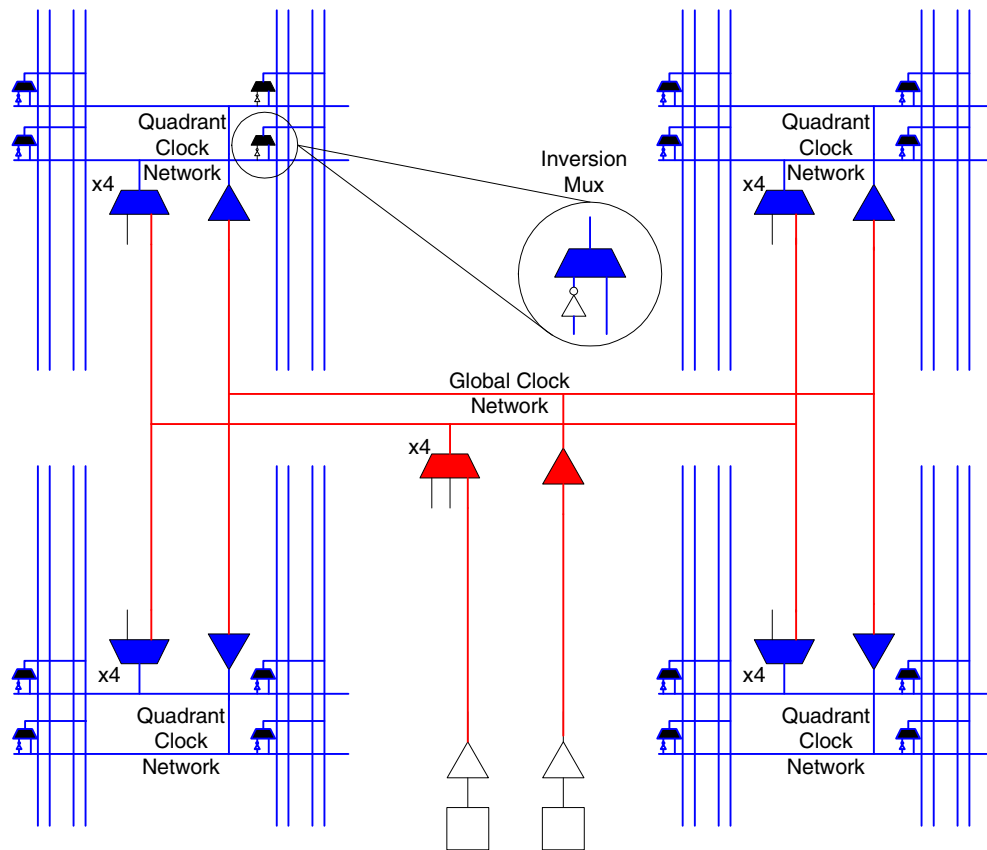
**Figure 7** and **Figure 8** are only true for this particular PUSH-POP clock frequency combination. The clock frequency and phase difference between **POP\_Clk** and **PUSH\_Clk** can cause an additional flush delay of one clock cycle in either domain because of the asynchronous relationship between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

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

## Clock Network Architecture

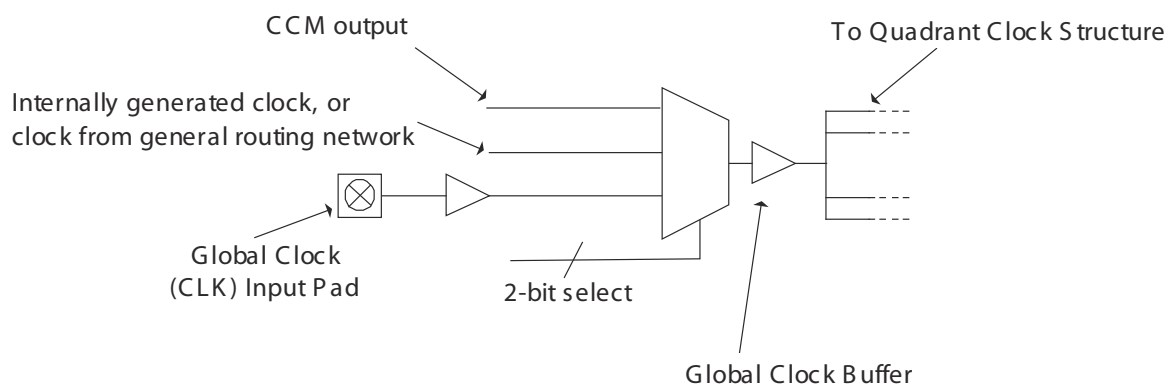
The PolarPro clock network architecture consists of a 2-level H-tree network as shown in Figure 9. The first level of each clock tree (high-lighted in red) spans from the clock input pad to the global clock network and to the center of each quadrant of the chip. The second level (high-lighted in blue) 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



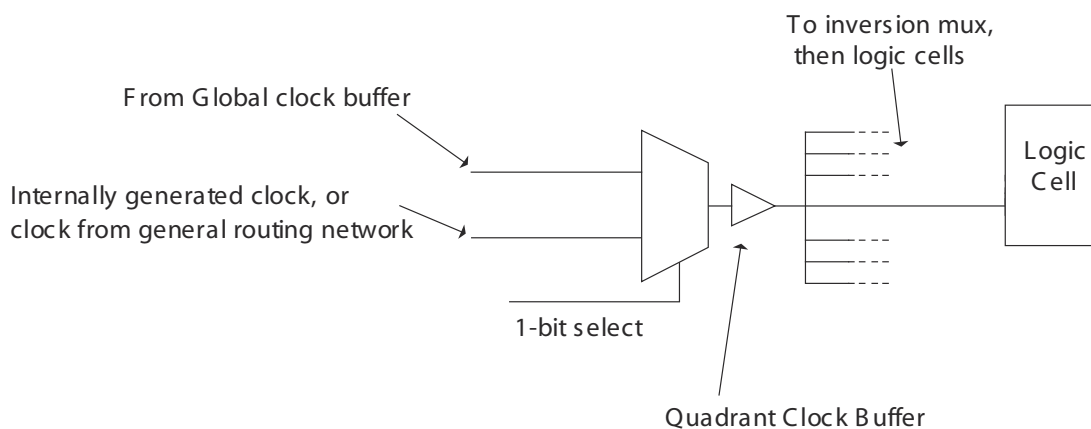
Of the five global clock networks, four can be either driven directly by clock pads, Configurable Clock Manager (CCM) outputs, or internally generated signals. These four global clocks go through 3-input global clock muxes located in the middle of the die. See **Figure 10** for a diagram of a 3-input 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](#).

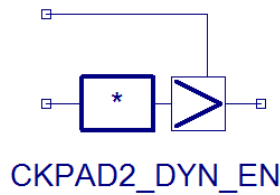
## Dynamic Clock Enable

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

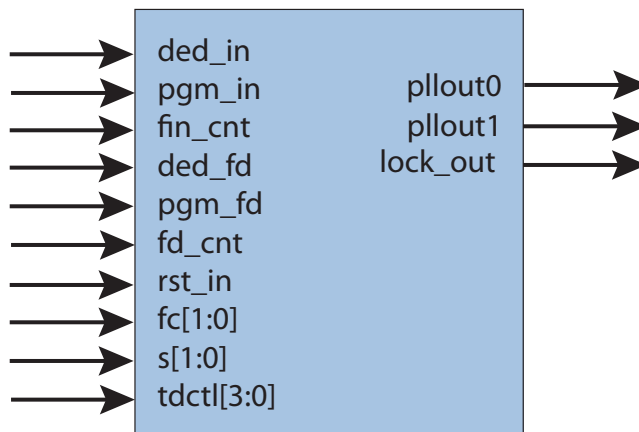


## Configurable Clock Managers (CCMs)

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  $\mu$ s 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. 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.

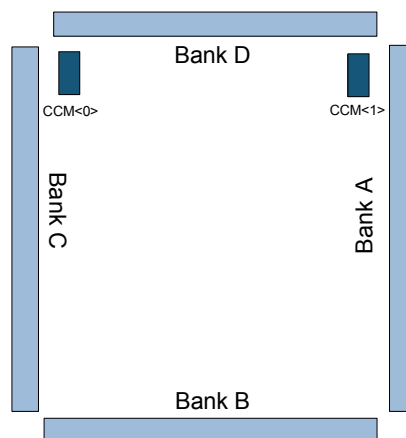
For more information on CCMs and how to use them in QuickWorks, refer to [Application Note 87 Configurable Clock Managers](#).

## 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

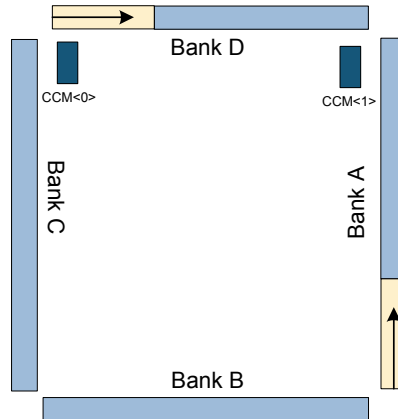


SSOs placed in Bank C and Bank D in close proximity to CCM<0> may affect that CCM's functionality. Similarly, SSOs placed in Bank A and Bank D in close proximity to CCM<1> may affect that CCM's functionality.



**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 (Bank A and Bank D) or (Bank C and Bank D)	Slew Rate Setting							
	Wow		Very Fast		Fast		Slow	
	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO 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 (Bank A and Bank D) or (Bank C and Bank D)	Slew Rate Setting							
	Wow		Very Fast		Fast		Slow	
	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO 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 (Bank A and Bank D) or (Bank C and Bank D)	Slew Rate Setting							
	Wow		Very Fast		Fast		Slow	
	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO 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 (Bank A and Bank D) or (Bank C and Bank D)	Slew Rate Setting							
	Wow		Very Fast		Fast		Slow	
	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO 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

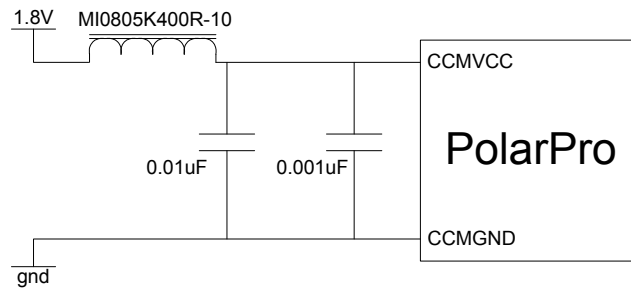
Total SSO in (Bank A and Bank D) or (Bank C and Bank D)	Slew Rate Setting							
	Wow		Very Fast		Fast		Slow	
	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D
<b>QL1P075 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 (Bank A and Bank D) or (Bank C and Bank D)	Slew Rate Setting							
	Wow		Very Fast		Fast		Slow	
	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO in Bank D	Max. SSO in Bank A/ Bank C	Max. SSO 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



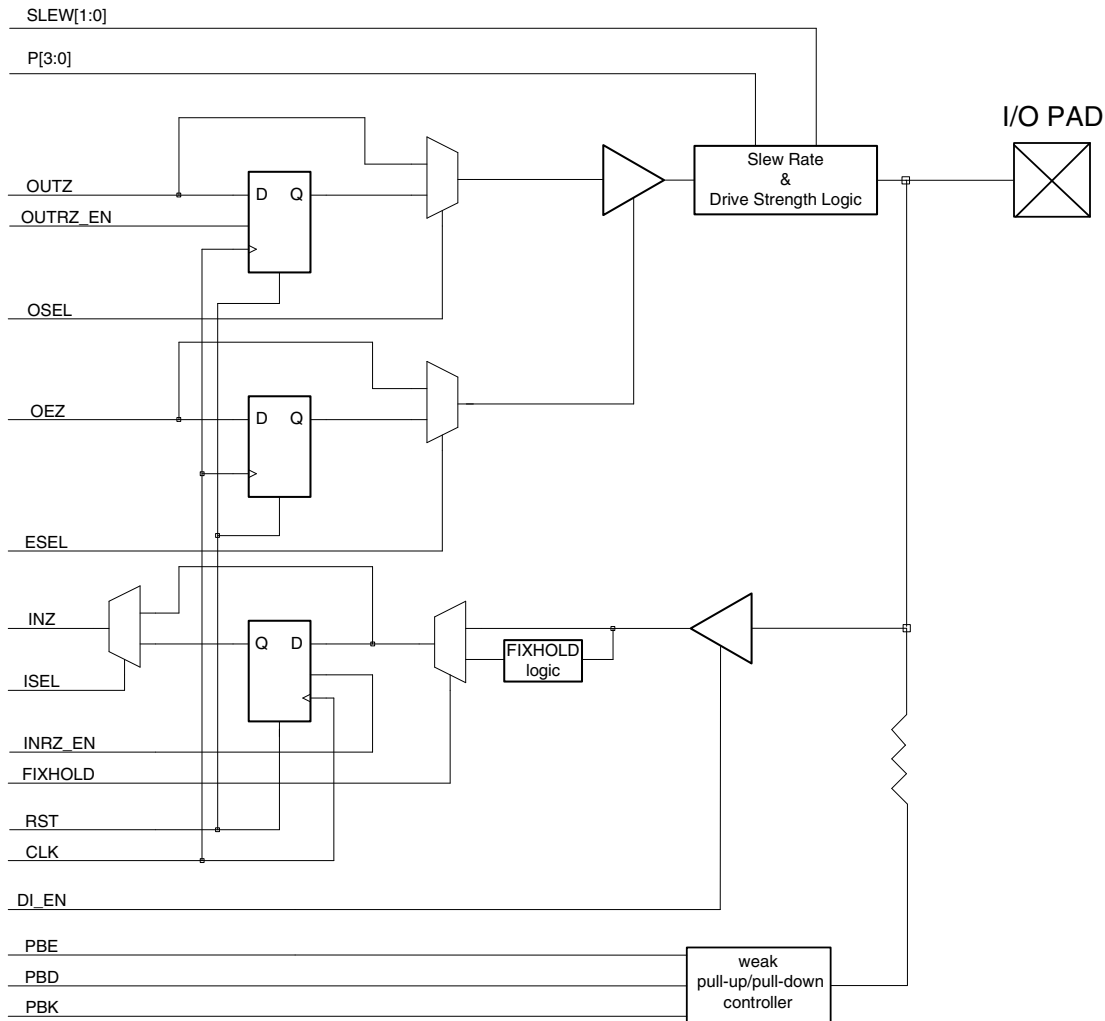
## General Purpose Input Output (GPIO) Cell Structure

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 LVTTTL).

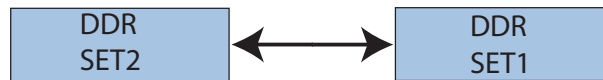
Table 26: I/O Standards and Applications

I/O Standard	VCCIO Voltage	Application
LVTTTL	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



DQ	DQ	DQ	DQ	DQ	DQS	DQCK_N	DQCK_P	DQ	DQ	DQ	DQM
----	----	----	----	----	-----	--------	--------	----	----	----	-----

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

## Double Data Rate (DDR) I/O

The DDR features include:

- Programmable slew rate
- Programmable drive strength
- Programmable pull-up

Figure 19: DDRIO DQ Configuration

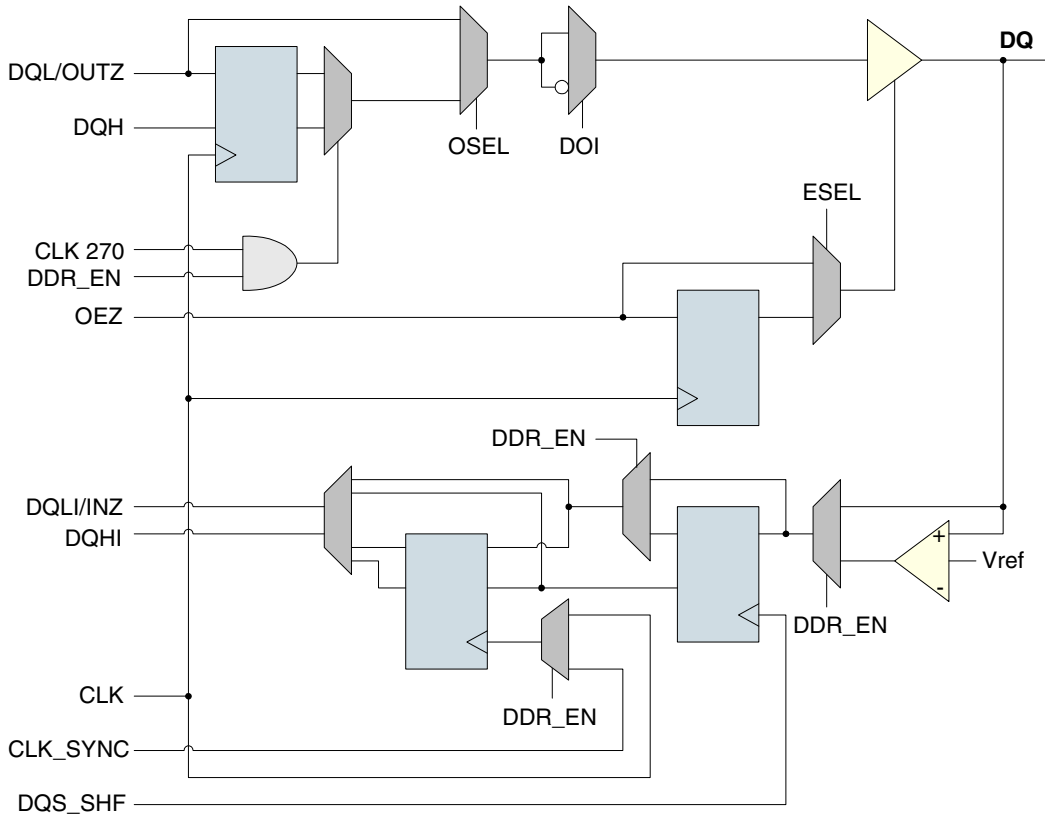


Figure 20: DDRIO DQS Configuration

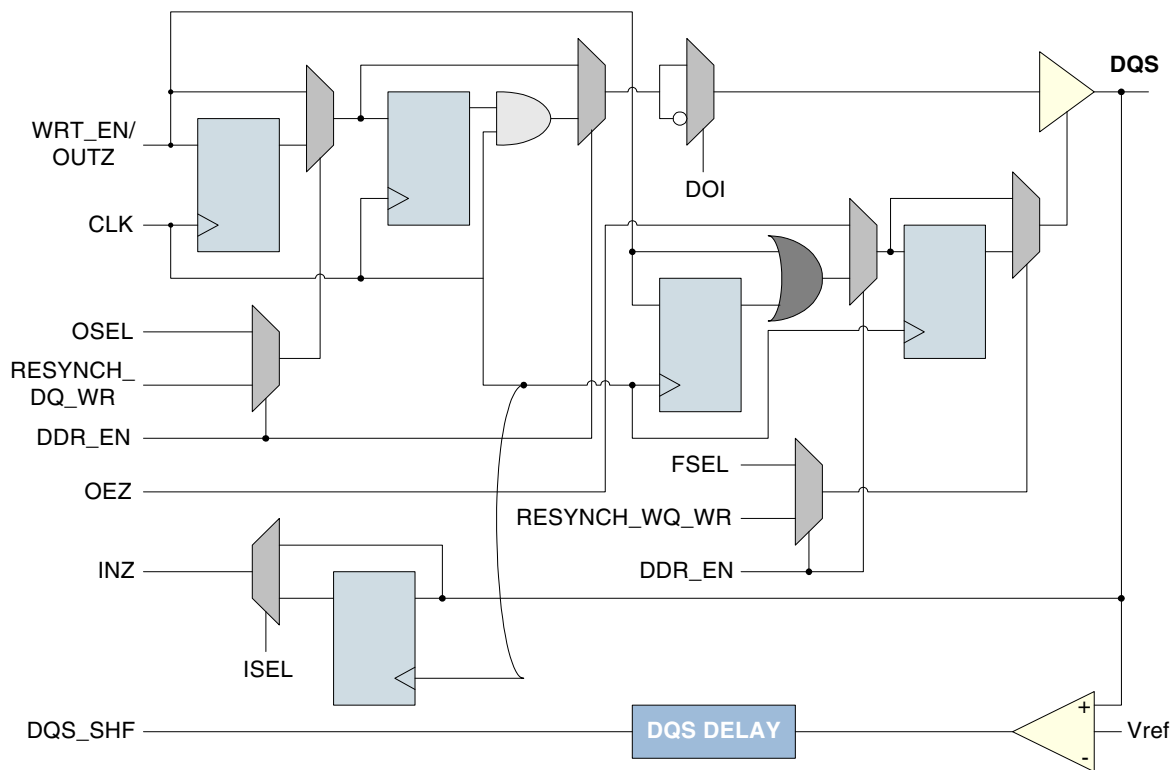


Table 28: DDR DQ Fabric Interface Signals

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. 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. 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>Routable 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. 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. 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:

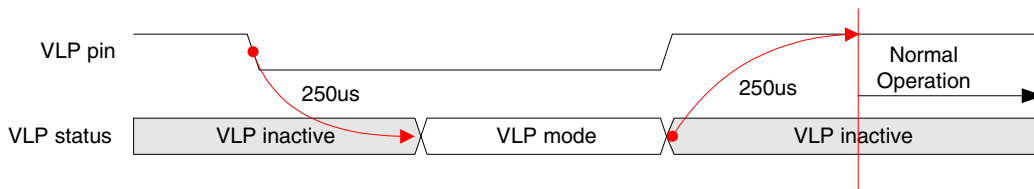
- All logic cell registers and GPIO registers values are held
- All RAM cell data is retained
- The outputs from all GPIO to the internal logic are tied to a weak '1'
- GPIO outputs drive the previous values
- GPIO output enables retain the previous values
- DDRIO outputs are pulled down through a weak 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 $\Omega$ .

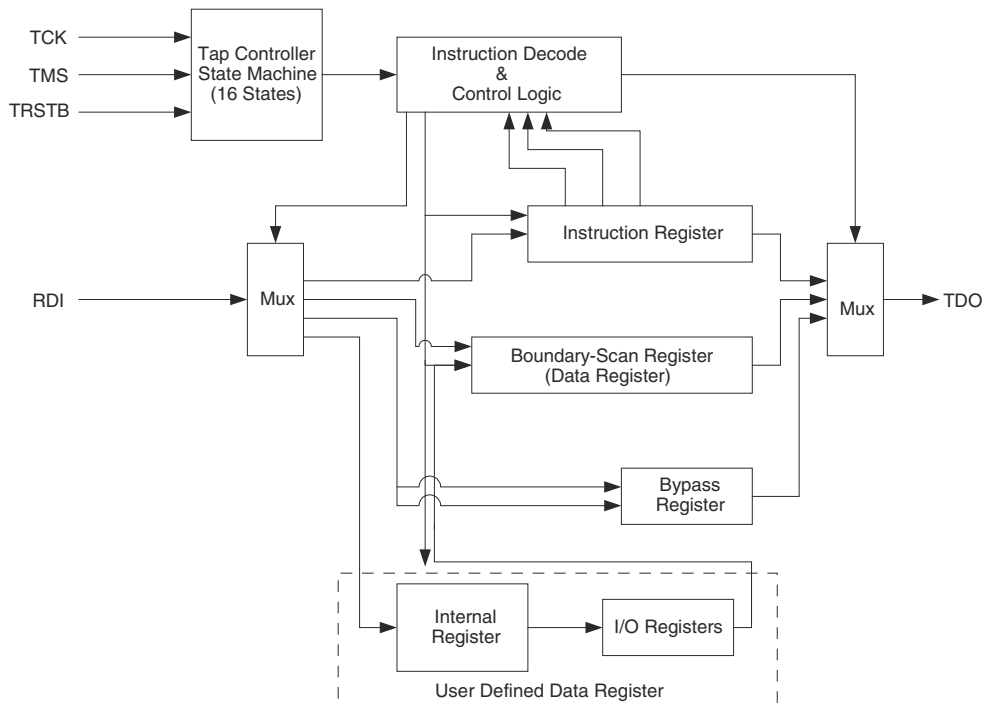
As the device exits out of VLP mode, the data from the registers, RAM, and GPIO will be used to recover the functionality of the device. Furthermore, since the CCMs were in a reset state during VLP mode, they will have to re-acquire the correct output signals before asserting lock\_out. The time required 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 V <sub>CCIO</sub>	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

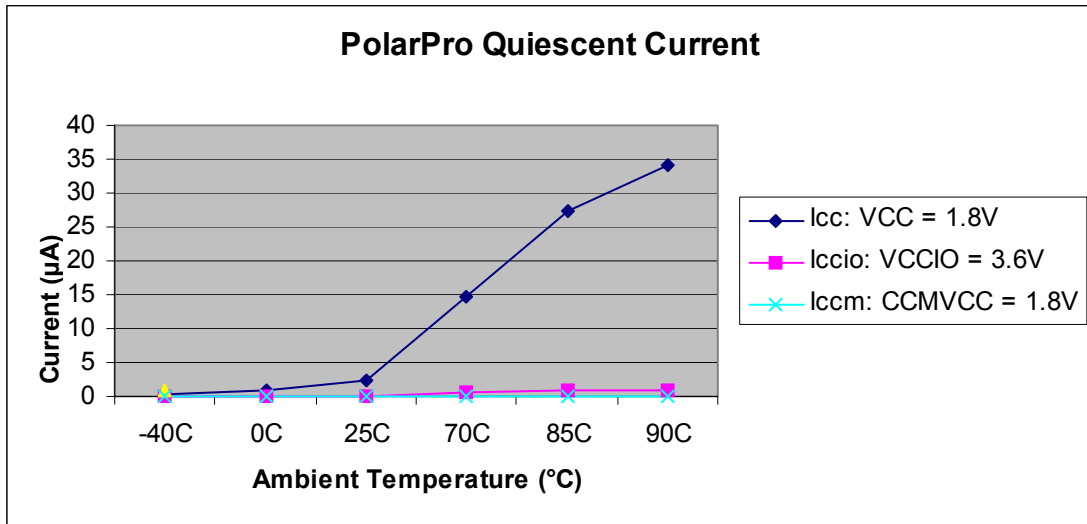


Figure 24: Quiescent Current for QL1P075 and QL1P100 with VLP = 3.3 V

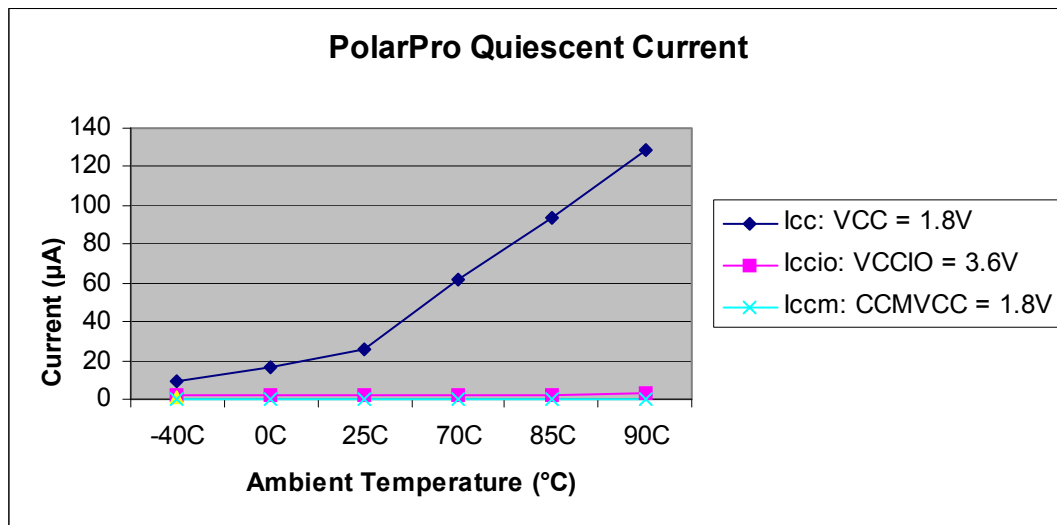


Figure 25 and Figure 26 illustrate quiescent current for QL1P200 and QL1P300 with VLP = 0 V and 3.3 V.

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

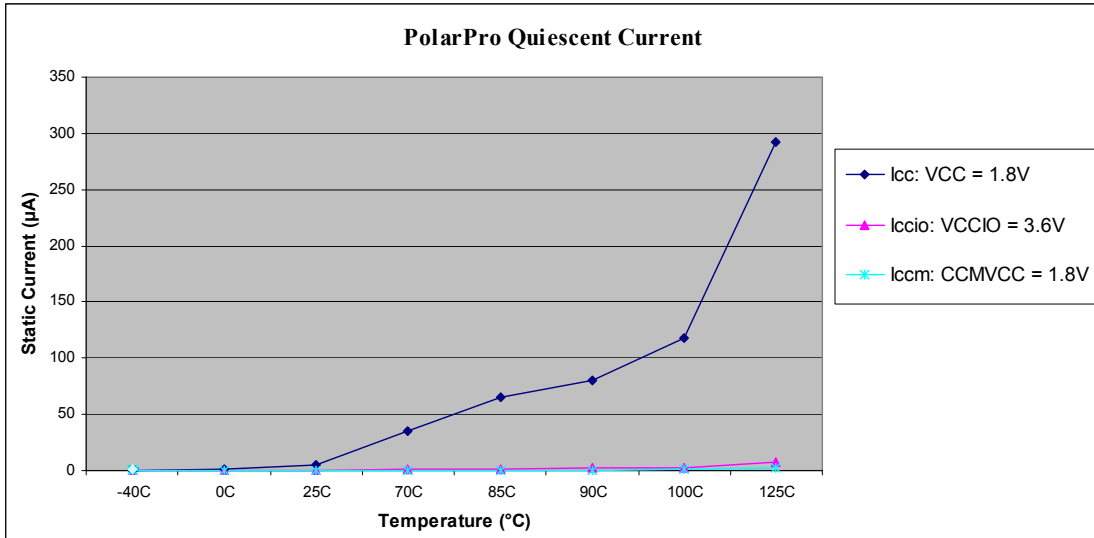
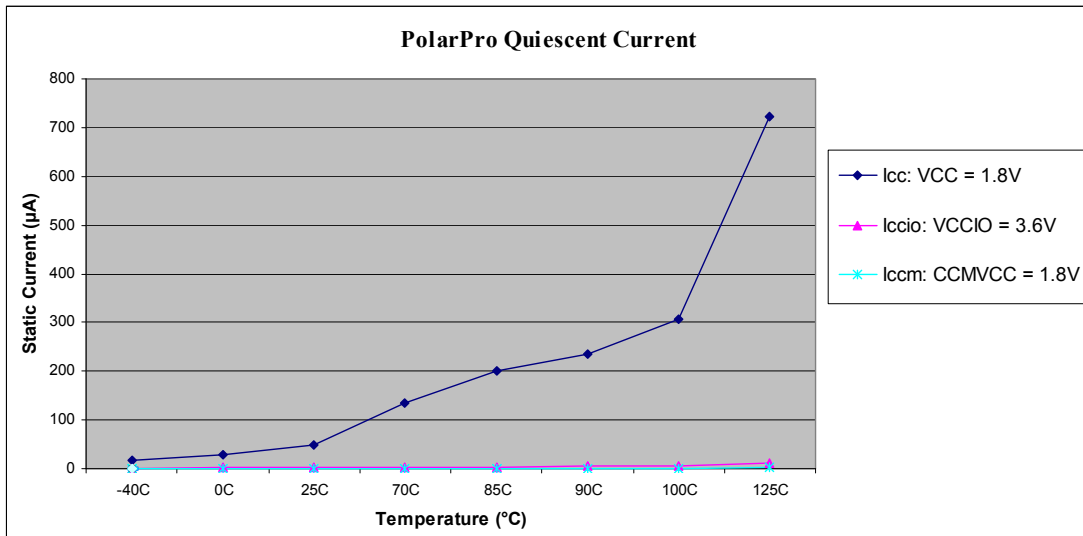


Figure 26: Quiescent Current for QL1P200 and QL1P300 with VLP = 3.3 V



## 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

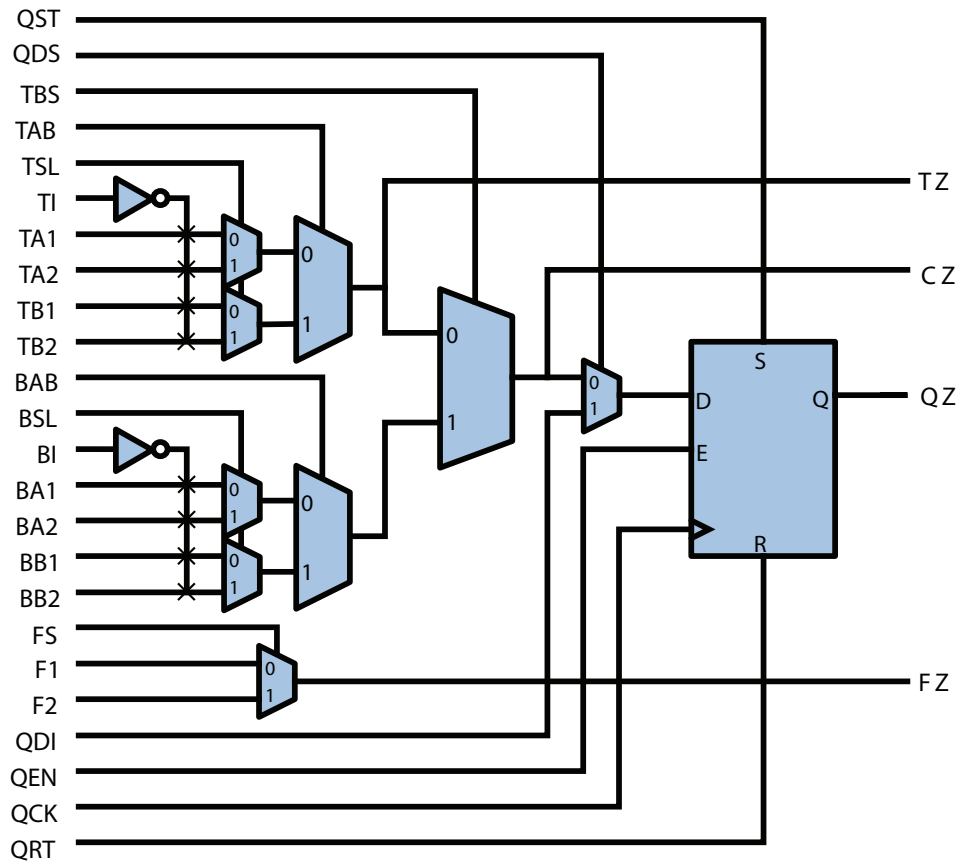




Table 36: Logic Cell Delays

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

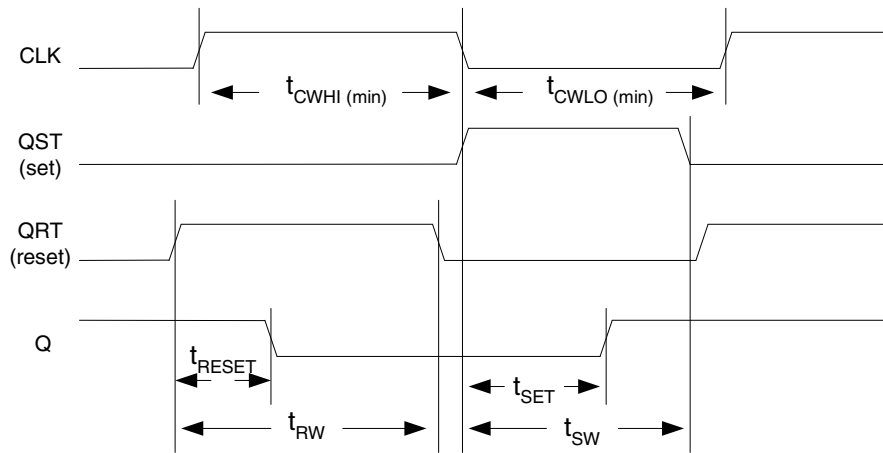


Figure 29: Logic Cell Flip-Flop Timings—Second Waveform

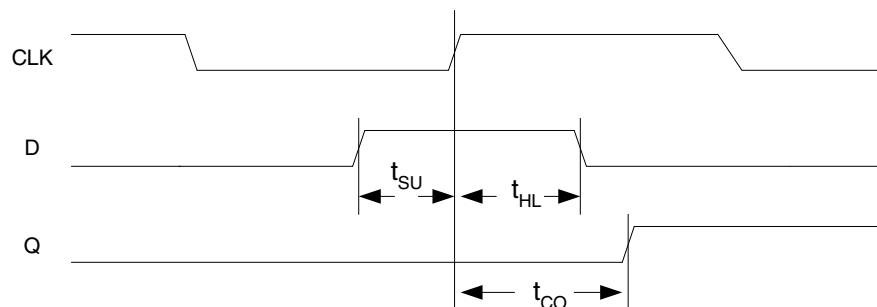


Figure 30: PolarPro Clock Network

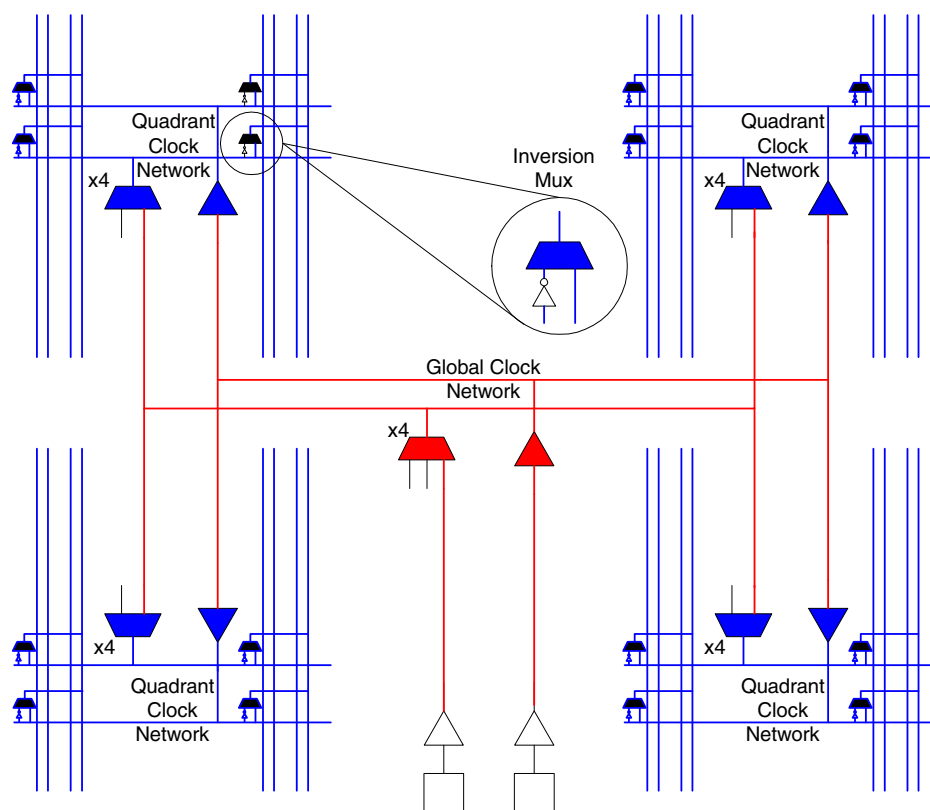


Table 37: PolarPro Tree Clock Delay

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

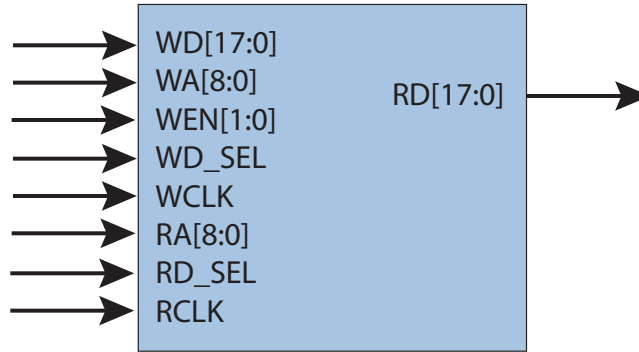


Table 38: RAM Cell Synchronous Write Timing

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

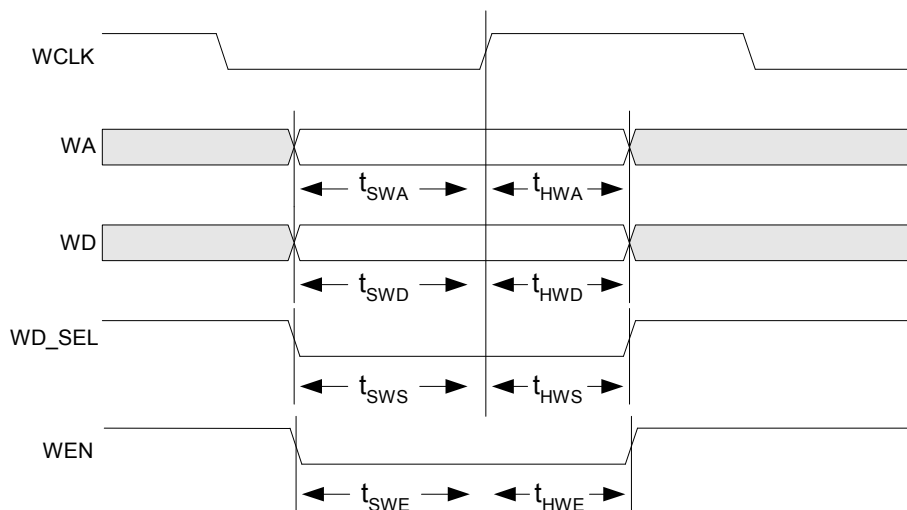
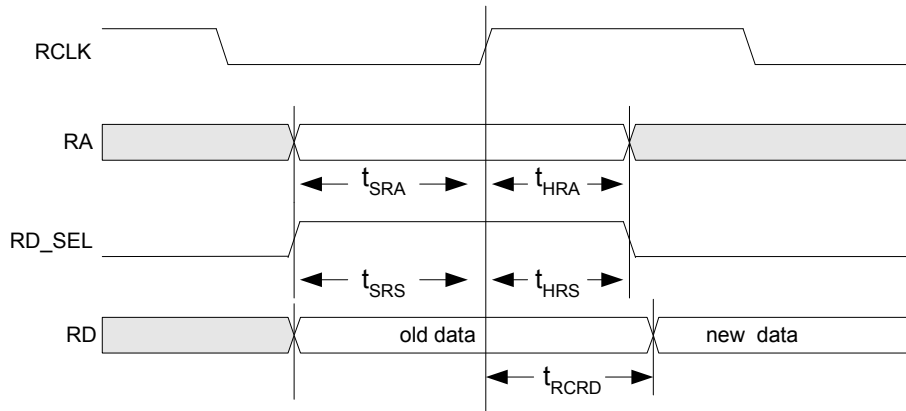


Table 39: RAM Cell Synchronous Read Timing

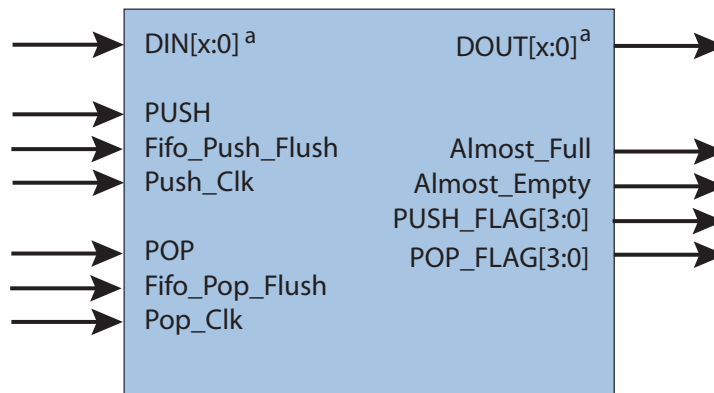
Symbol	Parameter	Commercial		Industrial	
		Min.	Max.	Min.	Max.
$t_{SRA}$	RA setup time to RCLK: time the READ ADDRESS must be stable before the active edge of the READ CLOCK	0.29 ns	1.10 ns	0.31 ns	1.28 ns
$t_{HRA}$	RA hold time to RCLK: time the READ ADDRESS must be stable after the active edge of the READ CLOCK	0 ns	0.21 ns	0 ns	0.20 ns
$t_{SRS}$	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
$t_{HRS}$	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
$t_{RCD}$	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

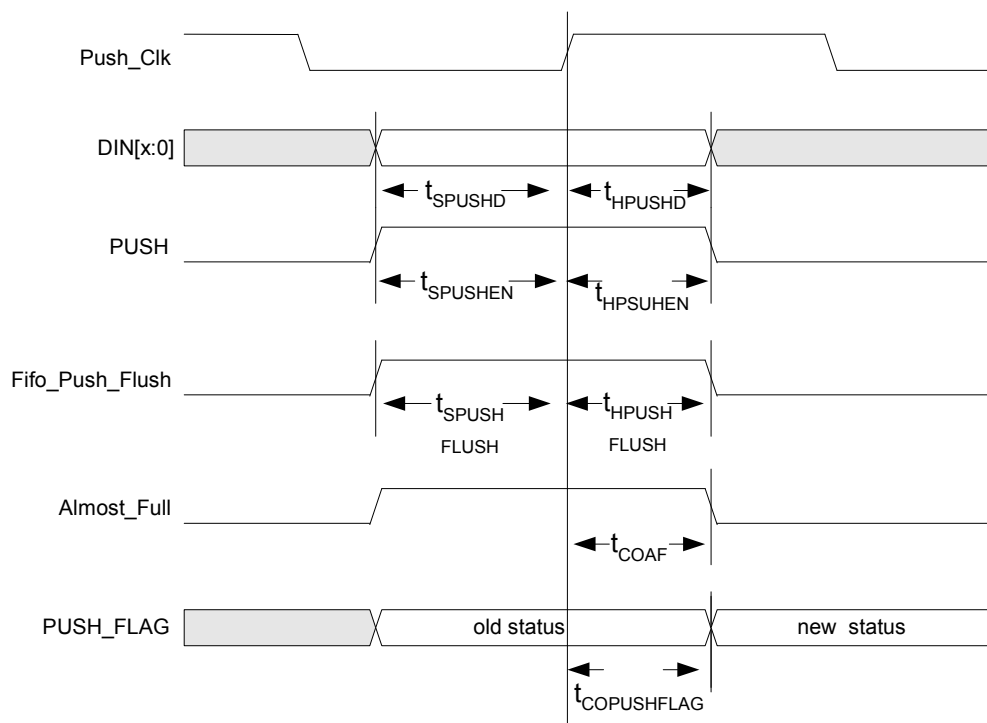
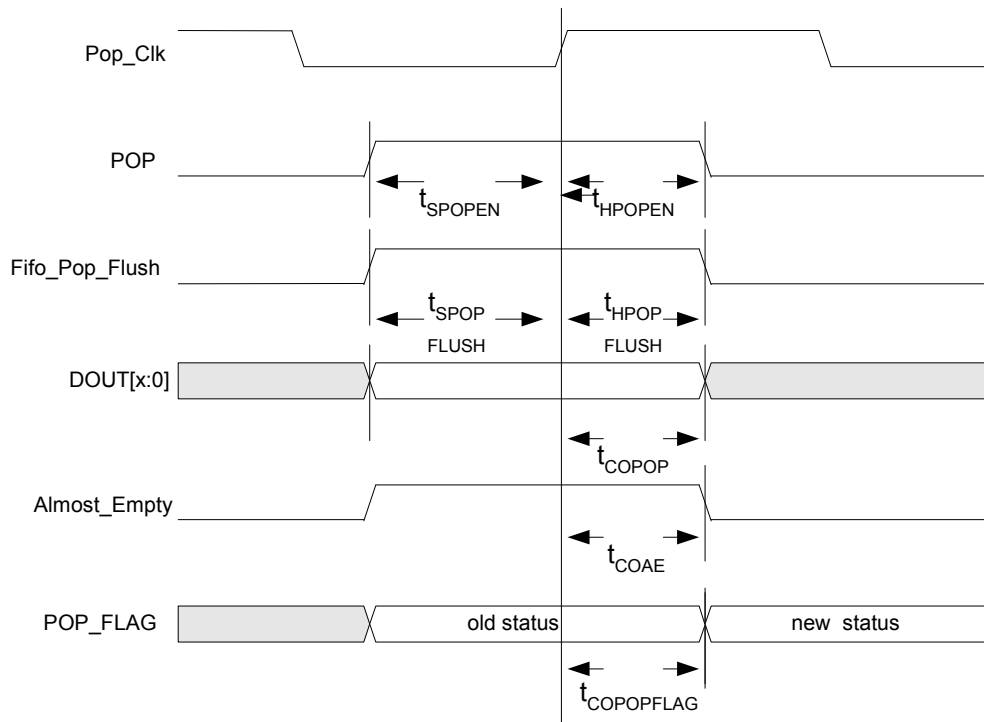


Table 41: FIFO POP Timing

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

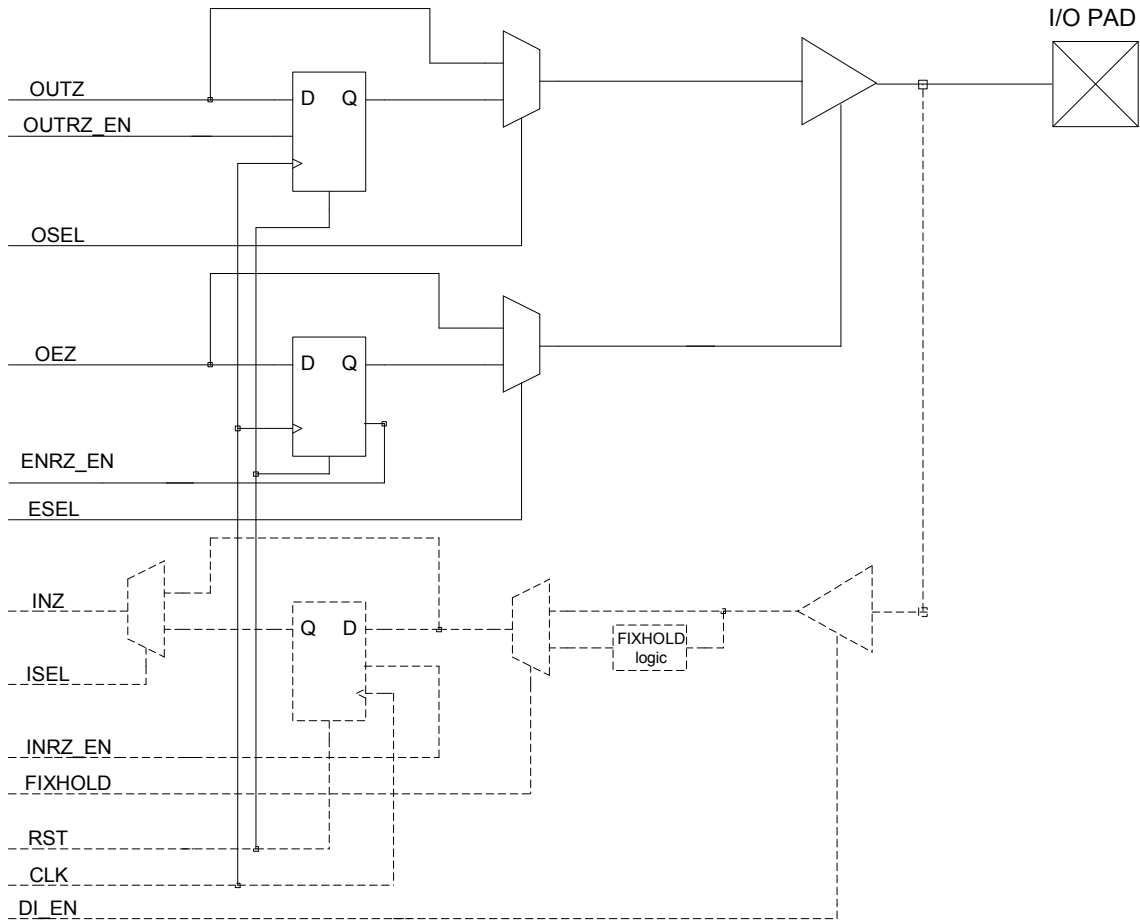


Figure 38: PolarPro I/O Cell Output Enable Timing

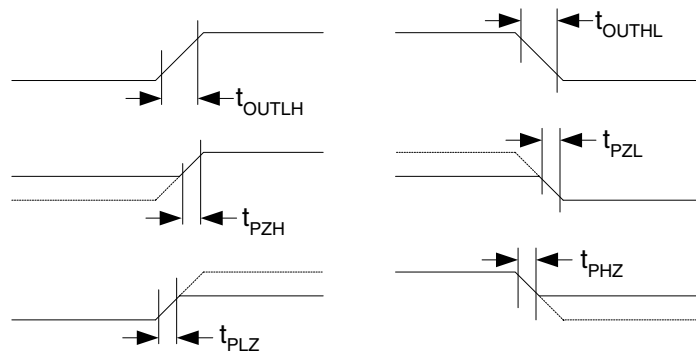




Table 42: Output Timing Characteristics @ VCCIO = 3.3 V, T = 25° C

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

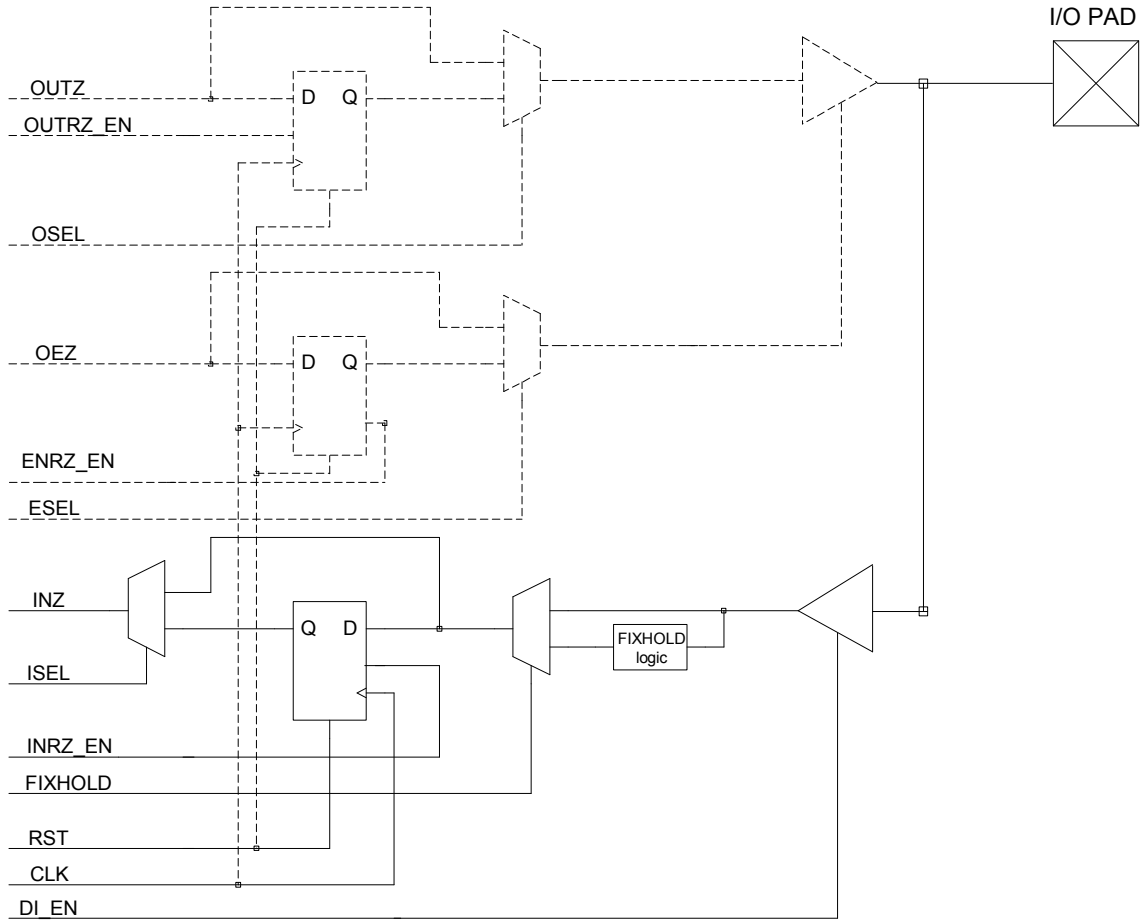


Figure 40: PolarPro Input Register Cell Timing

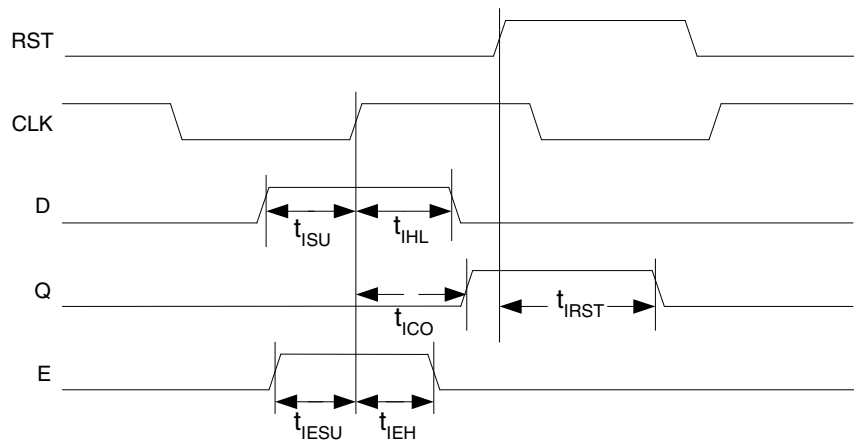


Table 47: I/O Input Register Cell Timing

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

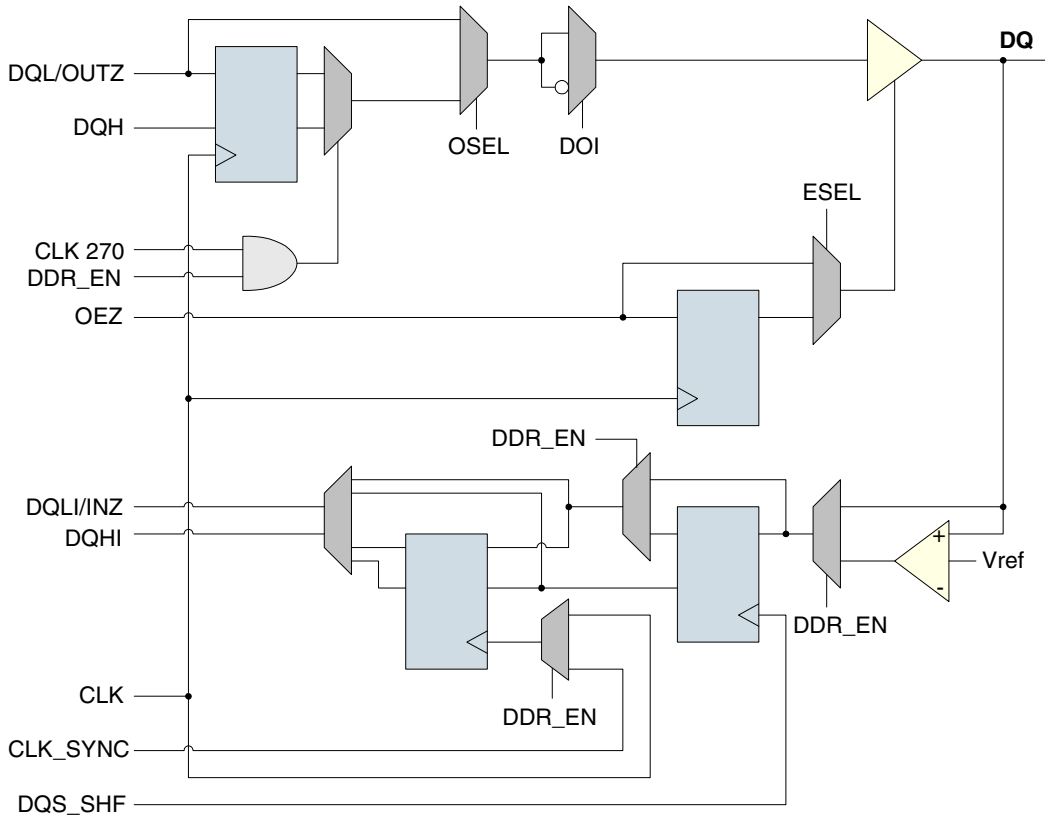


Table 49: DQ Cell Timing

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.
$t_{\text{DQSU}}$	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
$t_{\text{DQH}}$	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
$t_{\text{IPD}}$	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.
$t_{\text{OSU}}$	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
$t_{\text{OH}}$	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
$t_{\text{OCO}}$	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
$t_{\text{OESU}}$	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
$t_{\text{OEH}}$	Output data enable hold time: time OENZ must be stable after the active clock edge	0 ns	0 ns	0 ns	0 ns
$t_{\text{OESU}}$	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
$t_{\text{OEH}}$	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
$t_{\text{OPD}}$	Output propagation delay: propagation time from OUTZ to the output pad	3.65 ns	3.87 ns	4.06 ns	4.24 ns
$t_{\text{ISU}}$	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
$t_{\text{IHL}}$	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
$t_{\text{ICO}}$	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
$t_{\text{IESU}}$	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
$t_{\text{IEH}}$	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
$t_{\text{IPD}}$	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

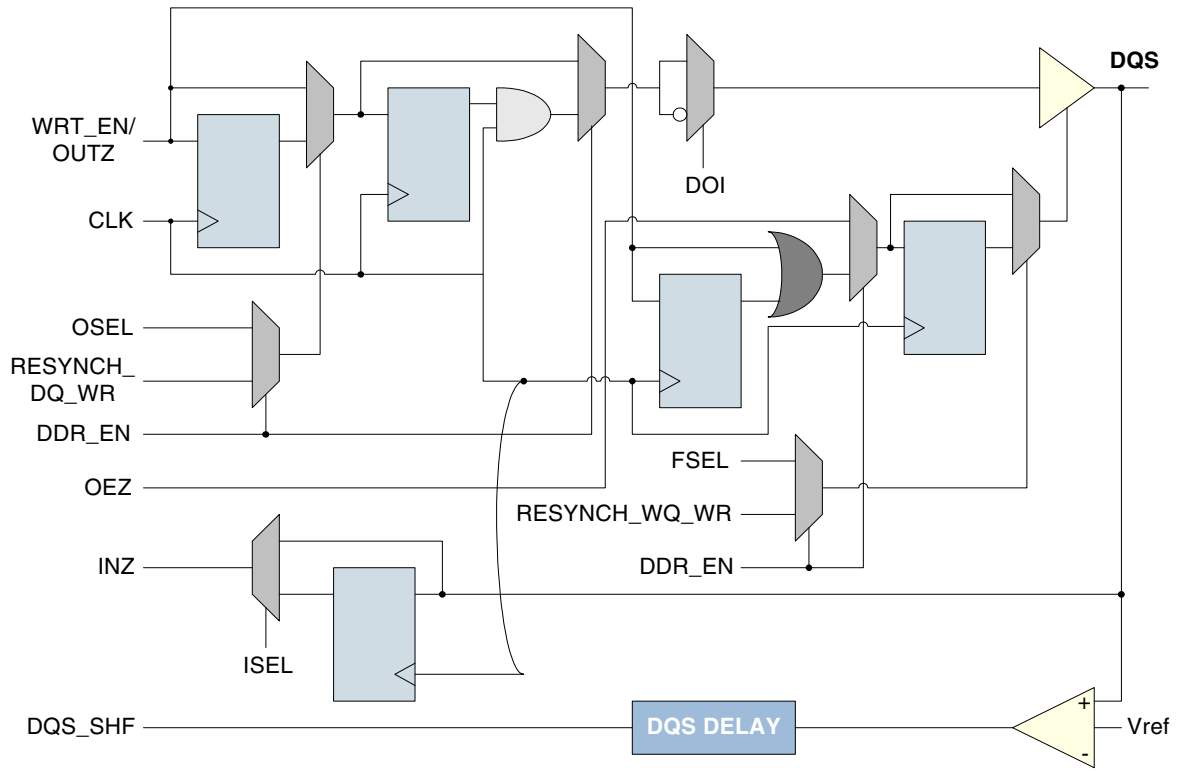


Table 51: DQS Cell Timing

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	4.77ns
$t_{OESU}$	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 (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 (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.

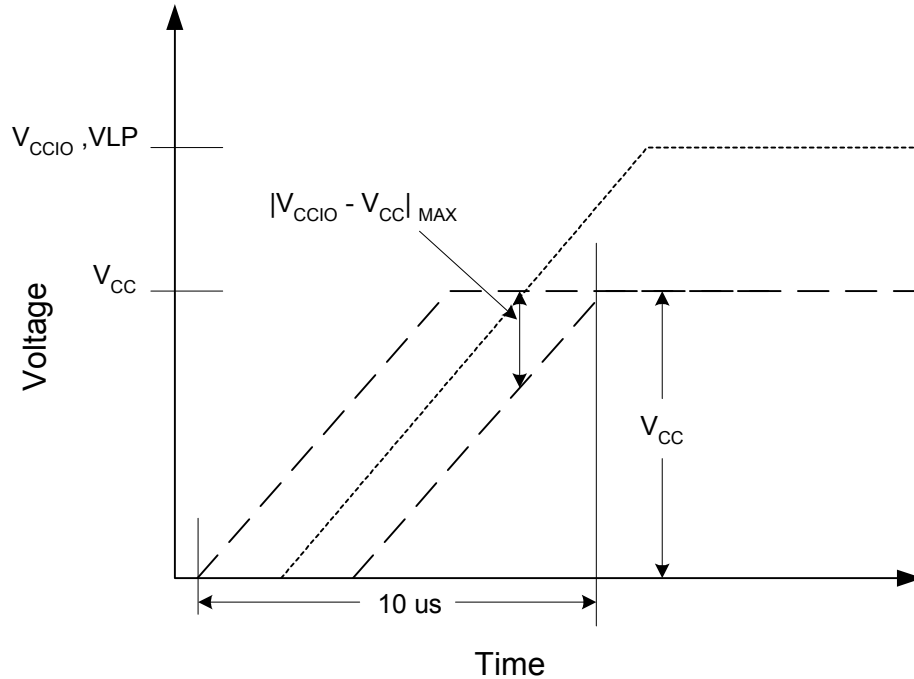
Table 54: Solder and Lead Finish Composition

	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  $V_{CCIO} = 3.3 \text{ V}$ . 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  $500 \text{ mV}$  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  $500 \text{ mV}$  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  $500 \text{ mV}$  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  $1.5 \text{ mA}$ . Consequently, if using a pull-up resistor, use a pull-up resistor with a value that is less than  $2 \text{ K}\Omega$ .

## 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> / 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> / 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> / 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> / 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 TFBGA Pinout Table

Table 57: QL1P075 – 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 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)/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/ 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	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 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)	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	TDO
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

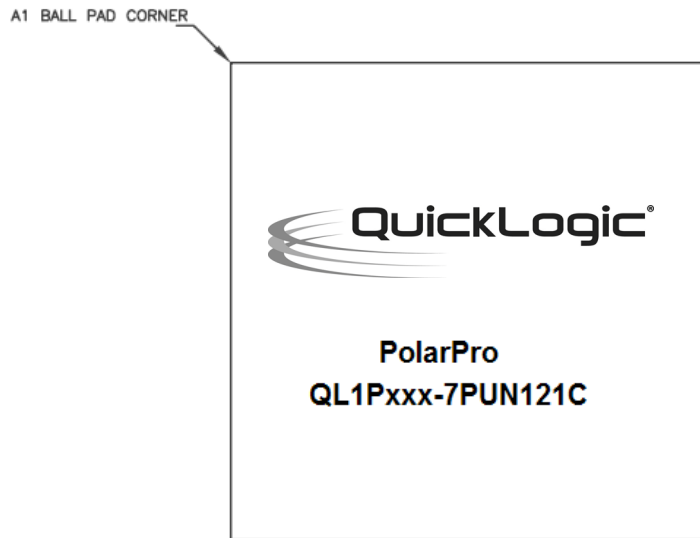
Table 70: QL1P300 – 256 LPGA Pinout Table

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)/ 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)		

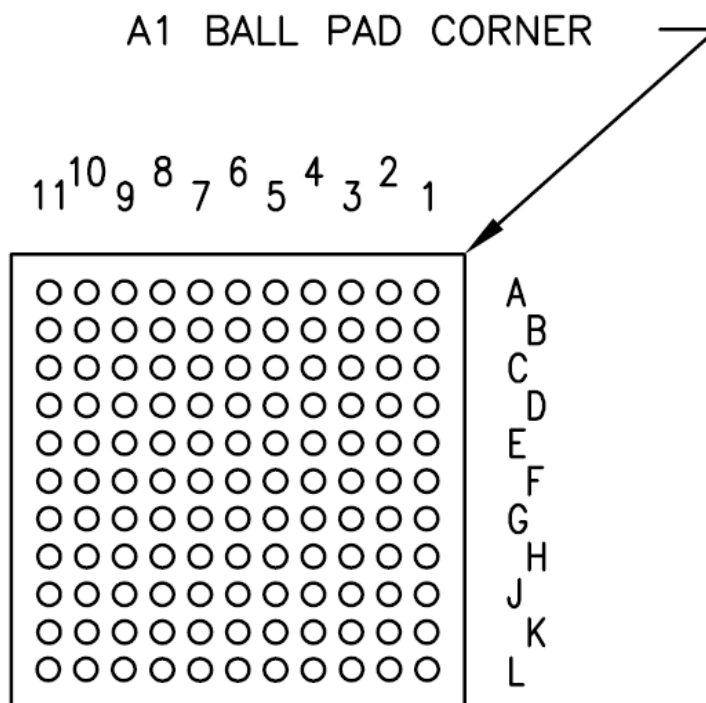
## Packaging Pinout Diagrams

### PolarPro QL1Pxxx - 121 TFBGA Pinout Diagram

Top



Bottom

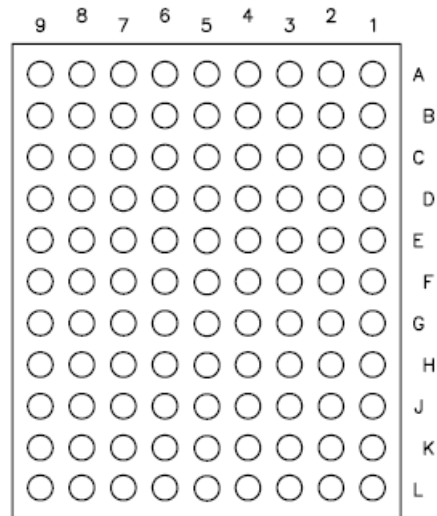


## PolarPro QL1Pxxx - 99 WLCSP Pinout Diagram

Top



Bottom

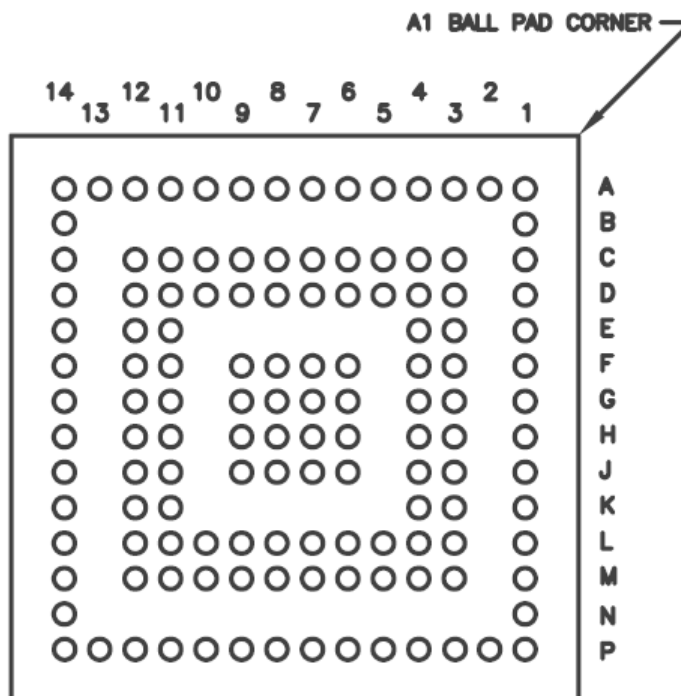


## PolarPro QL1Pxxx - 132 TFBGA (8 mm x 8 mm) Pinout Diagram

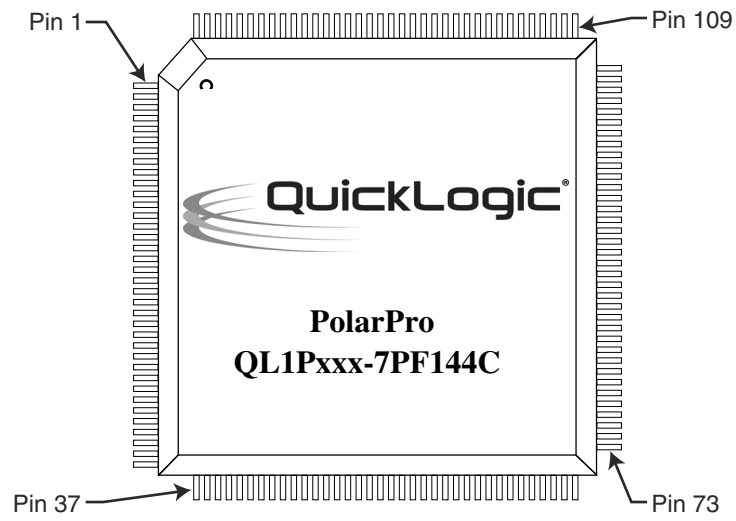
Top



Bottom



## PolarPro QL1Pxxx - 144 TQFP Pinout Diagram



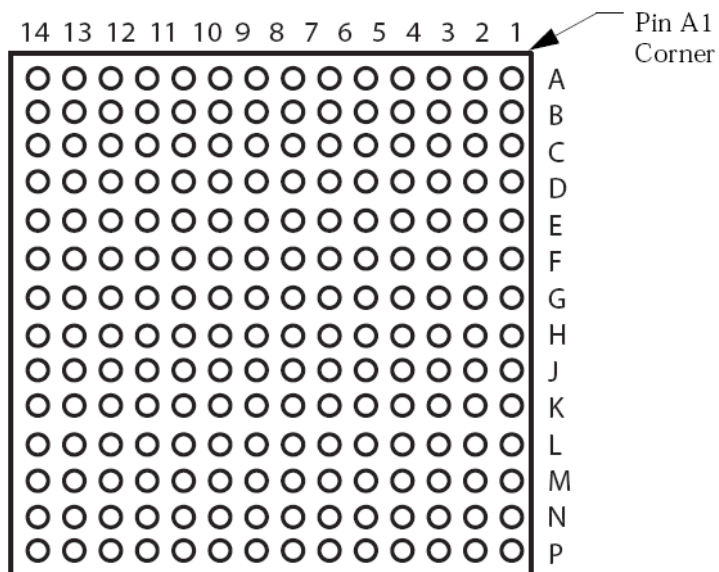


## PolarPro QL1Pxxx - 196 TFBGA (12 mm x 12 mm) Pinout Diagram

Top

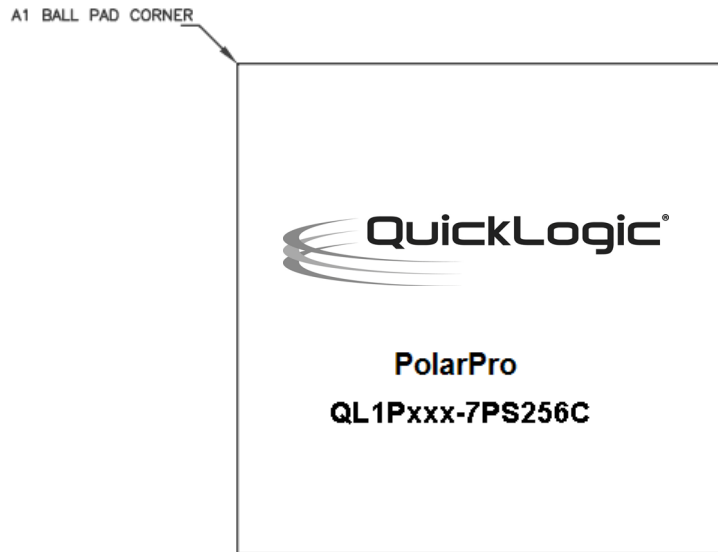


Bottom

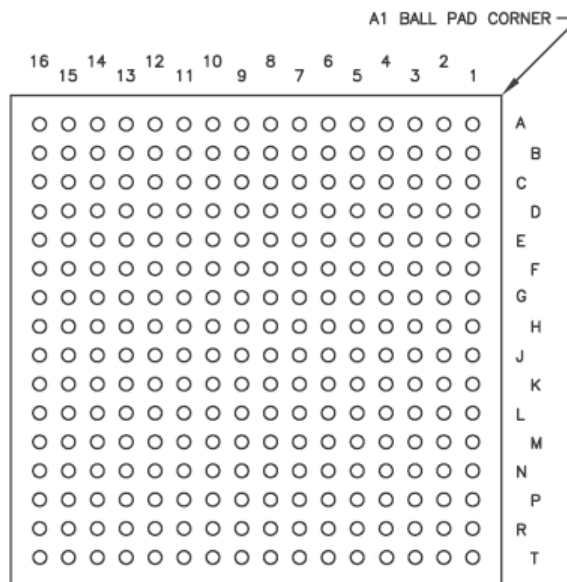


## PolarPro QL1Pxxx - 256 LBGAs Pinout Diagram

### Top

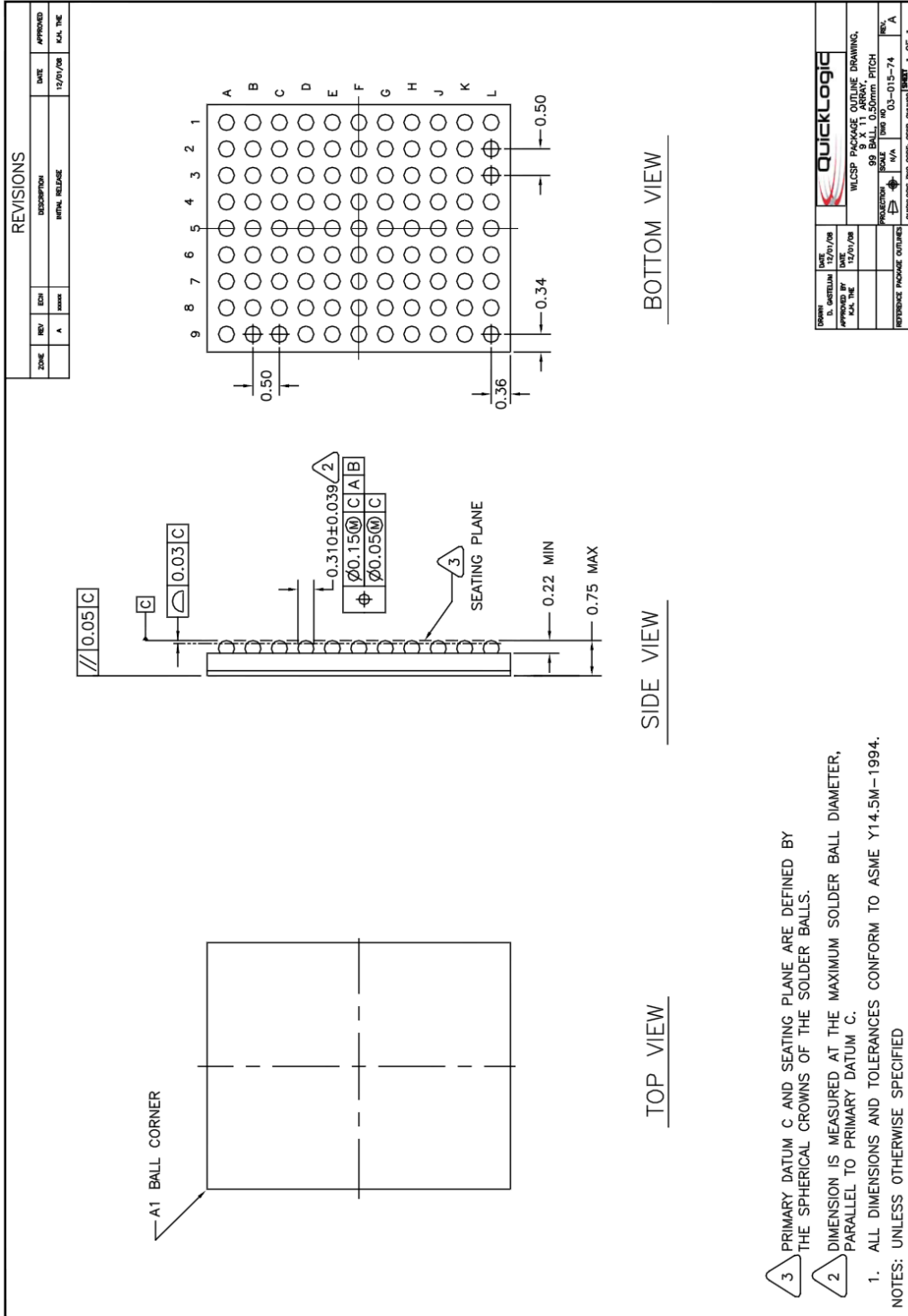


### Bottom



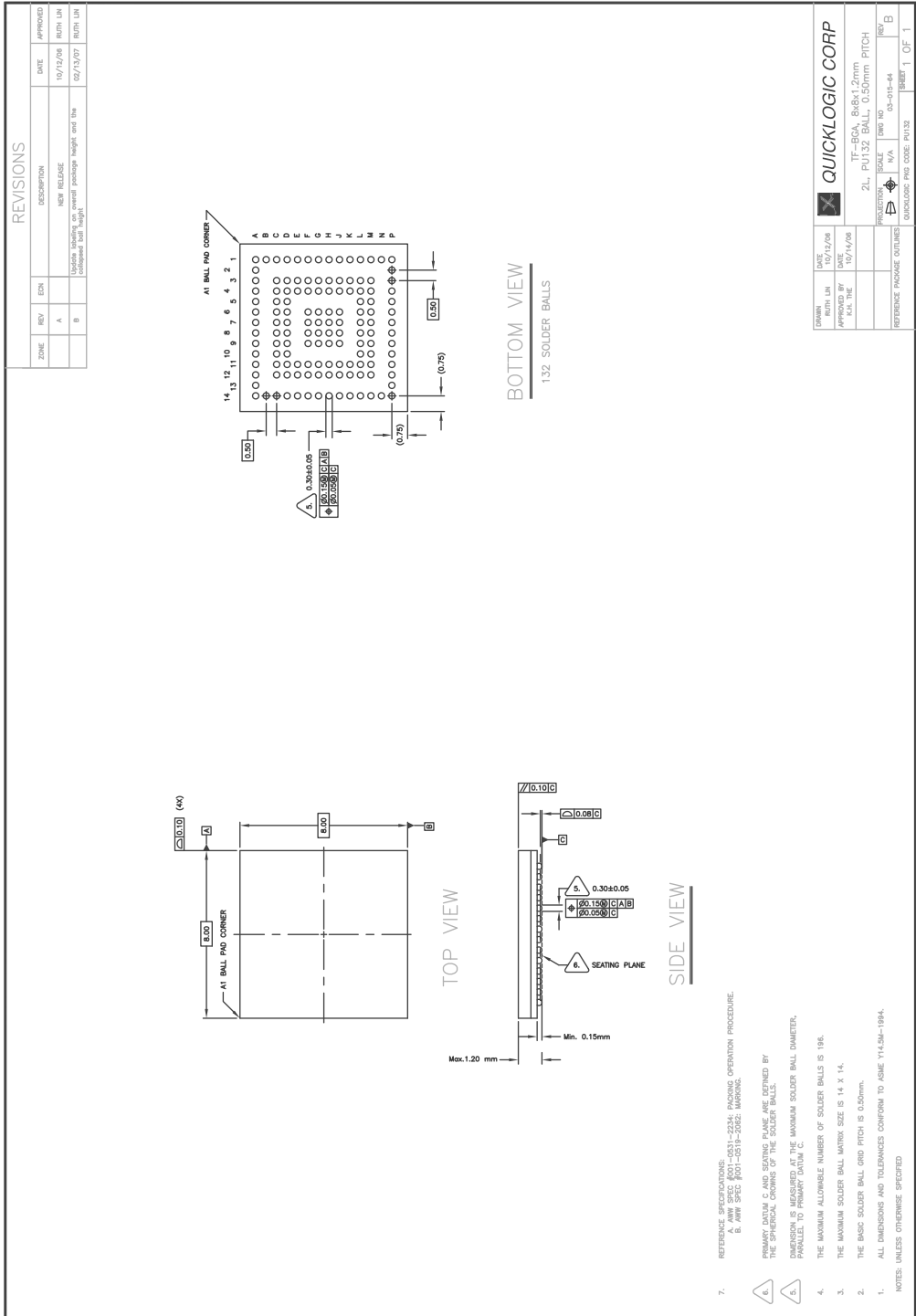
## Package Mechanical Drawings

# 99 WLCSP Packaging Drawing



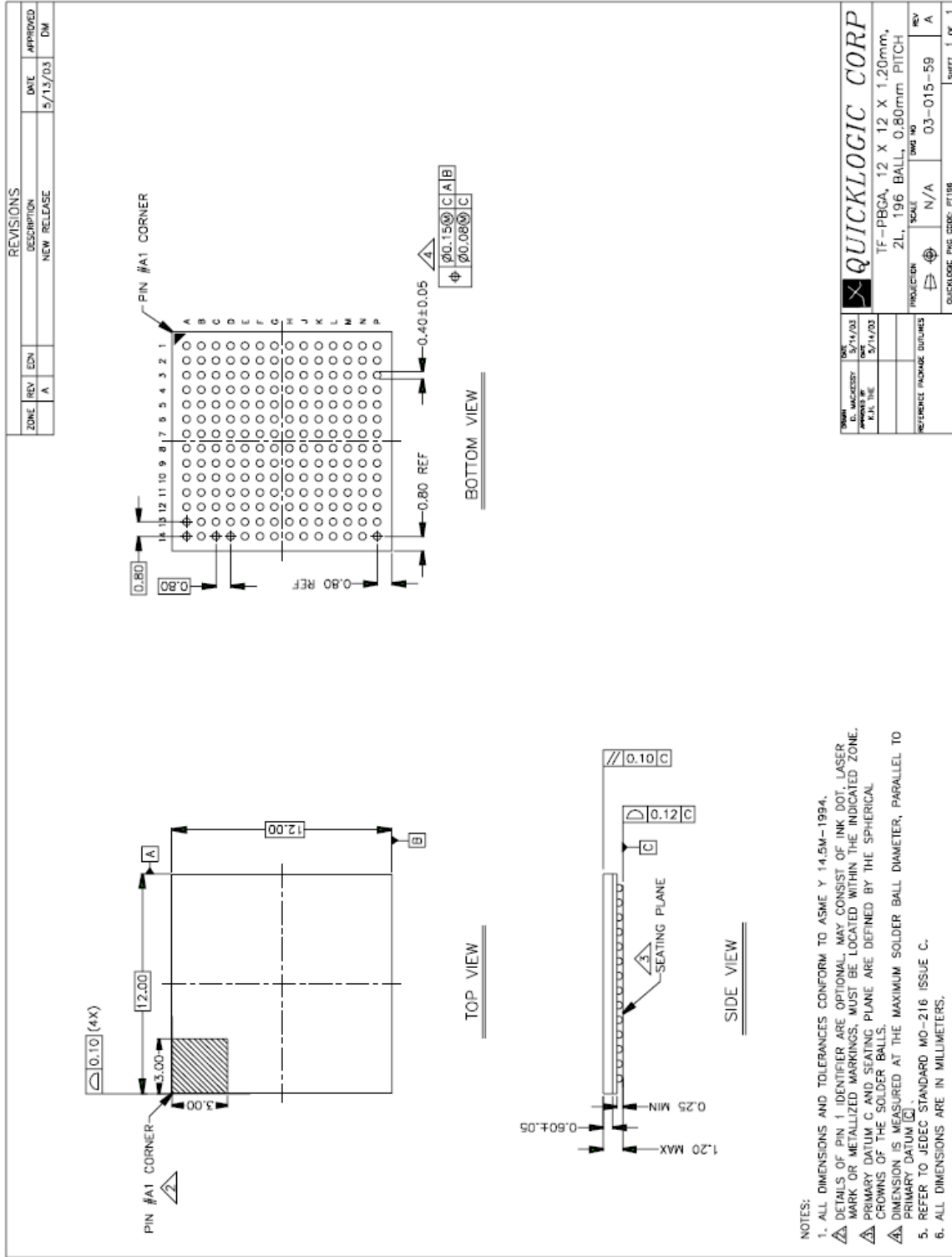


# 132 TFBGA Packaging Drawing





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



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





## Packaging Information

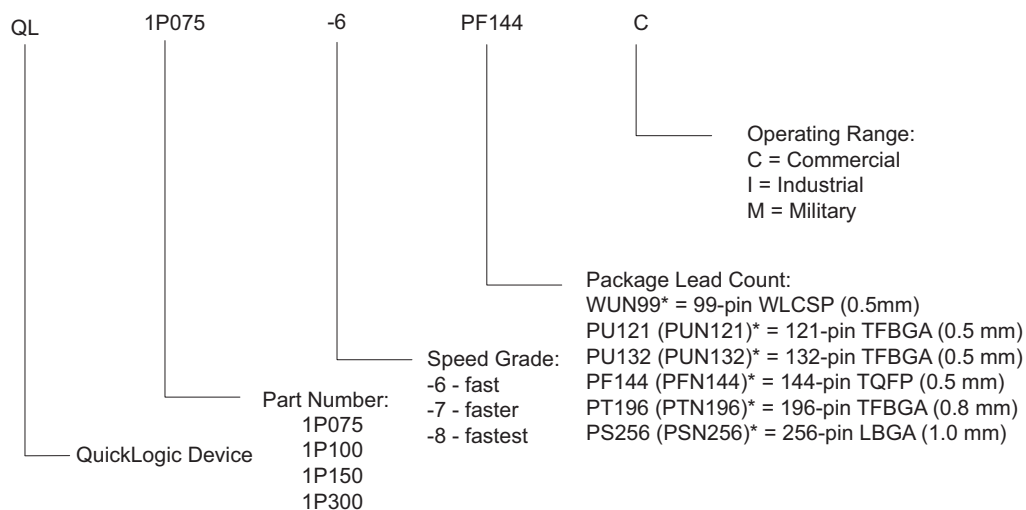
The PolarPro QL1P075, QL1P100, QL1P200 and QL1P300 device packaging information is presented in Table 71.

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 (20 mm x 20 mm) Pitch - 0.50 mm	X	X	121 TFBGA (6 mm x 6 mm) Pitch - 0.50 mm		X	99 WLCSP Pitch - 0.50 mm		X
	196 TFBGA (12 mm x 12 mm) Pitch - 0.80 mm	X	X	132 TFBGA (8 mm x 8 mm) Pitch - 0.50 mm		X	132 TFBGA (8 mm x 8 mm) Pitch - 0.50 mm		X
	256 LBGA (17 mm x 17 mm) Pitch - 1.0 mm	X	X	144 TQFP (20 mm x 20 mm) Pitch - 0.50 mm	X	X	256 LBGA (17 mm x 17 mm) Pitch - 1.0 mm	X	X
				196 TFBGA (12 mm x 12 mm) Pitch - 0.80 mm	X	X			
				256 LBGA (17 mm x 17 mm) 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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Internet: [www.quicklogic.com](http://www.quicklogic.com)

## Revision History

Revision	Date	Originator and Comments
A	November 2007	Jason Lew and Kathleen Murchek - First release
B	January 2008	Jason Lew and Kathleen Murchek - Clock Dynamic Enable section changed clock2_dyn_en to CKPAD2_DYN_EN. - Logic Cell Delays table change $t_{HL}$ Max. to N/A.
C	July 2008	Jason Lew and Kathleen Murchek - Updated Copyright and Trademark Information. - Updated Contact Information. - Added Notice of Disclaimer
D	January 2009	Jason Lew and Kathleen Murchek - Updated Thermal Characteristics. - Added 99-pin WLCSP package information.
E	June 2009	Jason Lew and Kathleen Murchek - Updated PolarPro QL1P300 - 99 WLCSP Pinout Table. Corrected pin L9 from GPIO(B) to TDO.
F	July 2010	Jason Lew and Kathleen Murchek - Updated PolarPro QL1P300 - 99 WLCSP Pinout Table. Corrected pin F9 from CLK(C)/CCMIN(0 to CLK(C).

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