

••••• Combining Performance, Density, and Embedded RAM

Device Highlights

Flexible Programmable Logic

- .25 μm , Five layer metal CMOS Process
- 2.5 V V_{CC} , 2.5/3.3 V Drive Capable I/O
- 4,032 Logic Cells
- 583,008 Max System Gates
- Up to 506 I/O Pins

Embedded Dual Port SRAM

- Thirty six 2,304-bit Dual Port High Performance SRAM Blocks
- 82,900 RAM Bits
- RAM/ROM/FIFO Wizard for Automatic Configuration
- Configurable and Cascadable

Programmable I/O

- High performance Enhanced I/O (EIO):
Less than 3 ns T_{CO}
- Programmable Slew Rate Control
- Programmable I/O Standards:
 - LVTTTL, LVCMOS, PCI, GTL+, SSTL2, and SSTL3
 - Eight Independent I/O Banks
 - Three Register Configurations: Input, Output, and Output Enable

Advanced Clock Network

- Nine Global Clock Networks:
 - One Dedicated
 - Eight Programmable
- 20 Quad-Net Networks: Five per Quadrant
- 16 I/O Controls: Two per I/O Bank

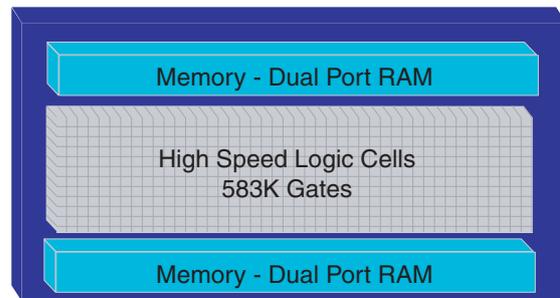


Figure 1: Eclipse Block Diagram

Electrical Specifications

AC Characteristics at $V_{CC} = 2.5\text{ V}$, $T_A = 25^\circ\text{ C}$ ($K = 0.74$)

The AC Specifications are provided from **Table 1** to **Table 10**. Logic Cell diagrams and waveforms are provided from **Figure 2** to **Figure 15**.

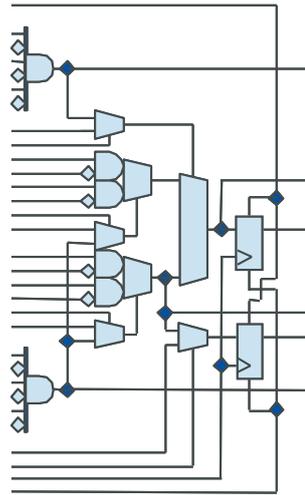


Figure 2: Eclipse Logic Cell

Table 1: Logic Cells

Symbol Logic Cells	Parameter	Value (ns)	
		Min	Max
t_{PD}	Combinatorial Delay of the longest path: time taken by the combinatorial circuit to output	-	0.257
t_{SU}	Setup time: time the synchronous input of the flip-flop must be stable before the active clock edge	0.22	-
t_{HL}	Hold time: time the synchronous input of the flip-flop must be stable after the active clock edge	0	-
t_{CO}	Clock to out delay: the amount of time taken by the flip-flop to output after the active clock edge.	-	0.255
t_{CWHI}	Clock High Time: required minimum time the clock stays high	0.46	-
t_{CWLO}	Clock Low Time: required minimum time that the clock stays low	0.46	-
t_{SET}	Set Delay: time between when the flip-flop is "set" (high) and when the output is consequently "set" (high)	-	0.18
t_{RESET}	Reset Delay: time between when the flip-flop is "reset" (low) and when the output is consequently "reset" (low)	-	0.09
t_{SW}	Set Width: time that the SET signal remains high/low	0.3	-
t_{RW}	Reset Width: time that the RESET signal remains high/low	0.3	-

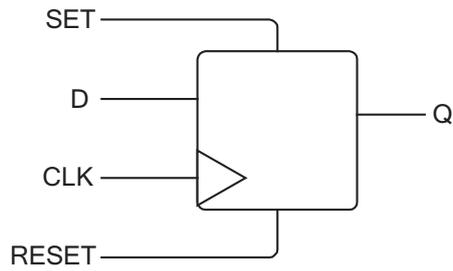


Figure 3: Logic Cell Flip Flop

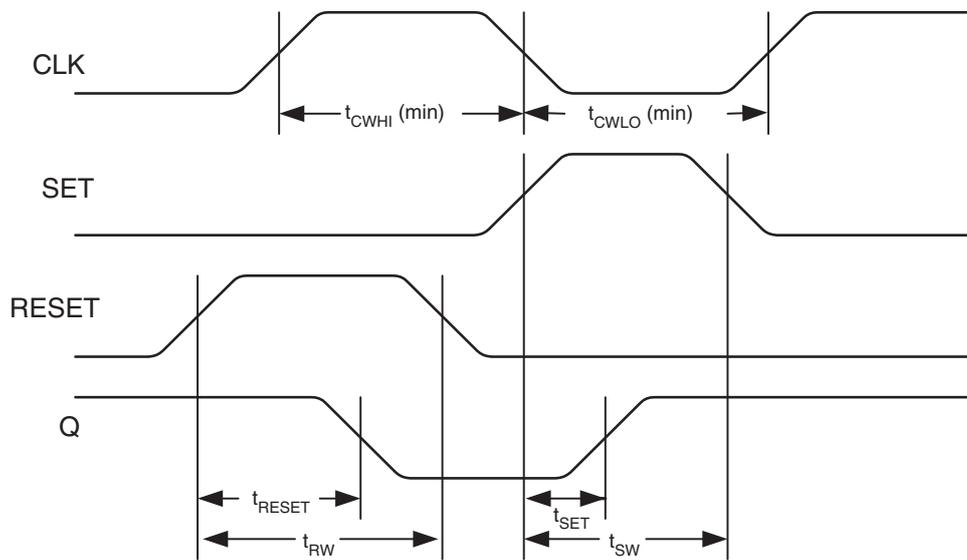


Figure 4: Logic Cell Flip Flop Timings - First Waveform

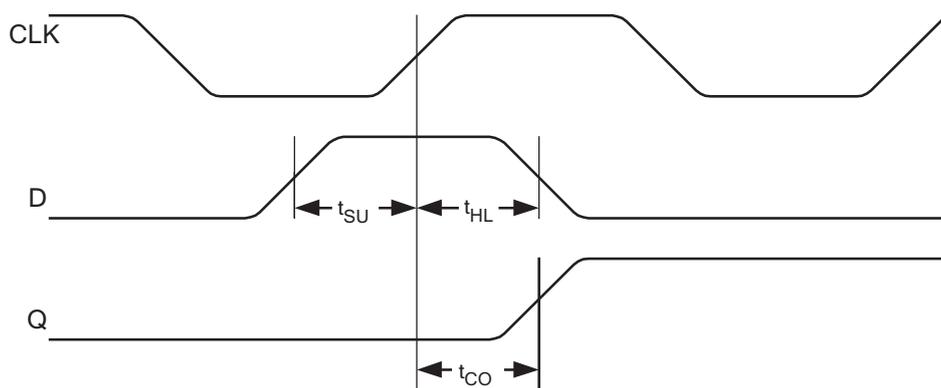


Figure 5: Logic Cell Flip Flop Timings - Second Waveform

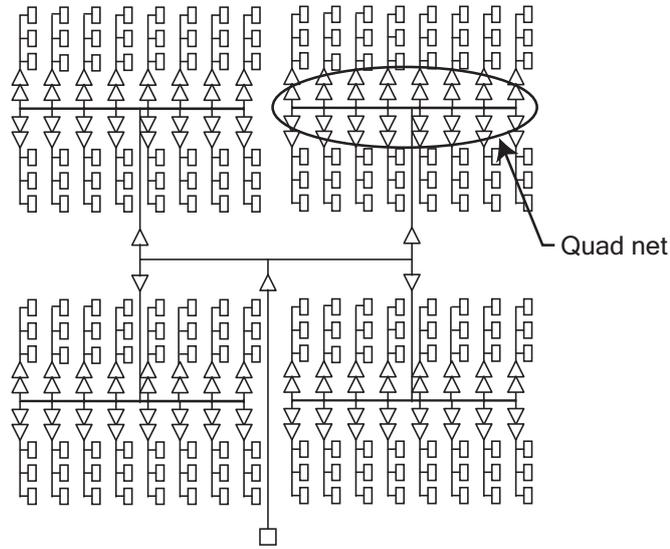


Figure 6: Eclipse Global Clock Structure

Table 2: Eclipse Clock Performance

Clock	Parameters	Clock Performance	
		Global	Dedicated
Logic Cells (Internal)	Clock signal generated internally	1.51 ns (max)	1.59 ns (max)
I/O's (External)	Clock signal generated externally	2.06 ns (max)	1.73 ns (max)

Table 3: Eclipse Global Clock Performance

Clock Segment	Parameter	Value (ns)	
		Min	Max
t_{PGCK}	Global clock pin delay to quad net	-	1.34
t_{BGCK}	Global clock buffer delay (quad net to flip-flop)	-	0.56

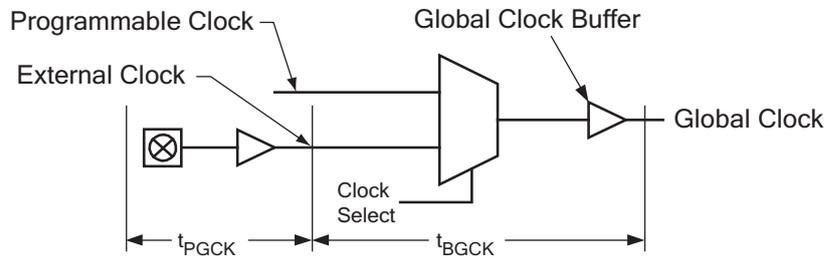


Figure 7: Global Clock Structure Schematic

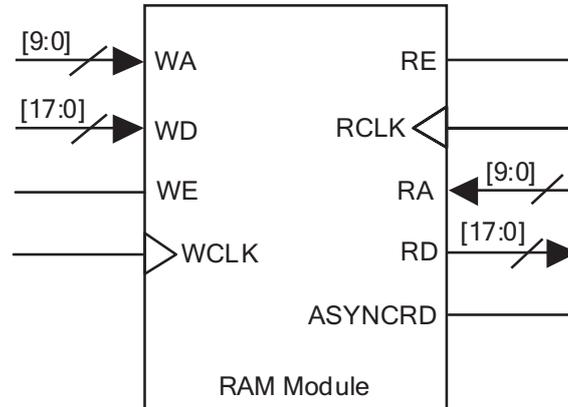


Figure 8: RAM Module

Table 4: RAM Cell Synchronous Write Timing

Symbol	Parameter	Value (ns)	
		Min	Max
RAM Cell Synchronous Write Timing			
t_{SWA}	WA setup time to WCLK: time the WRITE ADDRESS must be stable before the active edge of the WRITE CLOCK	0.675	-
t_{HWA}	WA hold time to WCLK: time the WRITE ADDRESS must be stable after the active edge of the WRITE CLOCK	0	-
t_{SWD}	WD setup time to WCLK: time the WRITE DATA must be stable before the active edge of the WRITE CLOCK	0.654	-
t_{HWD}	WD hold time to WCLK: time the WRITE DATA must be stable after the active edge of the WRITE CLOCK	0	-
t_{SWE}	WE setup time to WCLK: time the WRITE ENABLE must be stable before the active edge of the WRITE CLOCK	0.623	-
t_{HWE}	WE hold time to WCLK: time the WRITE ENABLE must be stable after the active edge of the WRITE CLOCK	0	-
t_{WCRD}	WCLK to RD (WA = RA): time between the active WRITE CLOCK edge and the time when the data is available at RD	-	4.38

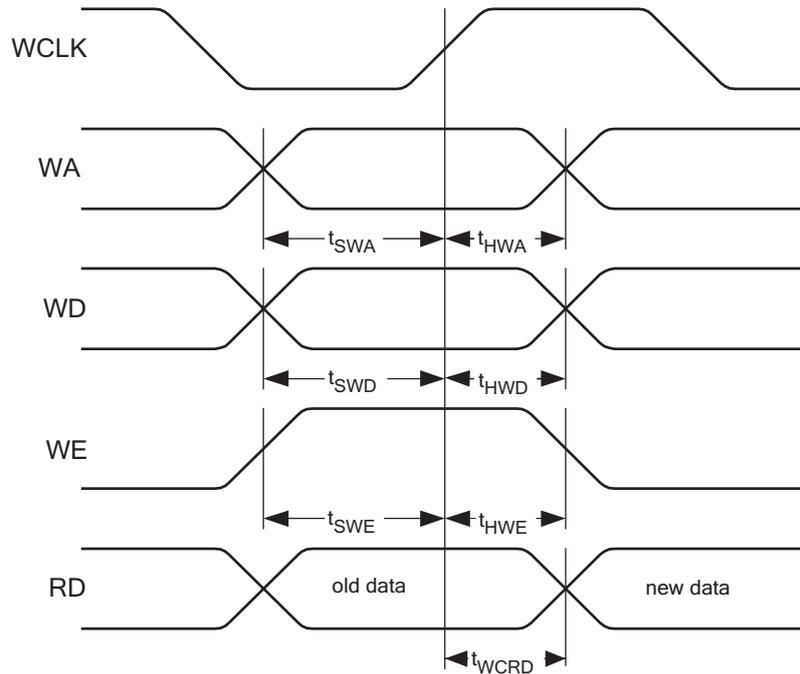


Figure 9: RAM Cell Synchronous Write Timing

Table 5: RAM Cell Synchronous & Asynchronous Read Timing

Symbol	Parameter	Value (ns)	
		Min	Max
RAM Cell Synchronous Read Timing			
t_{SRA}	RA setup time to RCLK: time the READ ADDRESS must be stable before the active edge of the READ CLOCK	0.686	-
t_{HRA}	RA hold time to RCLK: time the READ ADDRESS must be stable after the active edge of the READ CLOCK	0	-
t_{SRE}	RE setup time to WCLK: time the READ ENABLE must be stable before the active edge of the READ CLOCK	0.243	-
t_{HRE}	RE hold time to WCLK: time the READ ENABLE must be stable after the active edge of the READ CLOCK	0	-
t_{RCRD}	RCLK to RD: time between the active READ CLOCK edge and the time when the data is available at RD	-	4.38
RAM Cell Asynchronous Read Timing			
t_{PDRD}	RA to RD: time between when the READ ADDRESS is input and when the DATA is output	-	2.06

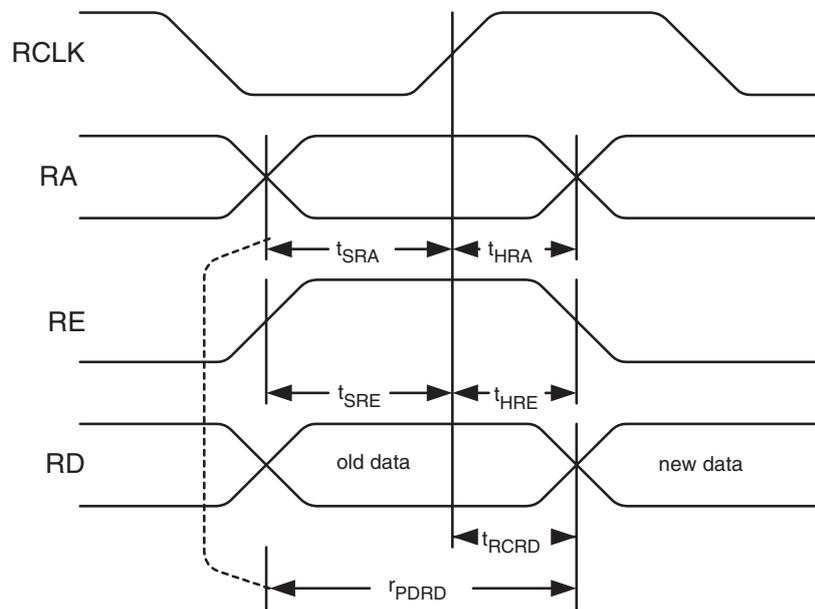


Figure 10: RAM Cell Synchronous & Asynchronous Read Timing

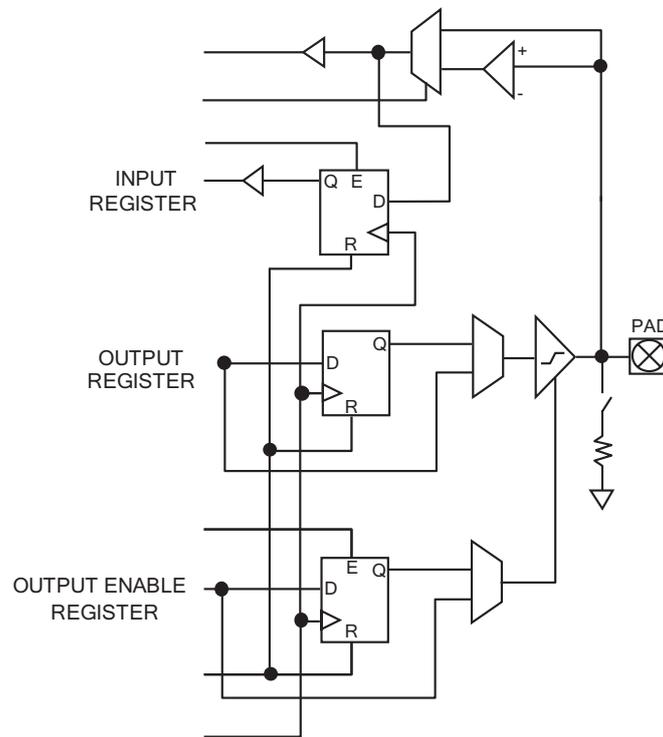


Figure 11: Eclipse Cell I/O

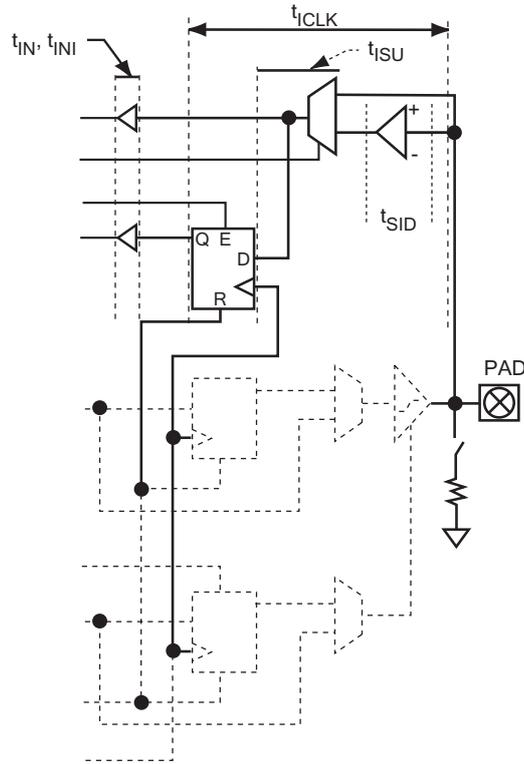


Figure 12: Eclipse Input Register Cell

Table 6: Input Register Cell

Symbol	Parameter	Value (ns)	
		Min	Max
Input Register Cell Only			
t_{ISU}	Input register setup time: time the synchronous input of the flip-flop must be stable before the active clock edge	3.12	-
t_{IHL}	Input register hold time: time the synchronous input of the flip-flop must be stable after the active clock edge	0	-
t_{ICO}	Input register clock to out: time taken by the flip-flop to output after the active clock edge	-	1.08
t_{IRST}	Input register reset delay: time between when the flip-flop is “reset”(low) and when the output is consequently “reset” (low)	-	0.99
t_{IESU}	Input register clock enable setup time: time “enable” must be stable before the active clock edge	0.37	-
t_{IEH}	Input register clock enable hold time: time “enable” must be stable after the active clock edge	0	-

Table 7: Standard Input Delays

Symbol	Parameter To get the total input delay add this delay to t _{ISU}	Value (ns)	
		Min	Max
t _{SID} (LVTTTL)	LVTTTL input delay: Low Voltage TTL for 3.3 V applications	-	0.34
t _{SID} (LVCMOS2)	LVCMOS2 input delay: Low Voltage CMOS for 2.5 V and lower applications	-	0.42
t _{SID} (GTL+)	GTL+ input delay: Gunning Transceiver Logic	-	0.68
t _{SID} (SSTL3)	SSTL3 input delay: Stub Series Terminated Logic for 3.3 V	-	0.55
t _{SID} (SSTL2)	SSTL2 input delay: Stub Series Terminated Logic for 2.5 V	-	0.61

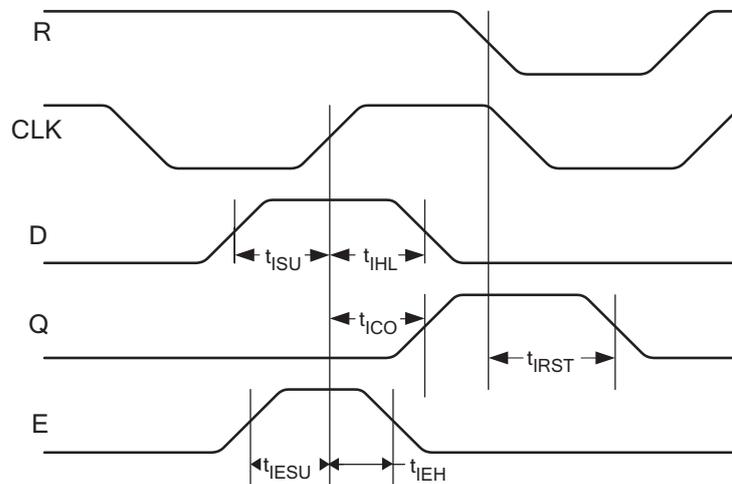


Figure 13: Eclipse Input Register Cell Timing

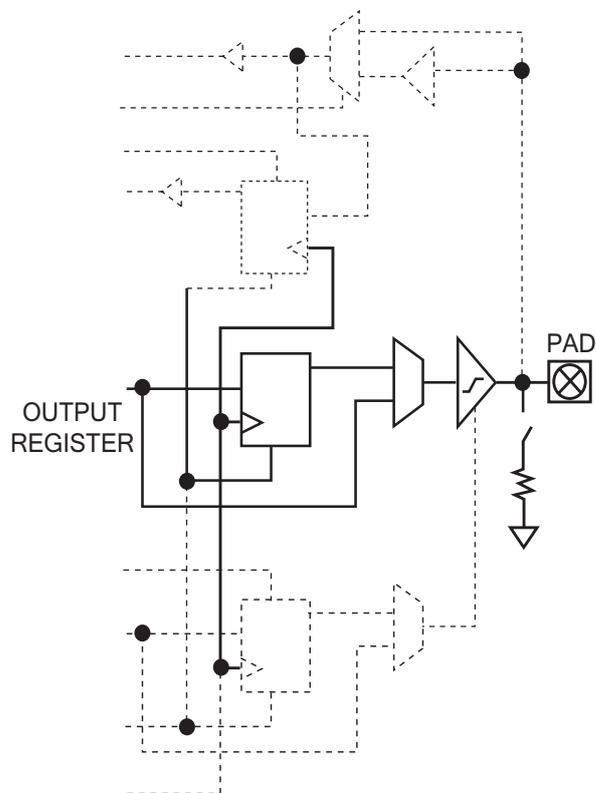


Figure 14: Eclipse Output Register Cell

Table 8: Eclipse Output Register Cell

Symbol	Parameter	Value (ns)	
		Min	Max
Output Register Cell Only			
t_{OUTLH}	Output Delay low to high (90% of H)	-	0.40
t_{OUTHl}	Output Delay high to low (10% of L)	-	0.55
t_{PZH}	Output Delay tri-state to high (90% of H)	-	2.94
t_{PZL}	Output Delay tri-state to low (10% of L)	-	2.34
t_{PHZ}	Output Delay high to tri-State	-	3.07
t_{PLZ}	Output Delay low to tri-State	-	2.53
t_{COP}	Clock-to-out delay (does not include clock tree delays)	-	3.15 (fast slew) 10.2 (slow slew)

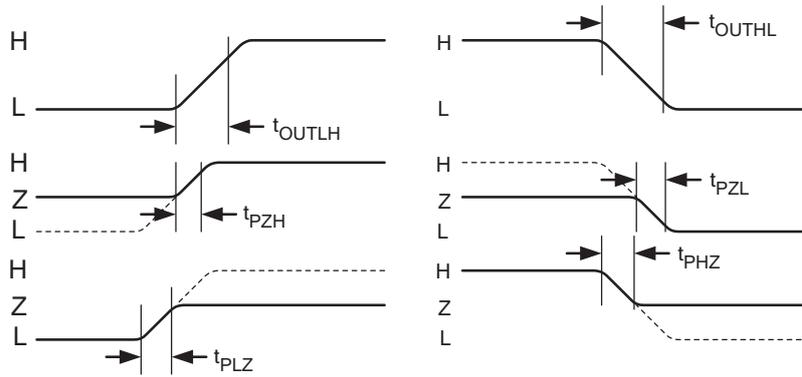


Figure 15: Eclipse Output Register Cell Timing

Table 9: Output Slew Rates @ $V_{CCIO} = 3.3\text{ V}$

	Fast Slew	Slow Slew
Rising Edge	2.8 V/ns	1.0 V/ns
Falling Edge	2.86 V/ns	1.0 V/ns

Table 10: Output Slew Rates @ $V_{CCIO} = 2.5\text{ V}$

	Fast Slew	Slow Slew
Rising Edge	1.7 V/ns	0.6 V/ns
Falling Edge	1.9 V/ns	0.6 V/ns

DC Characteristics

The DC Specifications are provided in **Table 11** through **Table 13**.

Table 11: Absolute Maximum Ratings

Parameter	Value	Parameter	Value
V _{CC} Voltage	-0.5 V to 3.6 V	DC Input Current	±20 mA
V _{CCIO} Voltage	-0.5 V to 4.6 V	ESD Pad Protection	±2000 V
INREF Voltage	2.7 V	Leaded Package Storage Temperature	-65° C to + 150° C
Input Voltage	-0.5 V to V _{CCIO} +0.5 V	Laminate Package (BGA) Storage Temperature	-55° C to + 125° C
Latch-up Immunity	±100 mA		

Table 12: Operating Range

Symbol	Parameter	Military		Industrial		Commercial		Unit	
		Min	Max	Min	Max	Min	Max		
V _{CC}	Supply Voltage	2.3	2.7	2.3	2.7	2.3	2.7	V	
V _{CCIO}	I/O Input Tolerance Voltage	2.3	3.6	2.3	3.6	2.3	3.6	V	
TA	Ambient Temperature	-55		-40	85	0	70	°C	
TC	Case Temperature	-	125	-	-	-	-	°C	
K	Delay Factor	-4 Speed Grade	0.42	2.3	0.43	2.16	0.47	2.11	n/a
		-5 Speed Grade	0.42	1.92	0.43	1.80	0.46	1.76	n/a
		-6 Speed Grade	0.42	1.35	0.43	1.26	0.46	1.23	n/a
		-7 Speed Grade	0.42	1.27	0.43	1.19	0.46	1.16	n/a

Table 13: DC Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
I _I	I or I/O Input Leakage Current	V _I = V _{CCIO} or GND	-10	10	μA
I _{OZ}	3-State Output Leakage Current	V _I = V _{CCIO} or GND	-10	10	μA
C _I	Input Capacitance ^a	-	-	8	pF
I _{OS}	Output Short Circuit Current ^b	V _o = GND V _o = V _{CC}	-15 40	-180 210	mA mA
I _{CC}	D.C. Supply Current ^c	V _I , V _o = V _{CCIO} or GND	0.50 (typ)	2	mA
I _{CCIO}	D.C. Supply Current on V _{CCIO}	-	0	2	mA
I _{CCIO(DIF)}	D.C. Supply Current on V _{CCIO} for Differential I/O	-	-	-	mA
I _{REF}	D.C. Supply Current on INREF	-	-10	10	μA
I _{PD}	Pad Pull-down (programmable)	V _{CCIO} = 3.6 V	-	150	μA

a. Capacitance is sample tested only. Clock pins are 12 pF maximum.

b. Only one output at a time. Duration should not exceed 30 seconds.

c. For -4/-5/-6/-7 commercial grade devices only. Maximum I_{CC} is 3 mA for -0 commercial grade and all industrial grade devices, and 5 mA for all military grade devices.

I/O Characteristics

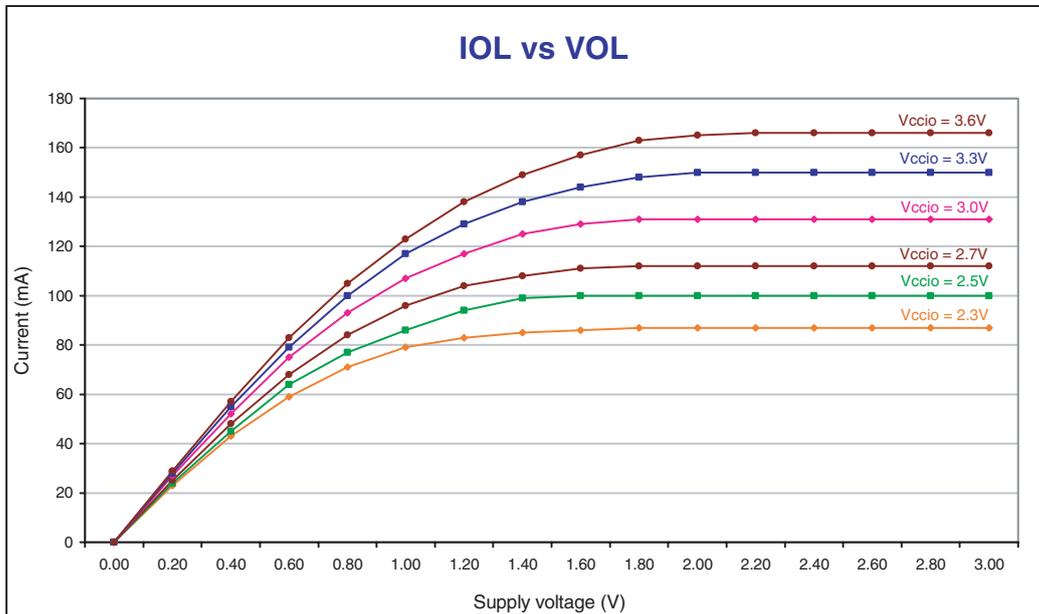


Figure 16: IOL vs. VOL

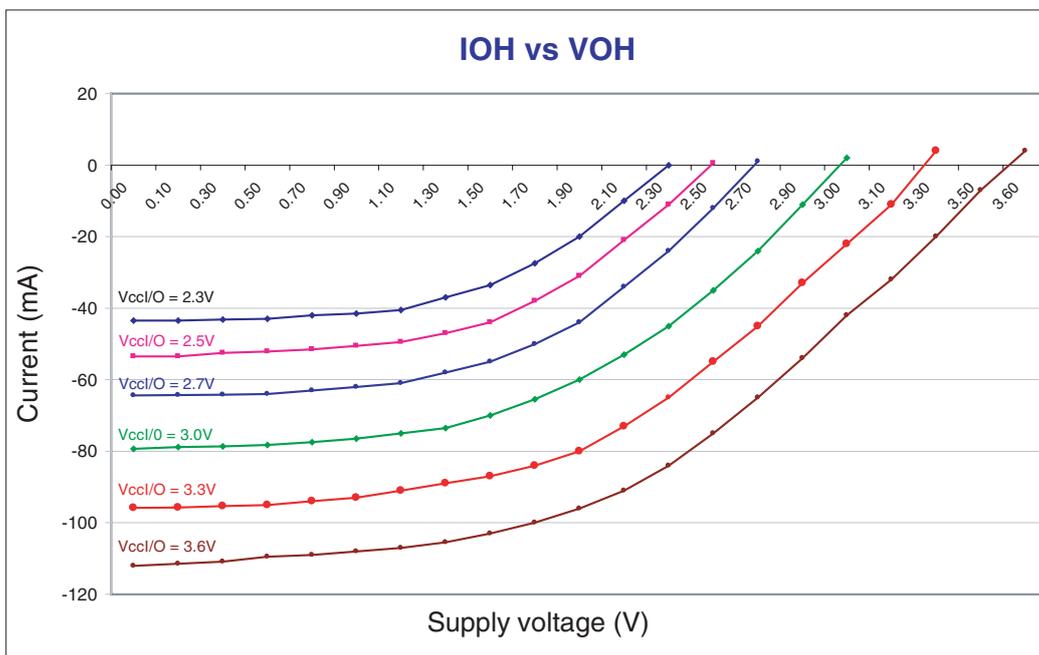


Figure 17: IOH vs. VOH

Table 14: DC Input and Output Levels

	INREF		V_{IL}		V_{IH}		V_{OL}	V_{OH}	I_{OL}	I_{OH}
	V_{MIN}	V_{MAX}	V_{MIN}	V_{MAX}	V_{MIN}	V_{MAX}	V_{MAX}	V_{MIN}	mA	mA
LVTTTL	n/a	n/a	-0.3	0.8	2.0	$V_{CCIO} + 0.3$	0.4	2.4	2.0	-2.0
LVC MOS2	n/a	n/a	-0.3	0.7	1.7	$V_{CCIO} + 0.3$	0.7	1.7	2.0	-2.0
GTL+	0.88	1.12	-0.3	INREF - 0.2	INREF + 0.2	$V_{CCIO} + 0.3$	0.6	n/a	40	n/a
PCI	n/a	n/a	-0.3	$0.3 \times V_{CCIO}$	$0.5 \times V_{CCIO}$	$V_{CCIO} + 0.5$	$0.1 \times V_{CCIO}$	$0.9 \times V_{CCIO}$	1.5	-0.5
SSTL2	1.15	1.35	-0.3	INREF - 0.18	INREF + 0.18	$V_{CCIO} + 0.3$	0.74	1.76	7.6	-7.6
SSTL3	1.3	1.7	-0.3	INREF - 0.2	INREF + 0.2	$V_{CCIO} + 0.3$	1.10	1.90	8	-8

NOTE: The data provided in **Table 14** are JEDEC and PCI Specifications. QuickLogic® devices either meet or exceed these requirements. For data specific to QuickLogic I/Os, see **Table 1** through **Table 13** and **Figure 1** through **Figure 17**.

NOTE: All CLK and INREF pins are clamped to the V_{CC} rail, not the V_{CCIO} . Therefore, these pins can only be driven up to $V_{CC} + 0.3$ V.

Package Thermal Characteristics

Thermal Resistance Equations:

$$\theta_{JC} = (T_J - T_C) / P$$

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

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

Parameter Description:

θ_{JC} : Junction-to-case thermal resistance

θ_{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 150° C. To calculate the maximum power dissipation for a device package look up θ_{JA} from **Table 15**, pick an appropriate T_{AMAX} and use:

$$P_{MAX} = (150^\circ \text{ C} - T_{AMAX}) / \theta_{JA}$$

Table 15: Package Thermal Characteristics

Package Description		θ_{JA} (°C/W) @ various flow rates (m/sec)				θ_{JC} (°C/W)
Pin Count	Package Type	0	0.5	1	2	
672	PBGA	22.0	20.0	19.0	18.0	8.0
516	PBGA	20.0	19.0	17.5	16.0	7.0
484	PBGA	28.0	26.0	25.0	23.0	9.0
280	LF-PBGA	18.5	17.0	15.5	14.0	7.0

Kv and Kt Graphs

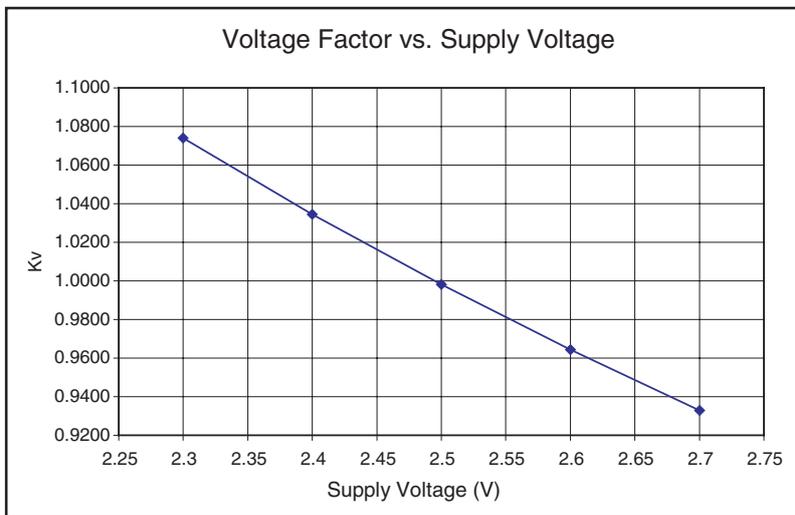


Figure 18: Voltage Factor vs. Supply Voltage

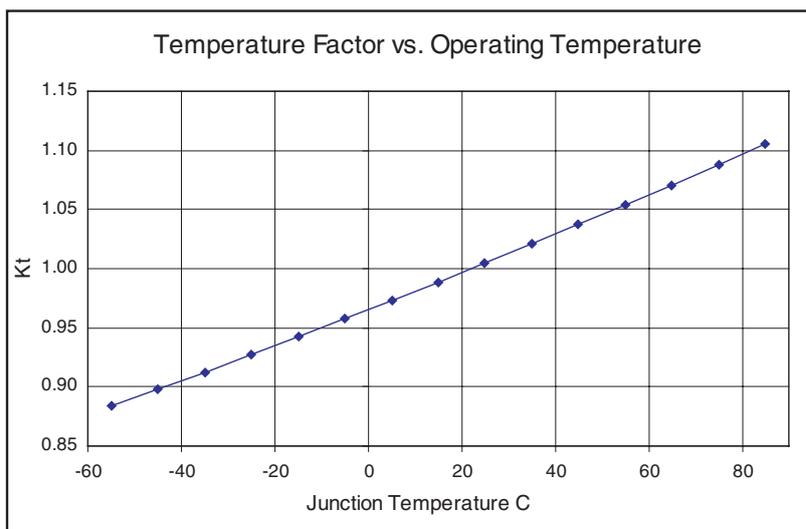


Figure 19: Temperature Factor vs. Operating Temperature

Power vs. Operating Frequency

The basic power equation which best models power consumption is given below:

$$P_{\text{TOTAL}} = 0.350 + f[0.0031 \eta_{\text{LC}} + 0.0948 \eta_{\text{CKBF}} + 0.01 \eta_{\text{CLBF}} + 0.0263 \eta_{\text{CKLD}} + 0.543 \eta_{\text{RAM}} + 0.20 \eta_{\text{PLL}} + 0.0035 \eta_{\text{INP}} + 0.0257 \eta_{\text{OUTP}}] \text{ (mW)}$$

Where

- η_{LC} is the total number of logic cells in the design
- η_{CKBF} = # of clock buffers
- η_{CLBF} = # of column clock buffers
- η_{CKLD} = # of loads connected to the column clock buffers
- η_{RAM} = # of RAM blocks
- η_{PLL} = # of PLLs
- η_{INP} is the number of input pins
- η_{OUTP} is the number of output pins

Figure 20 exhibits the power consumption in an Eclipse QL6600 device. The chip was filled with (300) 8-bit counters—approximately 76% logic cell utilization.

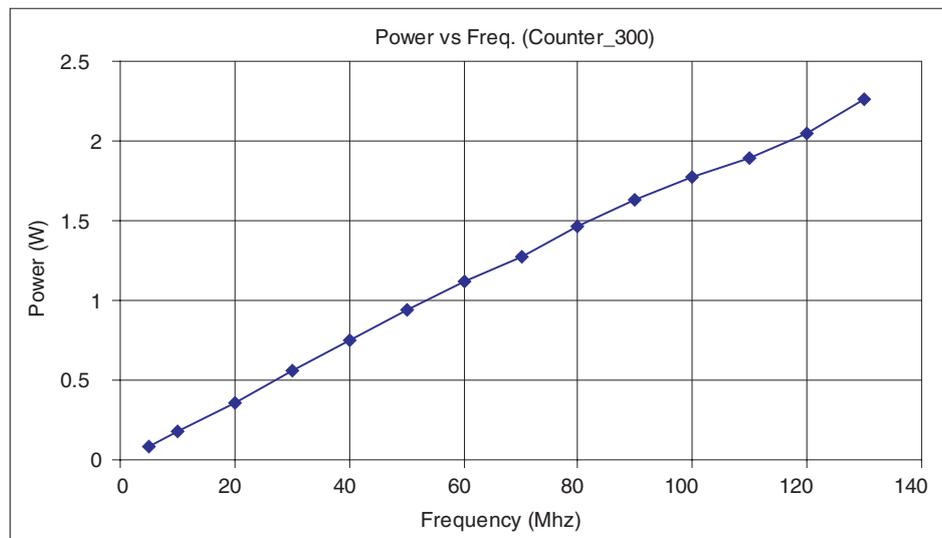


Figure 20: Power Consumption

Figure 21 illustrates the theoretical worst-case scenarios for 50%, 70%, and 90% utilizations of the 6500-516 package. The resources of the device are divided exactly in half; meaning, for 50% utilization, exactly 50% of the I/Os, Logic Cells, RAM blocks, clock network, etc are utilized. These situations may never occur in a real design, but they do provide a very rough quantitative measure of power consumption when talking in terms of 50% or 70% utilization of an Eclipse device.

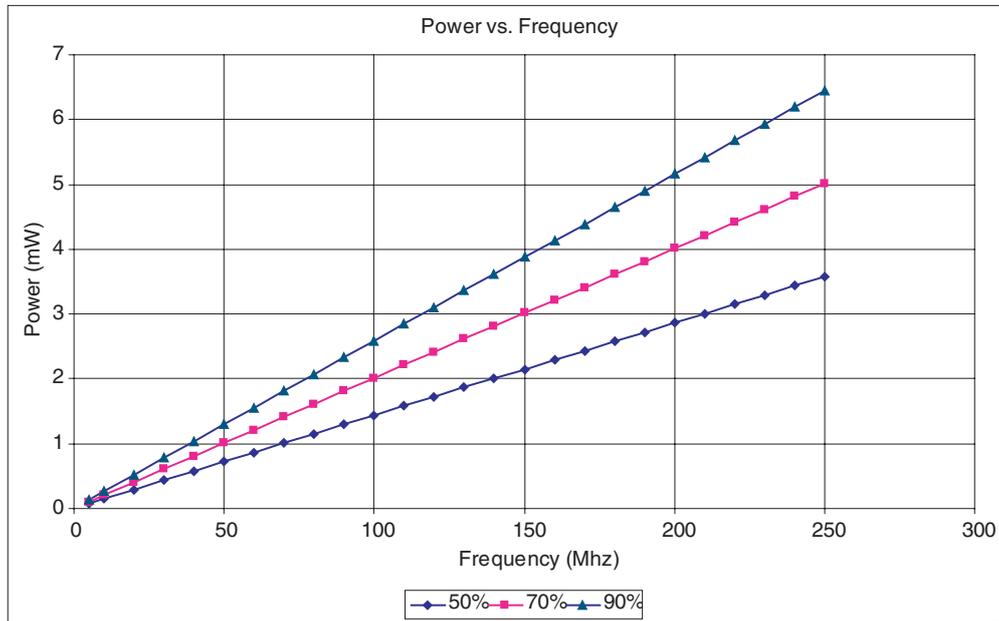


Figure 21: Power vs. Frequency (Absolute 50%, 70%, and 90% of the Available Resources on Chip)

To learn more about power consumption, please refer to application note #60 which is located at www.quicklogic.com.

Power-up Sequencing

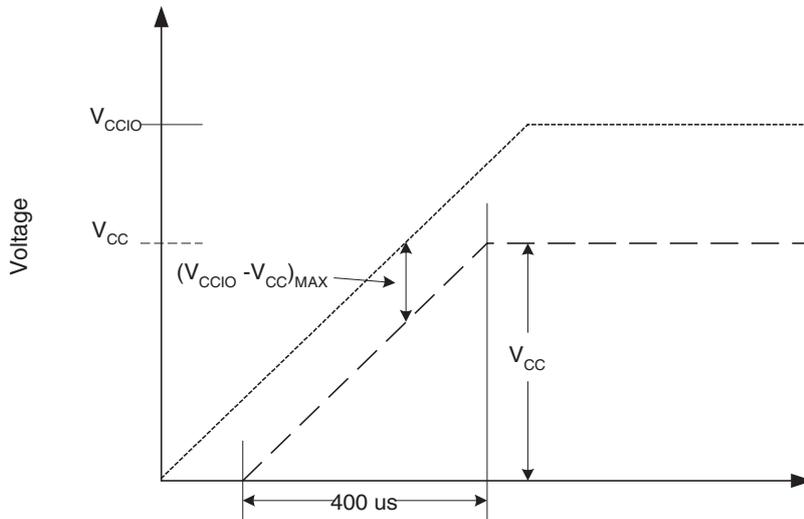


Figure 22: Power-up Requirements

The following requirements must be met when powering up a device (refer to **Figure 22**):

- When ramping up the power supplies keep $(V_{CCIO} - V_{CC})_{MAX} \leq 500$ mV. Deviation from this recommendation can cause permanent damage to the device.
- V_{CCIO} must lead V_{CC} when ramping the device.
- The power supply must be greater than or equal to 400 μ s to reach V_{CC} . Ramping to V_{CC}/V_{CCIO} before reaching 400 μ s can cause the device to behave improperly.

A diode is present in-between V_{CC} and V_{CCIO} , as shown in **Figure 23**.

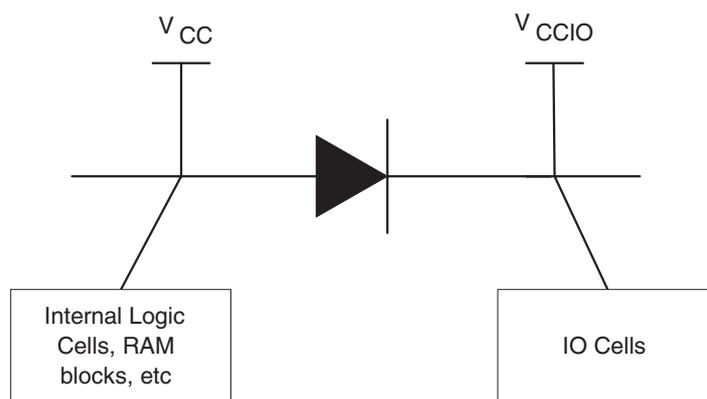


Figure 23: Internal Diode Between V_{CC} and V_{CCIO}

JTAG

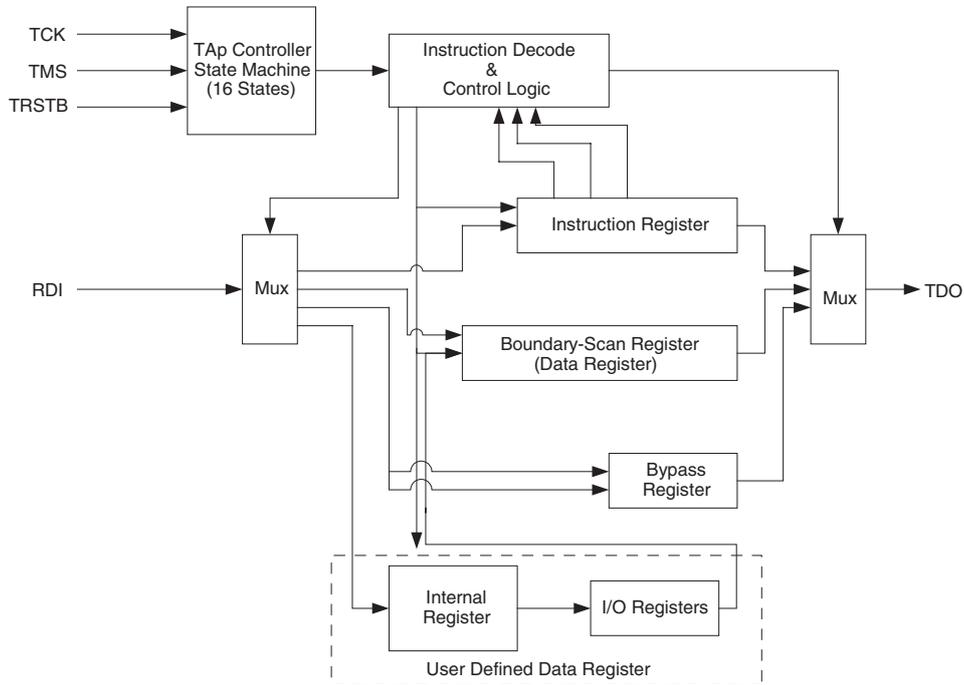


Figure 24: JTAG Block Diagram

Microprocessors and Application Specific Integrated Circuits (ASICs) pose many design challenges, not in the least of which concerns the accessibility of test points. The Joint Test Access Group (JTAG) formed in response to this challenge, resulting in 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 fuller verification of higher level system elements.

The 1149.1 standard requires the following three tests:

- **Extest Instruction.** The Extest instruction performs a 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's Test Data In (TDI) and Test Data Out (TDO) pins. Boundary scan cells are preloaded with test patterns (via the Sample/Preload Instruction), and input boundary cells capture the input data for analysis.
- **Sample/Preload Instruction.** This 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 via 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's 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.

Pin Descriptions

Table 16: JTAG Pin Descriptions

Pin	Function	Description
TDI/RSI	Test Data In for JTAG/RAM init. Serial Data In	Hold HIGH during normal operation. Connects to serial PROM data in for RAM initialization. Connect to V _{CC} if unused
TRSTB/RRO	Active low Reset for JTAG/RAM init. reset out	Hold LOW during normal operation. Connects to serial PROM reset for RAM initialization. Connect to GND if unused
TMS	Test Mode Select for JTAG	Hold HIGH during normal operation. Connect to V _{CC} if not used for JTAG
TCK	Test Clock for JTAG	Hold HIGH or LOW during normal operation. Connect to V _{CC} or ground if not used for JTAG
TDO/RCO	Test data out for JTAG/RAM init. clock out	Connect to serial PROM clock for RAM initialization. Must be left unconnected if not used for JTAG or RAM initialization

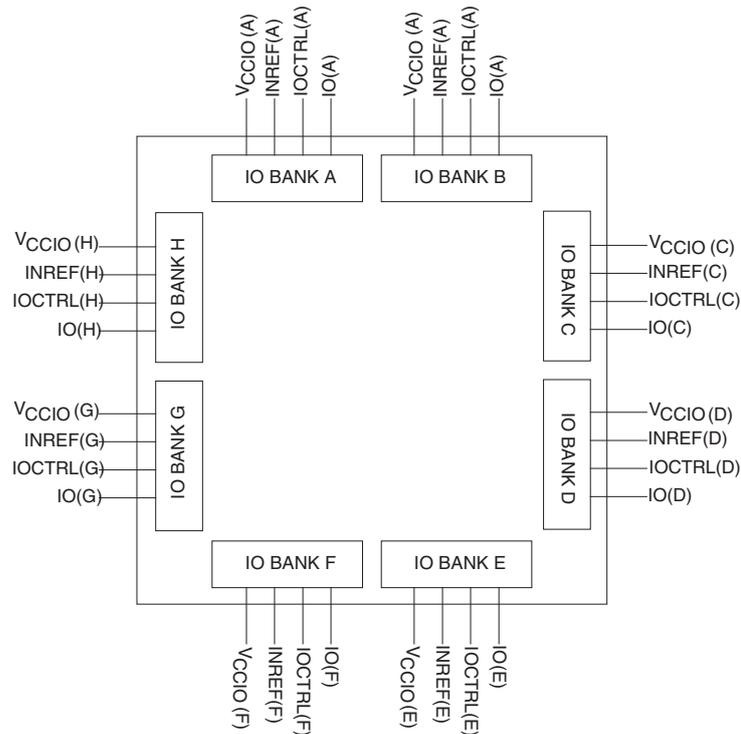


Figure 25: I/O Banks with Relevant Pins

Table 17: Dedicated Pin Descriptions

Pin	Function	Description
CLK	High-drive input and/or global clock network driver	Can be configured as either input or global clock
I/O(A)	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 A inside the parenthesis means that the I/O is located in Bank A. If an I/O is not used, SpDE (QuickWorks Tool) provides the option of tying that pin to GND, V_{CC} , or TriState during programming.
V_{CC}	Power supply pin	Connect to 2.5 V supply
$V_{CCIO}(A)$	Input voltage tolerance pin	This pin provides the flexibility to interface the device with either a 3.3 V device or a 2.5 V device. The A inside the parenthesis means that V_{CCIO} is located in BANK A. Every I/O pin in Bank A will be tolerant of V_{CCIO} input signals and will output V_{CCIO} level signals. This pin must be connected to either 3.3 V or V_{CC} .
GND	Ground pin	Connect to ground
PLLIN	PLL clock input	Clock input for PLL
DEDCLK	Dedicated clock pin	Low skew global clock
GNDPLL	Ground pin for PLL	Connect to GND
INREF(A)	Differential reference voltage	The INREF is the reference voltage pin for GTL+, SSTL2, and STTL3 standards. Follow the recommendations provided in Table 14 for the appropriate standard. The A inside the parenthesis means that INREF is located in BANK A. This pin should be tied to GND if not needed.
PLLOUT	PLL output pin	Dedicated PLL output pin. Otherwise may be left unconnected
IOCTRL(A)	Highdrive input	This pin provides fast RESET, SET, CLOCK, and ENABLE access to the I/O cell flip-flops, providing fast clock-to-out and fast I/O response times. This pin can also double as a high-drive pin to the internal logic cells. The A inside the parenthesis means that IOCTRL is located in Bank A. This pin should be tied to GND or V_{CC} if it is not used.

Recommended Unused Pin Terminations for the Eclipse devices

All unused, general purpose I/O pins can be tied to V_{CC} , GND, or HIZ (high impedance) internally using the Configuration Editor. This option is given in the bottom-right corner of the placement window. To use the Placement Editor, choose **Constraint** → **Fix Placement** in the Option pull-down menu of SpDE.

The rest of the pins should be terminated at the board level in the manner presented in **Table 18**.

Table 18: Recommended Unused Pin Terminations

Signal Name	Recommended Termination
PLLOUT<x>	Unused PLL output pins must be connected to either V_{CC} or GND so that their associated input buffer never floats. Utilized PLL output pins that route the PLL clock outside of the chip should not be tied to either V_{CC} or GND.
IOCTRL<y>	Any unused pins of this type must be connected to either V_{CC} or GND.
CLK/PLLIN<x>	Any unused clock pins should be connected to V_{CC} or GND.
PLLRST<x>	If a PLL module is not used, then the associated PLLRST<x> must be connected to V_{CC} ; under normal operation use it as needed.
INREF<y>	If an I/O bank does not require the use of INREF signal the pin should be connected to GND.

NOTE: x -> number, y -> alphabetical character.

Ordering Information

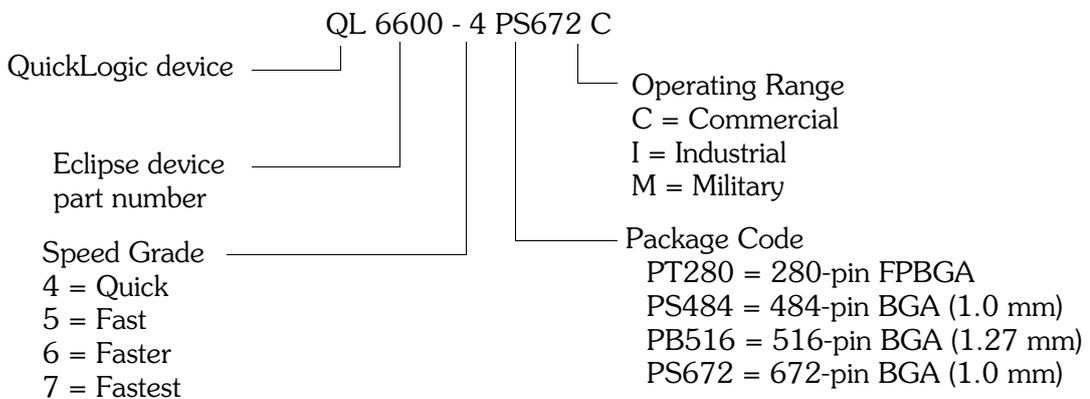


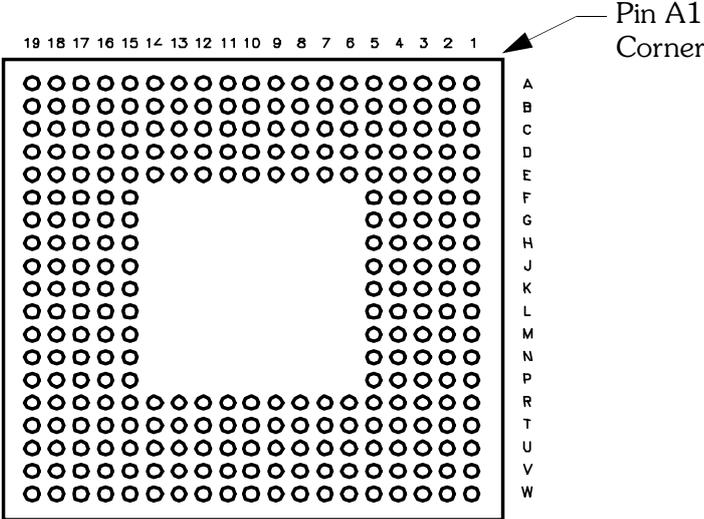
Figure 26: Ordering Information

280 PBGA Pinout Diagram

Top



Bottom



280 PBGA Pinout Table

Table 19: 280 PBGA Pinout Table

280 PBGA	Function	280 PBGA	Function	280 PBGA	Function	280 PBGA	Function	280 PBGA	Function	280 PBGA	Function
A1	PLLOUT<3>	C10	CLK<5>/PLLI N<3>	E19	IOCTRL<D>	K16	I/O<C>	R4	I/O<H>	U13	I/O
A2	GNDPLL<0>	C11	V _{ccio} <E>	F1	INREF<G>	K17	I/O<D>	R5	GND	U14	IOCTRL
A3	I/O<F>	C12	I/O<E>	F2	IOCTRL<G>	K18	I/O<C>	R6	GND	U15	V _{ccio}
A4	I/O<F>	C13	I/O<E>	F3	I/O<G>	K19	TRSTB	R7	V _{cc}	U16	I/O
A5	I/O<F>	C14	I/O<E>	F4	I/O<G>	L1	I/O<H>	R8	V _{cc}	U17	TDO
A6	IOCTRL<F>	C15	V _{ccio} <E>	F5	GND	L2	I/O<H>	R9	GND	U18	PLLRST<2>
A7	I/O<F>	C16	I/O<E>	F15	V _{cc}	L3	V _{ccio} <H>	R10	GND	U19	I/O
A8	I/O<F>	C17	I/O<E>	F16	IOCTRL<D>	L4	I/O<H>	R11	V _{cc}	V1	PLLOUT<2>
A9	I/O<F>	C18	I/O<E>	F17	I/O<D>	L5	V _{cc}	R12	V _{cc}	V2	GNDPLL<3>
A10	CLK<7>	C19	I/O<E>	F18	I/O<D>	L15	GND	R13	V _{cc}	V3	GND
A11	I/O<E>	D1	I/O<G>	F19	I/O<D>	L16	I/O<C>	R14	V _{cc}	V4	I/O<A>
A12	I/O<E>	D2	I/O<G>	G1	I/O<G>	L17	V _{ccio} <C>	R15	GND	V5	I/O<A>
A13	I/O<E>	D3	I/O<F>	G2	I/O<G>	L18	I/O<C>	R16	I/O<C>	V6	IOCTRL<A>
A14	IOCTRL<E>	D4	I/O<F>	G3	IOCTRL<G>	L19	I/O<C>	R17	V _{ccio} <C>	V7	I/O<A>
A15	I/O<E>	D5	I/O<F>	G4	I/O<G>	M1	I/O<H>	R18	I/O<C>	V8	I/O<A>
A16	I/O<E>	D6	I/O<F>	G5	V _{cc}	M2	I/O<H>	R19	I/O<C>	V9	I/O<A>
A17	I/O<E>	D7	I/O<F>	G15	V _{cc}	M3	I/O<H>	T1	I/O<H>	V10	CLK<1>
A18	PLLRST<1>	D8	I/O<F>	G16	I/O<D>	M4	I/O<H>	T2	I/O<H>	V11	CLK<4>/DEDCLK/PLLIN<0>
A19	GND	D9	CLK<8>	G17	I/O<D>	M5	V _{cc}	T3	I/O<A>	V12	I/O
B1	PLLRST<0>	D10	I/O<E>	G18	I/O<D>	M15	V _{cc}	T4	I/O<A>	V13	I/O
B2	GND	D11	I/O<E>	G19	I/O<D>	M16	INREF<C>	T5	I/O<A>	V14	INREF
B3	I/O<F>	D12	I/O<E>	H1	I/O<G>	M17	I/O<C>	T6	IOCTRL<A>	V15	I/O
B4	I/O<F>	D13	INREF<E>	H2	I/O<G>	M18	I/O<C>	T7	I/O<A>	V16	I/O
B5	I/O<F>	D14	I/O<E>	H3	I/O<G>	M19	I/O<C>	T8	I/O<A>	V17	I/O
B6	INREF<F>	D15	I/O<E>	H4	I/O<G>	N1	IOCTRL<H>	T9	I/O<A>	V18	GNDPLL<2>
B7	I/O<F>	D16	I/O<D>	H5	V _{cc}	N2	I/O<H>	T10	I/O<A>	V19	GND
B8	I/O<F>	D17	I/O<D>	H15	V _{cc}	N3	I/O<H>	T11	CLK<3>/PLLI N<1>	W1	GND
B9	TMS	D18	I/O<D>	H16	V _{cc}	N4	I/O<H>	T12	I/O	W2	PLLRST<3>
B10	CLK<6>	D19	I/O<D>	H17	I/O<D>	N5	V _{cc}	T13	I/O	W3	I/O<A>
B11	I/O<E>	E1	I/O<G>	H18	I/O<D>	N15	V _{cc}	T14	I/O	W4	I/O<A>
B12	I/O<E>	E2	I/O<G>	H19	I/O<D>	N16	I/O<C>	T15	I/O	W5	I/O<A>
B13	IOCTRL<E>	E3	V _{ccio} <G>	J1	I/O<C>	N17	I/O<C>	T16	I/O	W6	I/O<A>
B14	I/O<E>	E4	I/O<F>	J2	I/O<G>	N18	IOCTRL<C>	T17	V _{cc} PLL<2>	W7	I/O<A>
B15	I/O<E>	E5	GND	J3	V _{ccio} <G>	N19	IOCTRL<C>	T18	I/O	W8	I/O<A>
B16	I/O<E>	E6	V _{cc}	J4	I/O<G>	P1	I/O<H>	T19	I/O	W9	TDI
B17	V _{cc} PLL<1>	E7	V _{cc}	J5	GND	P2	I/O<H>	U1	I/O<A>	W10	CLK<2>/PLLI N<2>
B18	GNDPLL<1>	E8	V _{cc}	J15	V _{cc}	P3	IOCTRL<H>	U2	I/O<A>	W11	I/O
B19	PLLOUT<0>	E9	V _{cc}	J16	I/O<C>	P4	INREF<H>	U3	V _{cc} PLL<3>	W12	I/O
C1	I/O<F>	E10	GND	J17	V _{ccio} <D>	P5	V _{cc}	U4	I/O<A>	W13	I/O
C2	V _{cc} PLL<0>	E11	GND	J18	I/O<D>	P15	GND	U5	V _{ccio} <A>	W14	IOCTRL
C3	I/O<F>	E12	V _{cc}	J19	I/O<D>	P16	I/O<C>	U6	INREF<A>	W15	I/O
C4	I/O<F>	E13	V _{cc}	K1	V _{cc}	P17	I/O<C>	U7	I/O<A>	W16	I/O
C5	V _{ccio} <F>	E14	GND	K2	TCK	P18	I/O<C>	U8	I/O<A>	W17	I/O
C6	IOCTRL<F>	E15	GND	K3	I/O<G>	P19	I/O<C>	U9	V _{ccio} <A>	W18	I/O
C7	I/O<F>	E16	I/O<D>	K4	I/O<G>	R1	I/O<H>	U10	CLK<0>	W19	PLLOUT<1>
C8	I/O<F>	E17	V _{ccio} <D>	K5	GND	R2	I/O<H>	U11	V _{ccio} 		
C9	V _{ccio} <F>	E18	INREF<D>	K15	GND	R3	V _{ccio} <H>	U12	I/O		

280 PBGA Packaging Drawing

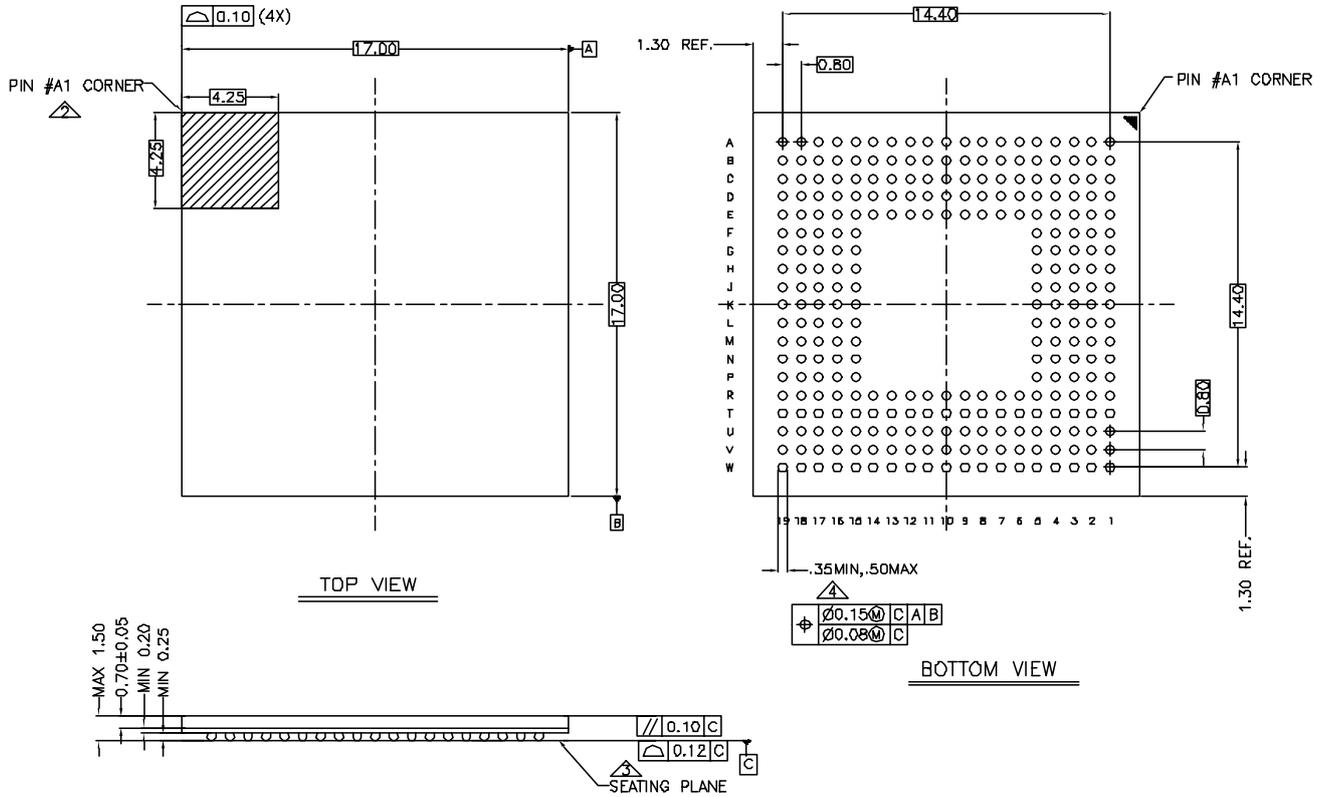


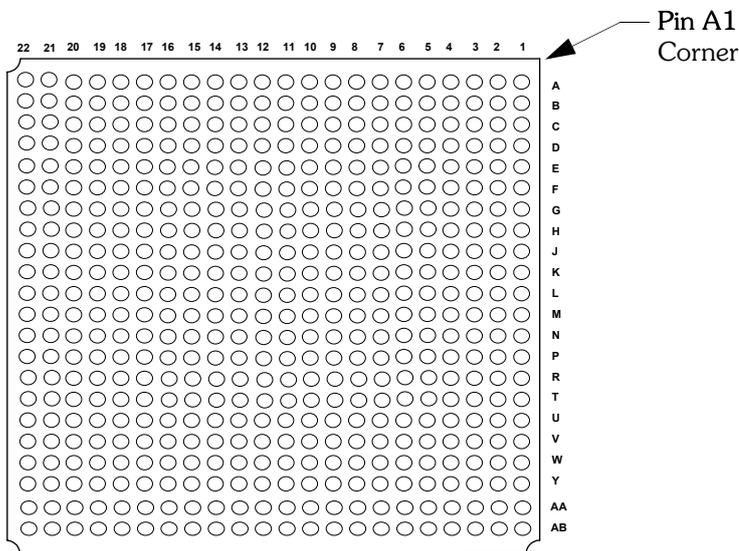
Figure 27: 280 PBGA Packaging Drawing

484 PBGA Pinout Diagram

Top



Bottom



484 PBGA Pinout Table

Table 20: 484 PBGA Pinout Table

484 PBGA	Function	484 PBGA	Function	484 PBGA	Function	484 PBGA	Function	484 PBGA	Function	484 PBGA	Function
A1	I/O<A>	C1	I/O<A>	E1	IOCTRL<A>	G1	I/O<A>	J1	I/O<A>	L1	CLK<4> DEDCLK/PLLIN<0>
A2	PLL RST<3>	C2	I/O<A>	E2	I/O<A>	G2	I/O<A>	J2	I/O<A>	L2	CLK<0>
A3	I/O<A>	C3	V _{CC} PLL<3>	E3	I/O<A>	G3	I/O<A>	J3	I/O<A>	L3	CLK<2>/PLLIN<2>
A4	I/O<A>	C4	PLLOUT<2>	E4	I/O<A>	G4	I/O<A>	J4	I/O<A>	L4	I/O<A>
A5	I/O<A>	C5	I/O<A>	E5	I/O<A>	G5	I/O<A>	J5	I/O<A>	L5	I/O<A>
A6	I/O<H>	C6	I/O<H>	E6	I/O<H>	G6	I/O<A>	J6	I/O<A>	L6	I/O<A>
A7	I/O<H>	C7	I/O<H>	E7	I/O<H>	G7	GND	J7	I/O<A>	L7	GND
A8	IOCTRL<H>	C8	I/O<H>	E8	I/O<H>	G8	I/O<H>	J8	V _{CC}	L8	GND
A9	I/O<H>	C9	IOCTRL<H>	E9	I/O<H>	G9	I/O<H>	J9	GND	L9	GND
A10	I/O<H>	C10	I/O<H>	E10	I/O<H>	G10	I/O<H>	J10	V _{CC}	L10	GND
A11	I/O<H>	C11	I/O<H>	E11	V _{CC}	G11	I/O<G>	J11	V _{CC}	L11	GND
A12	TCK	C12	I/O<H>	E12	I/O<G>	G12	GND	J12	GND	L12	GND
A13	I/O<G>	C13	I/O<G>	E13	I/O<G>	G13	I/O<G>	J13	V _{CC}	L13	GND
A14	I/O<G>	C14	I/O<G>	E14	I/O<G>	G14	I/O<G>	J14	GND	L14	V _{CC}
A15	I/O<G>	C15	I/O<G>	E15	IOCTRL<G>	G15	I/O<G>	J15	V _{CC}	L15	V _{CC}
A16	I/O<G>	C16	I/O<G>	E16	I/O<G>	G16	GND	J16	I/O<F>	L16	CLK<6>
A17	I/O<G>	C17	I/O<G>	E17	INREF<G>	G17	V _{CCIO} <F>	J17	V _{CCIO} <F>	L17	V _{CCIO} <F>
A18	I/O<G>	C18	I/O<G>	E18	I/O<G>	G18	I/O<F>	J18	I/O<F>	L18	I/O<F>
A19	I/O<F>	C19	I/O<F>	E19	I/O<F>	G19	I/O<F>	J19	I/O<F>	L19	CLK<8>
A20	GND	C20	GNDPLL<0>	E20	I/O<F>	G20	I/O<F>	J20	I/O<F>	L20	I/O<F>
A21	PLLOUT<3>	C21	I/O<F>	E21	I/O<F>	G21	INREF<F>	J21	I/O<F>	L21	I/O<F>
A22	I/O<F>	C22	I/O<F>	E22	I/O<F>	G22	I/O<F>	J22	I/O<F>	L22	I/O<F>
B1	I/O<A>	D1	I/O<A>	F1	I/O<A>	H1	I/O<A>	K1	TDI	M1	I/O
B2	GND	D2	I/O<A>	F2	INREF<A>	H2	I/O<A>	K2	I/O<A>	M2	I/O
B3	GNDPLL<3>	D3	I/O<A>	F3	I/O<A>	H3	I/O<A>	K3	I/O<A>	M3	I/O
B4	GND	D4	I/O<A>	F4	I/O<A>	H4	I/O<A>	K4	I/O<A>	M4	CLK<3>/PLLIN<1>
B5	I/O<A>	D5	I/O<A>	F5	I/O<A>	H5	IOCTRL<A>	K5	I/O<A>	M5	I/O
B6	I/O<H>	D6	I/O<H>	F6	V _{CCIO} <A>	H6	V _{CCIO} <A>	K6	V _{CCIO} <A>	M6	V _{CCIO}
B7	I/O<H>	D7	I/O<H>	F7	V _{CCIO} <H>	H7	I/O<H>	K7	I/O<A>	M7	CLK<1>
B8	INREF<H>	D8	I/O<H>	F8	I/O<H>	H8	GND	K8	V _{CC}	M8	V _{CC}
B9	I/O<H>	D9	I/O<H>	F9	V _{CCIO} <H>	H9	V _{CC}	K9	V _{CC}	M9	V _{CC}
B10	I/O<H>	D10	I/O<H>	F10	I/O<H>	H10	V _{CC}	K10	GND	M10	GND
B11	I/O<H>	D11	I/O<H>	F11	V _{CCIO} <H>	H11	V _{CC}	K11	GND	M11	GND
B12	I/O<G>	D12	I/O<G>	F12	V _{CCIO} <G>	H12	GND	K12	GND	M12	GND
B13	I/O<G>	D13	I/O<G>	F13	I/O<G>	H13	V _{CC}	K13	GND	M13	GND
B14	I/O<G>	D14	I/O<G>	F14	V _{CCIO} <G>	H14	V _{CC}	K14	V _{CC}	M14	GND
B15	I/O<G>	D15	IOCTRL<G>	F15	I/O<G>	H15	GND	K15	V _{CC}	M15	GND
B16	I/O<G>	D16	I/O<G>	F16	V _{CCIO} <G>	H16	I/O<F>	K16	I/O<F>	M16	GND
B17	I/O<G>	D17	I/O<G>	F17	I/O<G>	H17	I/O<F>	K17	I/O<F>	M17	I/O<E>
B18	I/O<G>	D18	I/O<F>	F18	I/O<F>	H18	I/O<F>	K18	I/O<F>	M18	I/O<E>
B19	PLL RST<0>	D19	V _{CC} PLL<0>	F19	I/O<F>	H19	I/O<F>	K19	I/O<F>	M19	I/O<E>
B20	I/O<F>	D20	I/O<F>	F20	IOCTRL<F>	H20	I/O<F>	K20	I/O<F>	M20	CLK<7>
B21	I/O<F>	D21	I/O<F>	F21	I/O<F>	H21	I/O<F>	K21	I/O<F>	M21	CLK<5>/PLLIN<3>
B22	I/O<F>	D22	I/O<F>	F22	IOCTRL<F>	H22	I/O<F>	K22	I/O<F>	M22	TMS

(Sheet 1 of 2)

Table 20: 484 PBGA Pinout Table (Continued)

484 PBGA	Function	484 PBGA	Function	484 PBGA	Function	484 PBGA	Function	484 PBGA	Function	484 PBGA	Function
N1	I/O	P16	I/O<E>	T9	I/O<C>	V2	I/O	W17	I/O<D>	AA10	I/O<C>
N2	I/O	P17	I/O<E>	T10	TRSTB	V3	I/O	W18	I/O<E>	AA11	I/O<C>
N3	I/O	P18	I/O<E>	T11	GND	V4	I/O	W19	I/O<E>	AA12	I/O<D>
N4	I/O	P19	I/O<E>	T12	I/O<C>	V5	I/O	W20	I/O<E>	AA13	I/O<D>
N5	I/O	P20	I/O<E>	T13	I/O<D>	V6	I/O<C>	W21	I/O<E>	AA14	I/O<D>
N6	I/O	P21	I/O<E>	T14	I/O<D>	V7	I/O<C>	W22	I/O<E>	AA15	I/O<D>
N7	I/O	P22	I/O<E>	T15	I/O<D>	V8	I/O<C>	Y1	I/O	AA16	I/O<D>
N8	V _{CC}	R1	I/O	T16	GND	V9	I/O<C>	Y2	I/O	AA17	I/O<D>
N9	V _{CC}	R2	INREF	T17	I/O<E>	V10	I/O<C>	Y3	V _{CC} PLL<2>	AA18	I/O<D>
N10	GND	R3	I/O	T18	I/O<E>	V11	I/O<C>	Y4	I/O<C>	AA19	I/O<E>
N11	GND	R4	I/O	T19	I/O<E>	V12	V _{CC}	Y5	I/O<C>	AA20	GNDPLL<1>
N12	GND	R5	I/O	T20	I/O<E>	V13	I/O<D>	Y6	I/O<C>	AA21	I/O<E>
N13	GND	R6	I/O	T21	IOCTRL<E>	V14	I/O<D>	Y7	I/O<C>	AA22	I/O<E>
N14	V _{CC}	R7	I/O	T22	I/O<E>	V15	I/O<D>	Y8	IOCTRL<C>	AB1	I/O
N15	V _{CC}	R8	GND	U1	IOCTRL	V16	INREF<D>	Y9	I/O<C>	AB2	GNDPLL<2>
N16	I/O<E>	R9	V _{CC}	U2	I/O	V17	I/O<D>	Y10	I/O<C>	AB3	PLL _{RST} <2>
N17	V _{CCIO} <E>	R10	V _{CC}	U3	IOCTRL	V18	I/O<E>	Y11	I/O<D>	AB4	I/O
N18	I/O<E>	R11	GND	U4	I/O	V19	I/O<E>	Y12	I/O<D>	AB5	I/O
N19	I/O<E>	R12	V _{CC}	U5	I/O	V20	I/O<E>	Y13	I/O<D>	AB6	I/O<C>
N20	I/O<E>	R13	V _{CC}	U6	I/O<C>	V21	I/O<E>	Y14	I/O<D>	AB7	I/O<C>
N21	I/O<E>	R14	V _{CC}	U7	V _{CCIO} <C>	V22	I/O<E>	Y15	IOCTRL<D>	AB8	IOCTRL<C>
N22	I/O<E>	R15	GND	U8	I/O<C>	W1	I/O	Y16	I/O<D>	AB9	I/O<C>
P1	I/O	R16	I/O<D>	U9	V _{CCIO} <C>	W2	I/O	Y17	I/O<D>	AB10	I/O<C>
P2	I/O	R17	V _{CCIO} <E>	U10	I/O<C>	W3	I/O	Y18	I/O<E>	AB11	I/O<C>
P3	I/O	R18	I/O<E>	U11	V _{CCIO} <C>	W4	I/O	Y19	PLL _{OUT} <0>	AB12	I/O<D>
P4	I/O	R19	I/O<E>	U12	V _{CCIO} <D>	W5	I/O	Y20	PLL _{RST} <1>	AB13	I/O<D>
P5	I/O	R20	I/O<E>	U13	I/O<D>	W6	I/O<C>	Y21	I/O<E>	AB14	I/O<D>
P6	V _{CCIO} 	R21	I/O<E>	U14	V _{CCIO} <D>	W7	I/O<C>	Y22	I/O<E>	AB15	I/O<D>
P7	I/O	R22	I/O<E>	U15	I/O<D>	W8	I/O<C>	AA1	TDO	AB16	IOCTRL<D>
P8	V _{CC}	T1	I/O	U16	V _{CCIO} <D>	W9	I/O<C>	AA2	PLL _{OUT} <1>	AB17	I/O<D>
P9	GND	T2	I/O	U17	V _{CCIO} <E>	W10	I/O<C>	AA3	GND	AB18	I/O<D>
P10	V _{CC}	T3	I/O	U18	I/O<E>	W11	I/O<C>	AA4	I/O	AB19	I/O<E>
P11	GND	T4	I/O	U19	I/O<E>	W12	I/O<D>	AA5	I/O<C>	AB20	GND
P12	V _{CC}	T5	I/O	U20	IOCTRL<E>	W13	I/O<D>	AA6	I/O<C>	AB21	V _{CC} PLL<1>
P13	V _{CC}	T6	V _{CCIO} 	U21	I/O<E>	W14	I/O<D>	AA7	I/O<C>	AB22	I/O<E>
P14	GND	T7	GND	U22	INREF<E>	W15	I/O<D>	AA8	INREF<C>		
P15	V _{CC}	T8	I/O<C>	V1	I/O	W16	I/O<D>	AA9	I/O<C>		

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484 PBGA Packaging Drawing

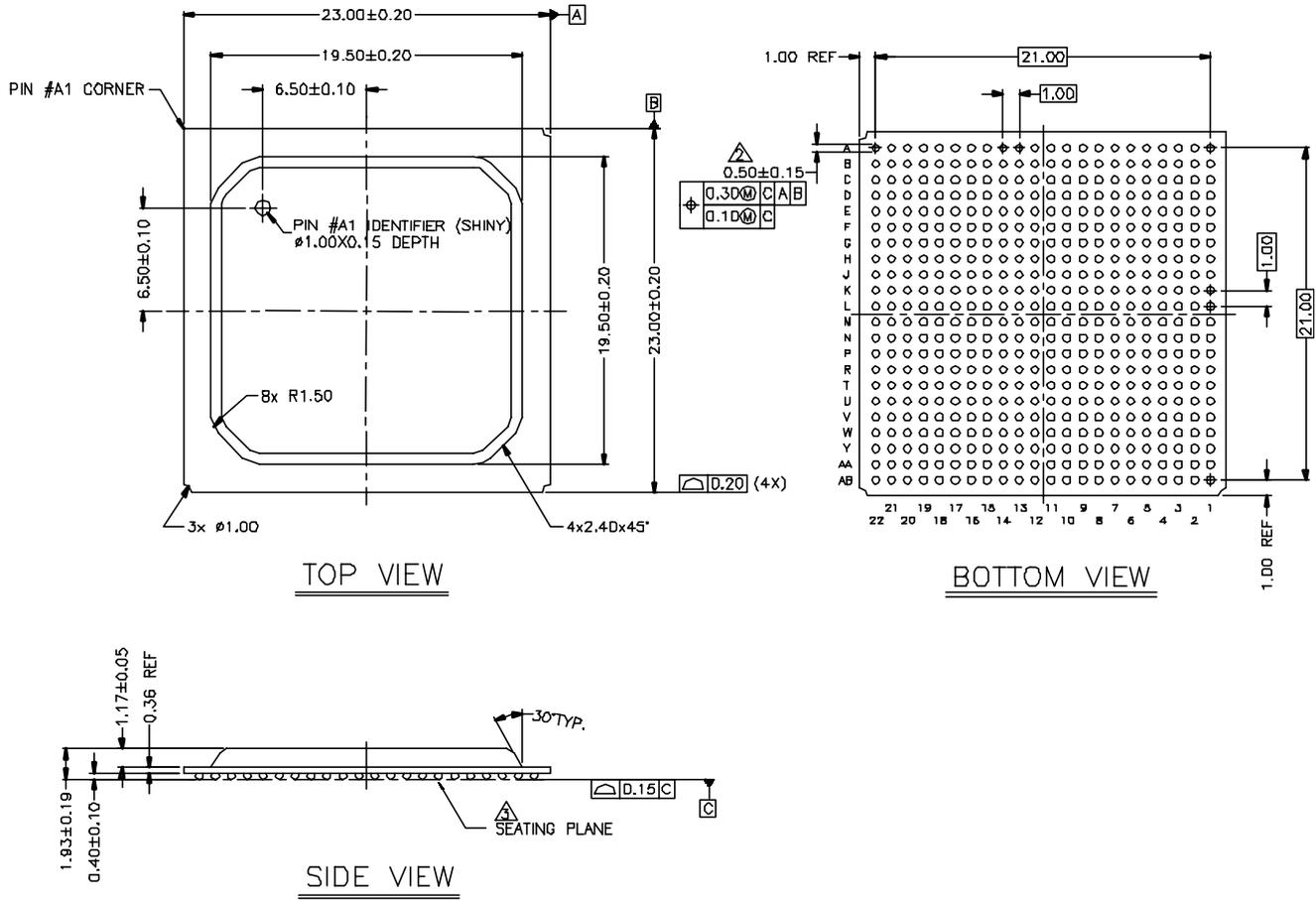
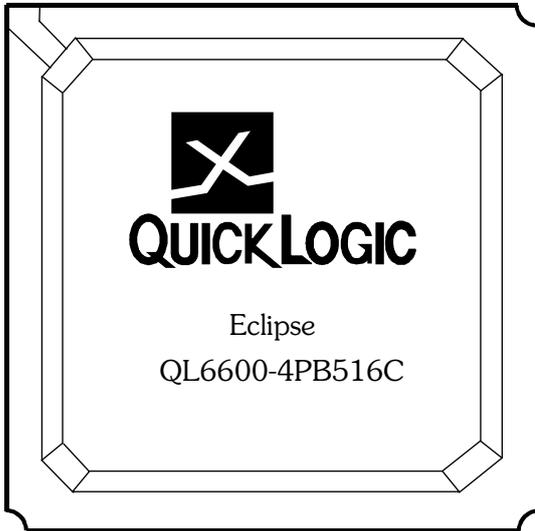


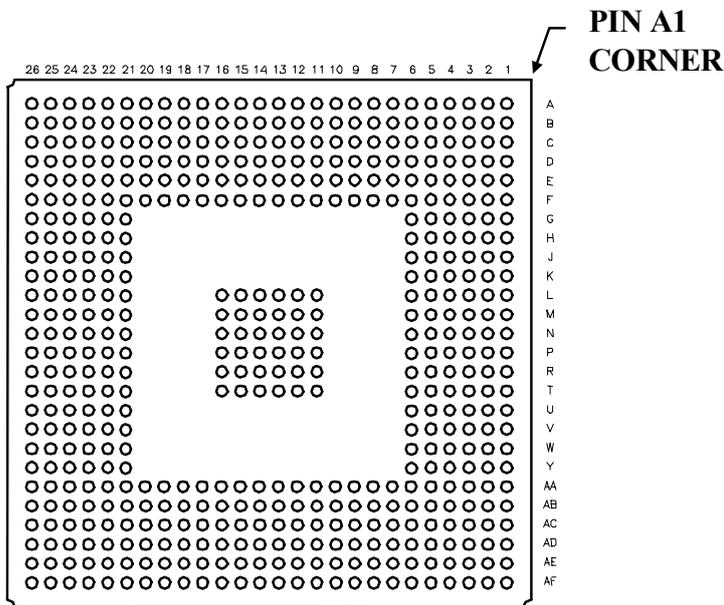
Figure 28: 484 PBGA Packaging Drawing

516 PBGA Pinout Diagram

Top



Bottom



516 PBGA Pinout Table

Table 21: 516 PBGA Pinout Table

516 PBGA	Function	516 PBGA	Function	516 PBGA	Function	516 PBGA	Function	516 PBGA	Function	516 PBGA	Function
A1	GND	C1	I/O<F>	E1	I/O<G>	G1	I/O<G>	L5	V _{CC}	P3	I/O<H>
A2	I/O<F>	C2	I/O<F>	E2	I/O<G>	G2	INREF<G>	L6	V _{CC}	P4	V _{CC}
A3	I/O<F>	C3	I/O<F>	E3	I/O<G>	G3	I/O<G>	L11	GND	P5	I/O<H>
A4	I/O<F>	C4	PLLOUT<3>	E4	V _{CC} PLL<0>	G4	I/O<G>	L12	GND	P6	V _{CCIO<H>}
A5	I/O<F>	C5	I/O<F>	E5	I/O<F>	G5	I/O<G>	L13	GND	P11	GND
A6	I/O<F>	C6	I/O<F>	E6	I/O<F>	G6	V _{CCIO<G>}	L14	GND	P12	GND
A7	IOCTRL<F>	C7	I/O<F>	E7	I/O<F>	G21	V _{CCIO<D>}	L15	GND	P13	GND
A8	I/O<F>	C8	INREF<F>	E8	V _{CC}	G22	I/O<D>	L16	GND	P14	GND
A9	I/O<F>	C9	I/O<F>	E9	I/O<F>	G23	I/O<D>	L21	V _{CC}	P15	GND
A10	I/O<F>	C10	I/O<F>	E10	I/O<F>	G24	I/O<D>	L22	I/O<D>	P16	GND
A11	I/O<F>	C11	I/O<F>	E11	I/O<F>	G25	I/O<D>	L23	I/O<D>	P21	V _{CCIO<C>}
A12	I/O<F>	C12	I/O<F>	E12	V _{CC}	G26	INREF<D>	L24	I/O<D>	P22	I/O<C>
A13	I/O<E>	C13	CLK<7>	E13	I/O<F>	H1	I/O<G>	L25	I/O<D>	P23	V _{CC}
A14	I/O<E>	C14	I/O<E>	E14	I/O<F>	H2	I/O<G>	L26	I/O<D>	P24	I/O<C>
A15	I/O<E>	C15	I/O<E>	E15	I/O<E>	H3	IOCTRL<G>	M1	I/O<G>	P25	I/O<C>
A16	I/O<E>	C16	I/O<E>	E16	V _{CC}	H4	I/O<G>	M2	I/O<G>	P26	TRSTB
A17	I/O<E>	C17	I/O<E>	E17	CLK<6>	H5	I/O<G>	M3	I/O<G>	R1	I/O<H>
A18	IOCTRL<E>	C18	I/O<E>	E18	I/O<E>	H6	V _{CC}	M4	I/O<G>	R2	I/O<H>
A19	IOCTRL<E>	C19	I/O<E>	E19	I/O<E>	H21	V _{CC}	M5	I/O<G>	R3	I/O<H>
A20	I/O<E>	C20	I/O<E>	E20	I/O<E>	H22	V _{CC}	M6	V _{CCIO<G>}	R4	I/O<H>
A21	I/O<E>	C21	I/O<E>	E21	I/O<E>	H23	I/O<D>	M11	GND	R5	V _{CC}
A22	I/O<E>	C22	I/O<E>	E22	I/O<E>	H24	IOCTRL<D>	M12	GND	R6	V _{CC}
A23	I/O<E>	C23	I/O<E>	E23	GNDPLL<1>	H25	IOCTRL<D>	M13	GND	R11	GND
A24	I/O<E>	C24	I/O<E>	E24	I/O<E>	H26	I/O<D>	M14	GND	R12	GND
A25	PLLST<1>	C25	I/O<E>	E25	I/O<D>	J1	I/O<G>	M15	GND	R13	GND
A26	GND	C26	I/O<E>	E26	I/O<D>	J2	I/O<G>	M16	GND	R14	GND
B1	I/O<F>	D1	I/O<G>	F1	IOCTRL<G>	J3	I/O<G>	M21	V _{CCIO<D>}	R15	GND
B2	PLLST<0>	D2	I/O<G>	F2	I/O<G>	J4	I/O<G>	M22	V _{CC}	R16	GND
B3	I/O<F>	D3	I/O<F>	F3	I/O<G>	J5	I/O<G>	M23	I/O<D>	R21	V _{CC}
B4	I/O<F>	D4	I/O<F>	F4	I/O<G>	J6	V _{CCIO<G>}	M24	I/O<D>	R22	I/O<C>
B5	I/O<F>	D5	GNDPLL<0>	F5	I/O<F>	J21	V _{CCIO<D>}	M25	I/O<D>	R23	I/O<C>
B6	I/O<F>	D6	I/O<F>	F6	GND	J22	I/O<D>	M26	I/O<D>	R24	I/O<C>
B7	IOCTRL<F>	D7	I/O<F>	F7	V _{CCIO<F>}	J23	I/O<D>	N1	TCK	R25	I/O<C>
B8	I/O<F>	D8	I/O<F>	F8	V _{CC}	J24	I/O<D>	N2	I/O<H>	R26	I/O<C>
B9	I/O<F>	D9	I/O<F>	F9	V _{CCIO<F>}	J25	I/O<D>	N3	I/O<G>	T1	I/O<H>
B10	I/O<F>	D10	I/O<F>	F10	GND	J26	I/O<D>	N4	I/O<G>	T2	I/O<H>
B11	I/O<F>	D11	I/O<F>	F11	V _{CC}	K1	I/O<G>	N5	I/O<G>	T3	I/O<H>
B12	I/O<F>	D12	I/O<F>	F12	V _{CCIO<F>}	K2	I/O<G>	N6	GND	T4	I/O<H>
B13	CLK<5> /PLLIN<3>	D13	TMS	F13	GND	K3	I/O<G>	N11	GND	T5	I/O<H>
B14	I/O<E>	D14	I/O<E>	F14	V _{CCIO<E>}	K4	I/O<G>	N12	GND	T6	V _{CC}
B15	I/O<E>	D15	I/O<E>	F15	V _{CC}	K5	I/O<G>	N13	GND	T11	GND
B16	I/O<E>	D16	I/O<F>	F16	V _{CC}	K6	GND	N14	GND	T12	GND
B17	I/O<E>	D17	I/O<E>	F17	GND	K21	GND	N15	GND	T13	GND
B18	INREF<E>	D18	I/O<F>	F18	V _{CCIO<E>}	K22	I/O<D>	N16	GND	T14	GND
B19	I/O<E>	D19	CLK<8>	F19	V _{CC}	K23	I/O<D>	N21	GND	T15	GND
B20	I/O<E>	D20	I/O<E>	F20	V _{CCIO<E>}	K24	I/O<D>	N22	I/O<D>	T16	GND
B21	I/O<E>	D21	I/O<E>	F21	GND	K25	I/O<D>	N23	I/O<D>	T21	V _{CC}
B22	I/O<E>	D22	I/O<E>	F22	I/O<E>	K26	I/O<D>	N24	I/O<D>	T22	V _{CC}
B23	I/O<E>	D23	V _{CC} PLL<1>	F23	I/O<D>	L1	I/O<G>	N25	I/O<D>	T23	I/O<C>
B24	I/O<E>	D24	I/O<E>	F24	I/O<D>	L2	I/O<G>	N26	I/O<D>	T24	I/O<C>
B25	I/O<E>	D25	I/O<E>	F25	I/O<D>	L3	I/O<G>	P1	I/O<H>	T25	I/O<C>
B26	PLLOUT<0>	D26	I/O<D>	F26	I/O<D>	L4	I/O<G>	P2	I/O<H>	T26	I/O<C>

(Sheet 1 of 2)

Table 21: 516 PBGA Pinout Table (Continued)

516 PBGA	Function	516 PBGA	Function	516 PBGA	Function	516 PBGA	Function	516 PBGA	Function	516 PBGA	Function
U1	I/O<H>	W25	INREF<C>	AA21	GND	AC3	I/O<A>	AD11	I/O<A>	AE19	I/O
U2	I/O<H>	W26	I/O<C>	AA22	V _{CC} PLL<2>	AC4	I/O<A>	AD12	TDI	AE20	I/O
U3	I/O<H>	Y1	I/O<H>	AA23	I/O<C>	AC5	I/O<A>	AD13	CLK<4> DEDCLK/PLLIN<0>	AE21	I/O
U4	I/O<H>	Y2	I/O<H>	AA24	I/O<C>	AC6	I/O<A>	AD14	I/O<A>	AE22	I/O
U5	I/O<H>	Y3	I/O<H>	AA25	I/O<C>	AC7	I/O<A>	AD15	I/O	AE23	I/O
U6	GND	Y4	I/O<H>	AA26	I/O<C>	AC8	I/O<A>	AD16	I/O	AE24	I/O
U21	GND	Y5	I/O<H>	AB1	I/O<H>	AC9	I/O<A>	AD17	I/O	AE25	PLLRST<2>
U22	I/O<C>	Y6	V _{CCIO} <H>	AB2	I/O<H>	AC10	I/O<A>	AD18	INREF	AE26	I/O
U23	I/O<C>	Y21	V _{CCIO} <C>	AB3	I/O<A>	AC11	I/O<A>	AD19	I/O	AF1	I/O<A>
U24	I/O<C>	Y22	I/O<C>	AB4	GNDPLL<3>	AC12	I/O<A>	AD20	I/O	AF2	I/O<A>
U25	I/O<C>	Y23	I/O<C>	AB5	V _{CC} PLL<3>	AC13	I/O<A>	AD21	I/O	AF3	I/O<A>
U26	I/O<C>	Y24	I/O<C>	AB6	I/O<A>	AC14	CLK<1>	AD22	I/O	AF4	I/O<A>
V1	I/O<H>	Y25	I/O<C>	AB7	I/O<A>	AC15	I/O	AD23	I/O	AF5	I/O<A>
V2	IOCTRL<H>	Y26	IOCTRL<C>	AB8	I/O<A>	AC16	I/O	AD24	GND	AF6	IOCTRL<A>
V3	IOCTRL<H>	AA1	I/O<H>	AB9	I/O<A>	AC17	I/O	AD25	I/O	AF7	I/O<A>
V4	I/O<H>	AA2	I/O<H>	AB10	I/O<A>	AC18	I/O	AD26	I/O	AF8	I/O<A>
V5	I/O<H>	AA3	I/O<H>	AB11	V _{CC}	AC19	I/O	AE1	GND	AF9	I/O<A>
V6	V _{CCIO} <H>	AA4	I/O<A>	AB12	I/O<A>	AC20	I/O	AE2	GND	AF10	I/O<A>
V21	V _{CCIO} <C>	AA5	I/O<A>	AB13	I/O<A>	AC21	I/O	AE3	I/O<A>	AF11	I/O<A>
V22	I/O<C>	AA6	GND	AB14	CLK<3>/PLLIN<1>	AC22	TDO	AE4	I/O<A>	AF12	CLK<2> /PLLIN<2>
V23	I/O<C>	AA7	V _{CCIO} <A>	AB15	V _{CC}	AC23	PLLOUT<1>	AE5	I/O<A>	AF13	I/O
V24	IOCTRL<C>	AA8	V _{CC}	AB16	I/O	AC24	I/O	AE6	I/O<A>	AF14	I/O
V25	I/O<C>	AA9	V _{CCIO} <A>	AB17	I/O	AC25	I/O	AE7	INREF<A>	AF15	I/O
V26	I/O<C>	AA10	GND	AB18	I/O	AC26	I/O<C>	AE8	I/O<A>	AF16	I/O
W1	INREF<H>	AA11	V _{CC}	AB19	V _{CC}	AD1	I/O<A>	AE9	I/O<A>	AF17	I/O
W2	I/O<H>	AA12	V _{CCIO} <A>	AB20	I/O	AD2	PLLOUT<2>	AE10	I/O<A>	AF18	I/O
W3	I/O<H>	AA13	GND	AB21	I/O	AD3	PLLRST<3>	AE11	I/O<A>	AF19	IOCTRL
W4	I/O<H>	AA14	V _{CCIO} 	AB22	GNDPLL<2>	AD4	I/O<A>	AE12	CLK<0>	AF20	IOCTRL
W5	V _{CC}	AA15	V _{CC}	AB23	I/O	AD5	I/O<A>	AE13	I/O	AF21	I/O
W6	V _{CC}	AA16	V _{CC}	AB24	I/O<C>	AD6	I/O<A>	AE14	I/O	AF22	I/O
W21	V _{CC}	AA17	GND	AB25	I/O<C>	AD7	I/O<A>	AE15	I/O	AF23	I/O
W22	I/O<C>	AA18	V _{CCIO} 	AB26	I/O<C>	AD8	IOCTRL<A>	AE16	I/O	AF24	I/O
W23	I/O<C>	AA19	V _{CC}	AC1	I/O<A>	AD9	I/O<A>	AE17	I/O	AF25	I/O
W24	I/O<C>	AA20	V _{CCIO} 	AC2	I/O<A>	AD10	I/O<A>	AE18	I/O	AF26	I/O

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516 PBGA Packaging Drawing

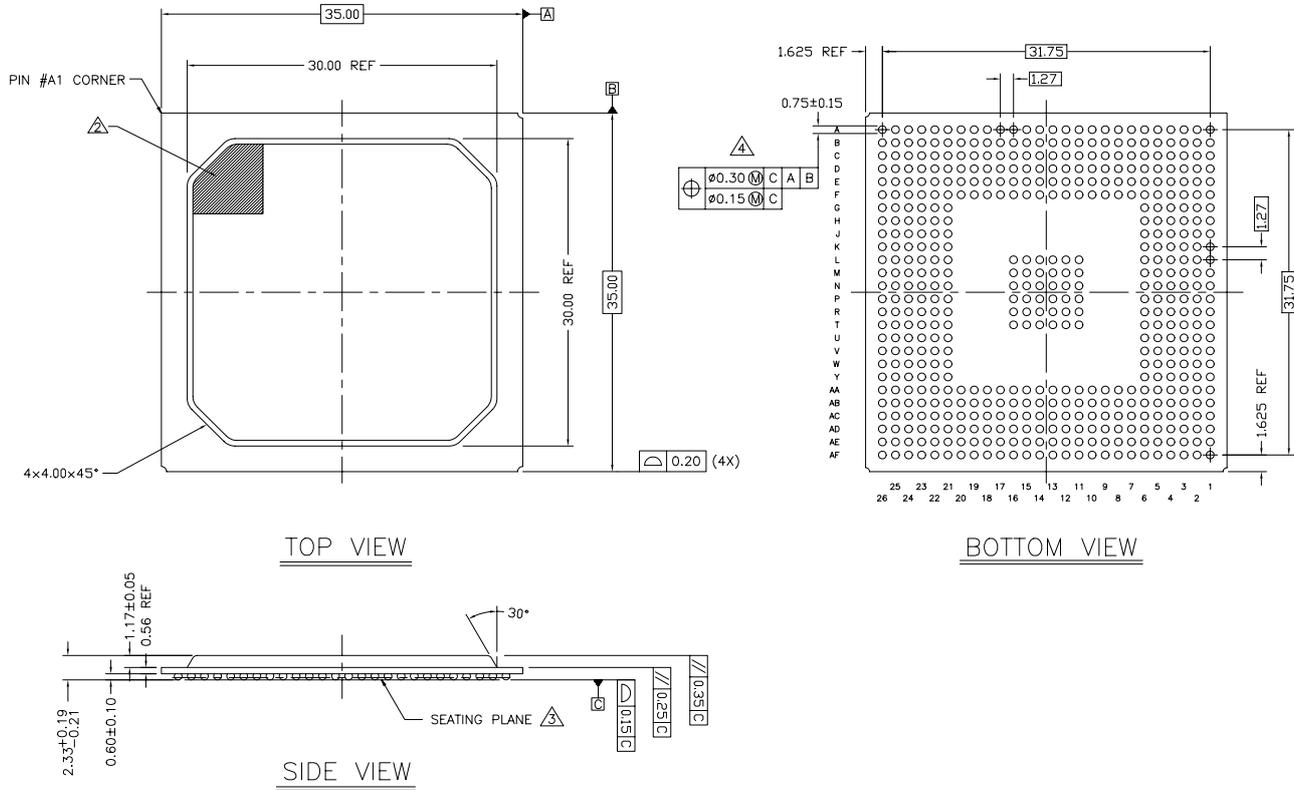
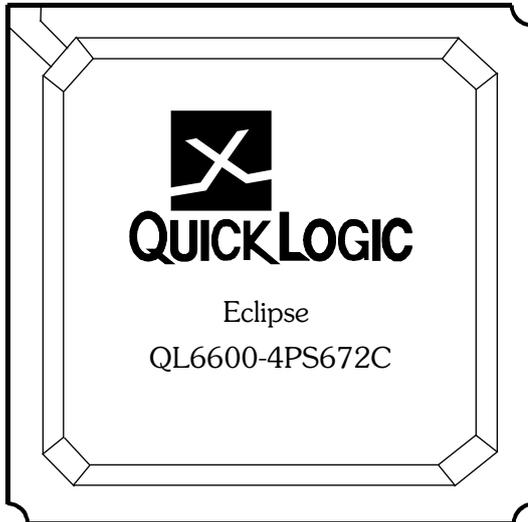


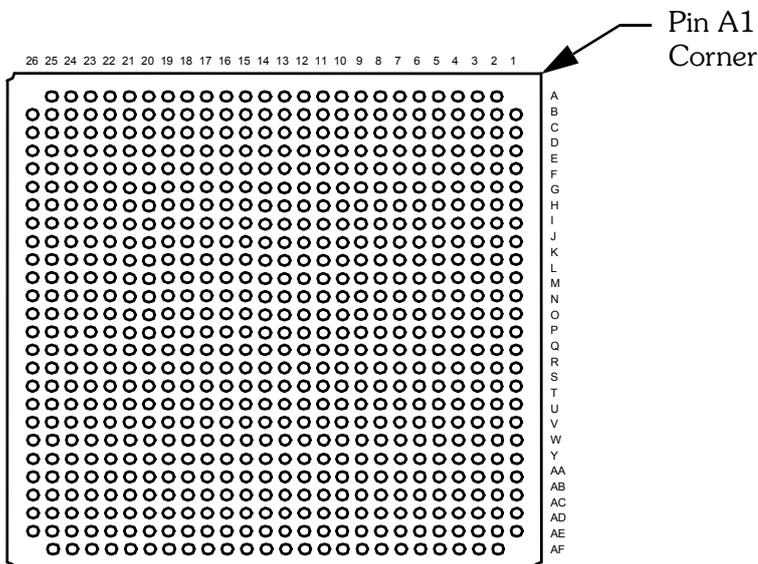
Figure 29: 516 PBGA Packaging Drawing

672 PBGA Pinout Diagram

Top



Bottom



672 PBGA Pinout Table

Table 22: 672 PBGA Pinout Table

672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function
A2	I/O<F>	C5	I/O<F>	E7	I/O<F>	G9	V _{CCIO<F>}	J11	I/O<F>	L13	V _{CC}
A3	I/O<F>	C6	I/O<F>	E8	I/O<F>	G10	I/O<F>	J12	I/O<F>	L14	GND
A4	I/O<F>	C7	I/O<F>	E9	IOCTRL<F>	G11	V _{CCIO<F>}	J13	I/O<F>	L15	V _{CC}
A5	I/O<F>	C8	I/O<F>	E10	I/O<F>	G12	I/O<F>	J14	GND	L16	GND
A6	I/O<E>	C9	INREF<F>	E11	I/O<F>	G13	V _{CCIO<F>}	J15	I/O<E>	L17	V _{CC}
A7	I/O<F>	C10	I/O<F>	E12	I/O<F>	G14	V _{CCIO<E>}	J16	I/O<E>	L18	I/O<D>
A8	I/O<F>	C11	I/O<F>	E13	I/O<F>	G15	I/O<E>	J17	I/O<E>	L19	I/O<D>
A9	I/O<F>	C12	I/O<F>	E14	I/O<E>	G16	V _{CCIO<E>}	J18	GND	L20	V _{CCIO<D>}
A10	I/O<F>	C13	I/O<F>	E15	I/O<E>	G17	I/O<E>	J19	I/O<E>	L21	I/O<D>
A11	I/O<F>	C14	I/O<E>	E16	I/O<E>	G18	V _{CCIO<E>}	J20	V _{CCIO<D>}	L22	I/O<D>
A12	I/O<F>	C15	I/O<E>	E17	I/O<E>	G19	V _{CCIO<E>}	J21	I/O<D>	L23	I/O<D>
A13	CLK<7>	C16	I/O<E>	E18	I/O<E>	G20	V _{CCPLL<1>}	J22	INREF<D>	L24	I/O<D>
A14	CLK<5> /PLLIN<3>	C17	IOCTRL<E>	E19	I/O<E>	G21	I/O<E>	J23	IOCTRL<D>	L25	I/O<D>
A15	I/O<E>	C18	I/O<E>	E20	I/O<E>	G22	I/O<E>	J24	IOCTRL<D>	L26	I/O<D>
A16	I/O<E>	C19	I/O<E>	E21	PLL _{RST} <1>	G23	I/O<D>	J25	I/O<D>	M1	I/O<G>
A17	I/O<E>	C20	I/O<E>	E22	GND	G24	I/O<D>	J26	I/O<D>	M2	I/O<G>
A18	I/O<E>	C21	I/O<E>	E23	I/O<E>	G25	I/O<D>	K1	I/O<G>	M3	I/O<G>
A19	I/O<E>	C22	I/O<E>	E24	I/O<E>	G26	I/O<D>	K2	I/O<G>	M4	I/O<G>
A20	I/O<E>	C23	I/O<E>	E25	I/O<D>	H1	I/O<G>	K3	I/O<G>	M5	I/O<G>
A21	I/O<E>	C24	I/O<E>	E26	I/O<D>	H2	I/O<G>	K4	I/O<G>	M6	I/O<G>
A22	I/O<E>	C25	I/O<E>	F1	I/O<G>	H3	I/O<G>	K5	I/O<G>	M7	I/O<G>
A23	IOCTRL<E>	C26	I/O<D>	F2	I/O<G>	H4	I/O<G>	K6	I/O<G>	M8	I/O<G>
A24	I/O<E>	D1	IOCTRL<G>	F3	I/O<G>	H5	I/O<G>	K7	I/O<G>	M9	I/O<G>
A25	I/O<E>	D2	I/O<G>	F4	I/O<F>	H6	I/O<G>	K8	I/O<G>	M10	V _{CC}
B1	I/O<G>	D3	I/O<F>	F5	GND	H7	V _{CCIO<G>}	K9	I/O<G>	M11	V _{CC}
B2	V _{CCPLL<0>}	D4	I/O<F>	F6	I/O<F>	H8	I/O<F>	K10	GND	M12	GND
B3	I/O<F>	D5	I/O<F>	F7	I/O<F>	H9	I/O<F>	K11	V _{CC}	M13	GND
B4	I/O<F>	D6	I/O<F>	F8	I/O<F>	H10	I/O<F>	K12	V _{CC}	M14	GND
B5	I/O<F>	D7	I/O<F>	F9	I/O<F>	H11	I/O<F>	K13	V _{CC}	M15	GND
B6	I/O<F>	D8	I/O<F>	F10	I/O<F>	H12	I/O<F>	K14	GND	M16	V _{CC}
B7	IOCTRL<F>	D9	I/O<F>	F11	I/O<F>	H13	CLK<8>	K15	V _{CC}	M17	V _{CC}
B8	I/O<F>	D10	I/O<F>	F12	I/O<F>	H14	CLK<6>	K16	V _{CC}	M18	I/O<D>
B9	I/O<F>	D11	I/O<F>	F13	I/O<F>	H15	I/O<E>	K17	GND	M19	I/O<D>
B10	I/O<F>	D12	I/O<F>	F14	I/O<F>	H16	I/O<E>	K18	I/O<D>	M20	I/O<D>
B11	I/O<F>	D13	I/O<F>	F15	I/O<E>	H17	I/O<E>	K19	I/O<D>	M21	I/O<D>
B12	I/O<F>	D14	I/O<E>	F16	I/O<E>	H18	I/O<E>	K20	I/O<D>	M22	I/O<D>
B13	TMS	D15	I/O<E>	F17	I/O<E>	H19	I/O<E>	K21	I/O<D>	M23	I/O<D>
B14	I/O<E>	D16	I/O<E>	F18	I/O<E>	H20	V _{CCIO<D>}	K22	I/O<D>	M24	I/O<D>
B15	I/O<E>	D17	I/O<E>	F19	I/O<E>	H21	I/O<D>	K23	I/O<D>	M25	I/O<D>
B16	I/O<E>	D18	I/O<E>	F20	I/O<E>	H22	I/O<D>	K24	I/O<D>	M26	I/O<D>
B17	I/O<E>	D19	I/O<E>	F21	GND _{PLL<1>}	H23	I/O<D>	K25	I/O<D>	N1	I/O<G>
B18	I/O<E>	D20	I/O<E>	F22	PLL _{OUT<0>}	H24	I/O<D>	K26	I/O<D>	N2	I/O<G>
B19	INREF<E>	D21	I/O<E>	F23	I/O<E>	H25	I/O<D>	L1	I/O<G>	N3	I/O<G>
B20	I/O<E>	D22	I/O<E>	F24	I/O<D>	H26	I/O<D>	L2	I/O<G>	N4	I/O<G>
B21	I/O<E>	D23	I/O<E>	F25	I/O<D>	J1	I/O<G>	L3	I/O<G>	N5	I/O<G>
B22	I/O<E>	D24	I/O<E>	F26	I/O<D>	J2	I/O<G>	L4	I/O<G>	N6	I/O<H>
B23	I/O<E>	D25	I/O<D>	G1	I/O<G>	J3	IOCTRL<G>	L5	I/O<G>	N7	V _{CCIO<G>}
B24	I/O<E>	D26	I/O<D>	G2	INREF<G>	J4	I/O<G>	L6	I/O<G>	N8	I/O<G>
B25	I/O<E>	E1	I/O<G>	G3	I/O<G>	J5	I/O<G>	L7	V _{CCIO<G>}	N9	GND
B26	I/O<D>	E2	I/O<G>	G4	I/O<G>	J6	I/O<G>	L8	I/O<G>	N10	GND
C1	I/O<G>	E3	I/O<F>	G5	PLL _{RST<0>}	J7	V _{CCIO<G>}	L9	I/O<G>	N11	GND
C2	I/O<F>	E4	I/O<F>	G6	I/O<G>	J8	GND _{PLL<0>}	L10	V _{CC}	N12	GND
C3	PLL _{OUT<3>}	E5	I/O<F>	G7	I/O<G>	J9	GND	L11	GND	N13	GND
C4	I/O<F>	E6	I/O<F>	G8	V _{CCIO<F>}	J10	I/O<F>	L12	V _{CC}	N14	GND

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Table 22: 672 PBGA Pinout Table (Continued)

672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function
N15	GND	R15	GND	U15	V _{CC}	W16	I/O	AA17	I/O	AC18	I/O
N16	V _{CC}	R16	V _{CC}	U16	V _{CC}	W17	I/O	AA18	I/O	AC19	I/O
N17	V _{CC}	R17	V _{CC}	U17	GND	W18	I/O	AA19	I/O	AC20	I/O
N18	I/O<D>	R18	I/O<C>	U18	I/O<C>	W19	GNDPLL<2>	AA20	I/O	AC21	I/O
N19	I/O<D>	R19	I/O<C>	U19	I/O<C>	W20	V _{CCIO<C>}	AA21	I/O	AC22	TDO
N20	V _{CCIO<D>}	R20	I/O<C>	U20	I/O<C>	W21	I/O	AA22	PLL _{RST<2>}	AC23	I/O
N21	V _{CC}	R21	I/O<C>	U21	I/O<C>	W22	I/O	AA23	I/O	AC24	I/O
N22	NC	R22	I/O<C>	U22	I/O<C>	W23	I/O<C>	AA24	I/O<C>	AC25	I/O<C>
N23	I/O<D>	R23	I/O<C>	U23	IOCTRL<C>	W24	I/O<C>	AA25	I/O<C>	AC26	I/O<C>
N24	I/O<D>	R24	I/O<C>	U24	INREF<C>	W25	IOCTRL<C>	AA26	I/O<C>	AD1	I/O<H>
N25	I/O<D>	R25	I/O<C>	U25	I/O<C>	W26	I/O<C>	AB1	I/O<H>	AD2	I/O<H>
N26	I/O<C>	R26	I/O<C>	U26	I/O<C>	Y1	I/O<H>	AB2	I/O<H>	AD3	I/O<A>
P1	I/O<H>	T1	I/O<H>	V1	I/O<H>	Y2	I/O<H>	AB3	I/O<A>	AD4	I/O<A>
P2	TCK	T2	I/O<H>	V2	I/O<H>	Y4	I/O<H>	AB4	I/O<A>	AD5	I/O<A>
P3	I/O<H>	T3	I/O<H>	V3	I/O<H>	Y5	I/O<H>	AB5	I/O<A>	AD6	I/O<A>
P4	I/O<H>	T4	I/O<H>	V4	I/O<H>	Y6	I/O<A>	AB6	PLL _{RST<3>}	AD7	I/O<A>
P5	V _{CC}	T5	I/O<H>	V5	I/O<H>	Y7	I/O<A>	AB7	I/O<A>	AD8	I/O<A>
P6	I/O<H>	T6	I/O<H>	V6	I/O<H>	Y8	I/O<A>	AB8	I/O<A>	AD9	IOCTRL<A>
P7	V _{CCIO<H>}	T7	V _{CCIO<H>}	V7	V _{CCIO<H>}	Y9	V _{CCIO<A>}	AB9	I/O<A>	AD10	I/O<A>
P8	I/O<H>	T8	I/O<H>	V8	GNDPLL<3>	Y10	V _{CCIO<A>}	AB10	I/O<A>	AD11	I/O<A>
P9	I/O<H>	T9	I/O<A>	V9	GND	Y11	V _{CCIO<A>}	AB11	I/O<A>	AD12	I/O<A>
P10	V _{CC}	T10	V _{CC}	V10	I/O<A>	Y12	V _{CCIO<A>}	AB12	I/O<A>	AD14	I/O<A>
P11	V _{CC}	T11	GND	V11	I/O<A>	Y13	I/O<A>	AB13	I/O<A>	AD13	I/O
P12	GND	T12	V _{CC}	V12	I/O<A>	Y14	V _{CCIO<A>}	AB14	CLK<3>/PLLI N<1>	AD15	I/O
P13	GND	T13	GND	V13	GND	Y15	V _{CCIO}	AB15	I/O	AD16	I/O
P14	GND	T14	V _{CC}	V14	I/O	Y16	V _{CC}	AB16	I/O	AD17	I/O
P15	GND	T15	GND	V15	I/O	Y17	V _{CCIO}	AB17	I/O	AD18	I/O
P16	GND	T16	I/O	V16	I/O	Y18	I/O	AB18	I/O	AD19	I/O
P17	GND	T17	V _{CC}	V18	I/O	Y19	V _{CCIO}	AB19	I/O	AD20	I/O
P18	GND	T18	I/O<C>	V19	GND	Y20	V _{CCIO}	AB20	I/O	AD21	I/O
P19	I/O<D>	T19	I/O<C>	V20	I/O<C>	Y21	I/O	AB21	PLL _{OUT<1>}	AD22	I/O
P20	V _{CCIO<C>}	T20	V _{CCIO<C>}	V21	V _{CCIO<C>}	Y22	I/O	AB22	GND	AD23	I/O
P21	I/O<C>	T21	I/O<C>	V22	I/O<C>	Y23	V _{CCPLL<2>}	AB23	I/O	AD24	I/O
P22	I/O<C>	T22	I/O<C>	V23	I/O<C>	Y24	I/O<C>	AB24	I/O	AD25	I/O
P23	I/O<C>	T23	I/O<C>	V24	I/O<C>	Y25	I/O<C>	AB25	I/O<C>	AD26	I/O<C>
P24	I/O<C>	T24	I/O<C>	V25	I/O<C>	Y26	I/O<C>	AB26	I/O<C>	AE1	I/O<H>
P25	I/O<C>	T25	I/O<C>	V26	I/O<C>	AA1	I/O<H>	AC2	IOCTRL<H>	AE2	I/O<A>
P26	TRSTB	T26	I/O<C>	W1	I/O<H>	AA2	I/O<H>	AC3	I/O<H>	AE3	I/O<A>
R1	I/O<H>	U1	I/O<H>	W2	INREF<H>	AA3	I/O<H>	AC4	I/O<H>	AE4	I/O<A>
R2	I/O<H>	U2	I/O<H>	W3	I/O<H>	AA4	I/O<A>	AC5	GND	AE5	I/O<A>
R3	I/O<H>	U3	IOCTRL<H>	W4	I/O<H>	AA5	PLL _{OUT<2>}	AC6	I/O<A>	AE6	I/O<A>
R4	I/O<H>	U4	I/O<H>	W5	I/O<H>	AA6	GND	AC7	I/O<A>	AE7	INREF<A>
R5	I/O<H>	U5	I/O<H>	W6	I/O<H>	AA7	V _{CCPLL<3>}	AC8	I/O<A>	AE8	I/O<A>
R6	I/O<H>	U6	I/O<H>	W7	V _{CCIO<H>}	AA8	I/O<A>	AC9	I/O<A>	AE9	I/O<A>
R7	I/O<H>	U7	I/O<H>	W8	I/O<A>	AA9	I/O<A>	AC10	I/O<A>	AE10	I/O<A>
R8	I/O<H>	U8	I/O<A>	W9	I/O<A>	AA10	I/O<A>	AC11	I/O<A>	AE11	I/O<A>
R9	I/O<H>	U9	I/O<A>	W10	I/O<A>	AA11	I/O<A>	AC12	I/O<A>	AE12	I/O<A>
R10	V _{CC}	U10	GND	W11	I/O<A>	AA12	I/O<A>	AC13	I/O<A>	AE13	TDI
R11	V _{CC}	U11	V _{CC}	W12	I/O<A>	AA13	I/O<A>	AC14	I/O	AE14	CLK<4> DEDCLK/PLLI N<0>
R12	GND	U12	V _{CC}	W13	CLK<1>	AA14	I/O	AC15	I/O	AE15	I/O
R13	GND	U13	GND	W14	I/O	AA15	I/O	AC16	I/O	AE16	I/O
R14	GND	U14	V _{CC}	W15	I/O	AA16	I/O	AC17	I/O	AE17	I/O

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Table 22: 672 PBGA Pinout Table (Continued)

672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function	672 PBGA	Function
AE18	I/O	AE24	I/O	AF5	I/O<A>	AF11	I/O<A>	AF17	I/O	AF23	INREF
AE19	IOCTRL	AE25	I/O	AF6	I/O<A>	AF12	I/O<A>	AF18	I/O	AF24	I/O
AE20	IOCTRL	AE26	I/O<C>	AF7	I/O<A>	AF13	CLK<0>	AF19	I/O	AF25	I/O
AE21	I/O	AF2	I/O<A>	AF8	I/O<A>	AF14	CLK<2> /PLLIN<2>	AF20	I/O		
AE22	I/O	AF3	I/O<A>	AF9	I/O<A>	AF15	I/O	AF21	I/O		
AE23	I/O	AF4	IOCTRL<A>	AF10	I/O<A>	AF16	I/O	AF22	I/O		

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672 PBGA Packaging Drawing

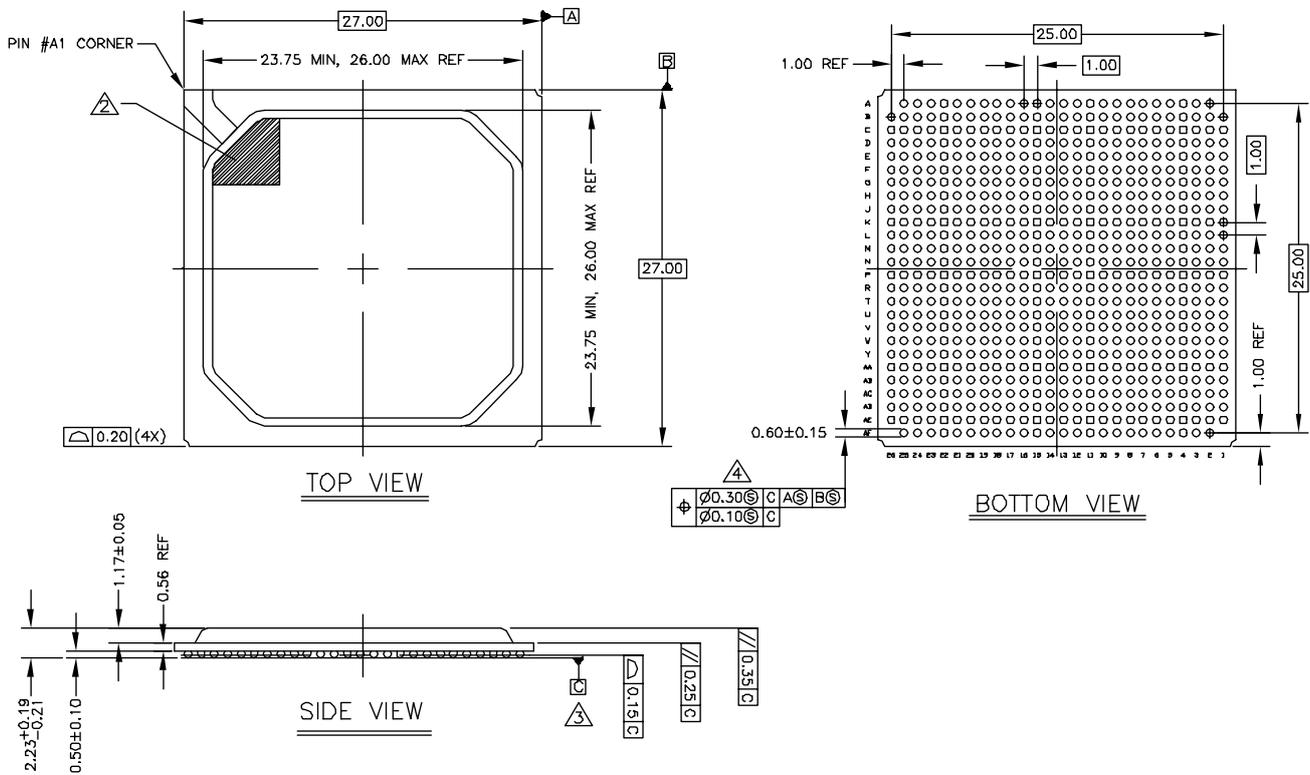


Figure 30: 672 PBGA Packaging Drawing

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Revision History

Table 23: Revision History

Revision	Date	Comments
A	April 2001	First release.
B	Jan 2002	Re-evaluation of AC/DC Specs and reformat
C	June 2002	Added Kfactor, Power-up, JTAG and mechanical drawing information.

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