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Understanding [Embedded - FPGAs \(Field Programmable Gate Array\)](#)

Embedded - FPGAs, or Field Programmable Gate Arrays, are advanced integrated circuits that offer unparalleled flexibility and performance for digital systems. Unlike traditional fixed-function logic devices, FPGAs can be programmed and reprogrammed to execute a wide array of logical operations, enabling customized functionality tailored to specific applications. This reprogrammability allows developers to iterate designs quickly and implement complex functions without the need for custom hardware.

Applications of Embedded - FPGAs

The versatility of Embedded - FPGAs makes them indispensable in numerous fields. In telecommunications.

Details

Product Status	Obsolete
Number of LABs/CLBs	200
Number of Logic Elements/Cells	-
Total RAM Bits	-
Number of I/O	70
Number of Gates	1500
Voltage - Supply	4.5V ~ 5.5V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 70°C (TA)
Package / Case	84-LCC (J-Lead)
Supplier Device Package	84-PLCC (29.31x29.31)
Purchase URL	https://www.e-xfl.com/product-detail/microsemi/a1415a-pl84c

ACT 3 Family Overview

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Horizontal Routing

Horizontal channels are located between the rows of modules and are composed of several routing tracks. The horizontal routing tracks within the channel are divided into one or more segments. The minimum horizontal segment length is the width of a module-pair, and the maximum horizontal segment length is the full length of the channel. Any segment that spans more than one-third the row length is considered a long horizontal segment. A typical channel is shown in [Figure 2-7](#). Undedicated horizontal routing tracks are used to route signal nets. Dedicated routing tracks are used for the global clock networks and for power and ground tie-off tracks.

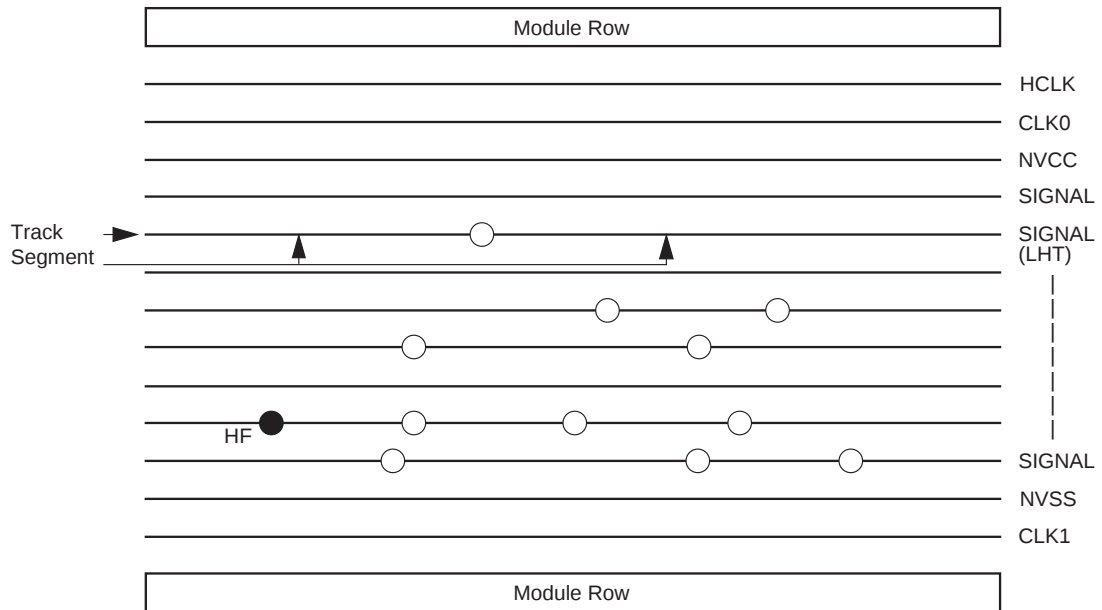


Figure 2-7 • Horizontal Routing Tracks and Segments

Vertical Routing

Other tracks run vertically through the modules. Vertical tracks are of three types: input, output, and long. Vertical tracks are also divided into one or more segments. Each segment in an input track is dedicated to the input of a particular module. Each segment in an output track is dedicated to the output of a particular module. Long segments are uncommitted and can be assigned during routing. Each output segment spans four channels (two above and two below), except near the top and bottom of the array where edge effects occur. LVTs contain either one or two segments. An example of vertical routing tracks and segments is shown in [Figure 2-8](#).

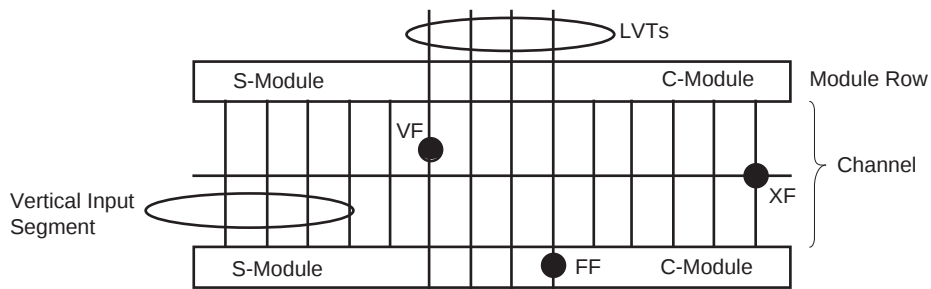


Figure 2-8 • Vertical Routing Tracks and Segments

Antifuse Connections

An antifuse is a “normally open” structure as opposed to the normally closed fuse structure used in PROMs or PALs. The use of antifuses to implement a programmable logic device results in highly testable structures as well as an efficient programming architecture. The structure is highly testable because there are no preexisting connections; temporary connections can be made using pass transistors. These temporary connections can isolate individual antifuses to be programmed as well as isolate individual circuit structures to be tested. This can be done both before and after programming. For example, all metal tracks can be tested for continuity and shorts between adjacent tracks, and the functionality of all logic modules can be verified.

Four types of antifuse connections are used in the routing structure of the ACT 3 array. (The physical structure of the antifuse is identical in each case; only the usage differs.)

Table 2-1 shows four types of antifuses.

Table 2-1 • Antifuse Types

Type	Description
XF	Horizontal-to-vertical connection
HF	Horizontal-to-horizontal connection
VF	Vertical-to-vertical connection
FF	"Fast" vertical connection

Examples of all four types of connections are shown in Figure 2-7 on page 2-6 and Figure 2-8 on page 2-6.

Module Interface

Connections to Logic and I/O modules are made through vertical segments that connect to the module inputs and outputs. These vertical segments lie on vertical tracks that span the entire height of the array.

Module Input Connections

The tracks dedicated to module inputs are segmented by pass transistors in each module row. During normal user operation, the pass transistors are inactive, which isolates the inputs of a module from the inputs of the module directly above or below it. During certain test modes, the pass transistors are active to verify the continuity of the metal tracks. Vertical input segments span only the channel above or the channel below. The logic modules are arranged such that half of the inputs are connected to the channel above and half of the inputs to segments in the channel below, as shown in Figure 2-9.

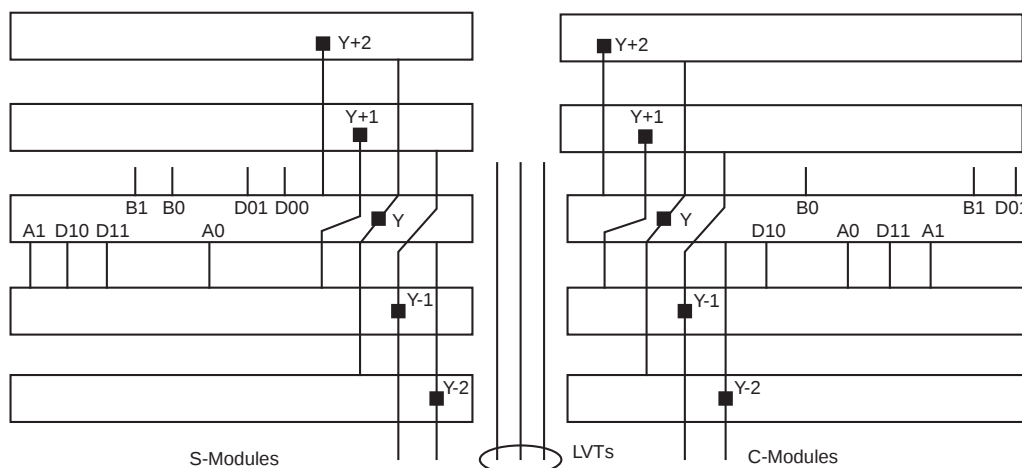


Figure 2-9 • Logic Module Routing Interface

Package Thermal Characteristics

The device junction to case thermal characteristic is θ_{jc} , and the junction to ambient air characteristic is θ_{ja} . The thermal characteristics for θ_{ja} are shown with two different air flow rates.

Maximum junction temperature is 150°C.

A sample calculation of the absolute maximum power dissipation allowed for a CPGA 175-pin package at commercial temperature and still air is as follows:

$$\frac{\text{Max. junction temp. (°C)} - \text{Max. ambient temp. (°C)}}{\theta_{ja} \text{ °C/W}} = \frac{150^{\circ}\text{C} - 70^{\circ}\text{C}}{25^{\circ}\text{C/W}} = 3.2 \text{ W}$$

EQ 2

Table 2-8 • Package Thermal Characteristics

Package Type*	Pin Count	θ_{jc}	θ_{ja} Still Air	θ_{ja} 300 ft./min.	Units
Ceramic Pin Grid Array	100	20	35	17	°C/W
	133	20	30	15	°C/W
	175	20	25	14	°C/W
	207	20	22	13	°C/W
	257	20	15	8	°C/W
Ceramic Quad Flatpack	132	13	55	30	°C/W
	196	13	36	24	°C/W
	256	13	30	18	°C/W
Plastic Quad Flatpack	100	13	51	40	°C/W
	160	10	33	26	°C/W
	208	10	33	26	°C/W
Very Thin Quad Flatpack	100	12	43	35	°C/W
Thin Quad Flatpack	176	11	32	25	°C/W
Power Quad Flatpack	208	0.4	17	13	°C/W
Plastic Leaded Chip Carrier	84	12	37	28	°C/W
Plastic Ball Grid Array	225	10	25	19	°C/W
	313	10	23	17	°C/W

Note: Maximum power dissipation in still air:

PQ160 = 2.4 W

PQ208 = 2.4 W

PQ100 = 1.6 W

VQ100 = 1.9 W

TQ176 = 2.5 W

PL84 = 2.2 W

RQ208 = 4.7 W

BG225 = 3.2 W

BG313 = 3.5 W

Equivalent capacitance is calculated by measuring ICC active at a specified frequency and voltage for each circuit component of interest. Measurements have been made over a range of frequencies at a fixed value of VCC. Equivalent capacitance is frequency independent so that the results may be used over a wide range of operating conditions. Equivalent capacitance values are shown in [Figure 2-10](#).

Table 2-10 • CEQ Values for Microsemi FPGAs

Item	CEQ Value
Modules (C_{EQM})	6.7
Input Buffers (C_{EQI})	7.2
Output Buffers (C_{EQO})	10.4
Routed Array Clock Buffer Loads (C_{EQCR})	1.6
Dedicated Clock Buffer Loads (C_{EQCD})	0.7
I/O Clock Buffer Loads (C_{EQCI})	0.9

To calculate the active power dissipated from the complete design, the switching frequency of each part of the logic must be known. [EQ 5](#) shows a piece-wise linear summation over all components.

$$\begin{aligned}
 \text{Power} = & VCC^2 * [(m * C_{EQM} * f_m)_{\text{modules}} + (n * C_{EQI} * f_n)_{\text{inputs}} \\
 & + (p * (C_{EQO} + C_L) * f_p)_{\text{outputs}} \\
 & + 0.5 * (q1 * C_{EQCR} * f_{q1})_{\text{routed_Clk1}} + (r1 * f_{q1})_{\text{routed_Clk1}} \\
 & + 0.5 * (q2 * C_{EQCR} * f_{q2})_{\text{routed_Clk2}} \\
 & + (r2 * f_{q2})_{\text{routed_Clk2}} + 0.5 * (s1 * C_{EQCD} * f_{s1})_{\text{dedicated_Clk}} \\
 & + (s2 * C_{EQCI} * f_{s2})_{\text{IO_Clk}}]
 \end{aligned}$$

EQ 5

Where:

m = Number of logic modules switching at f_m

n = Number of input buffers switching at f_n

p = Number of output buffers switching at f_p

q1 = Number of clock loads on the first routed array clock

q2 = Number of clock loads on the second routed array clock

r1 = Fixed capacitance due to first routed array clock

r2 = Fixed capacitance due to second routed array clock

s1 = Fixed number of clock loads on the dedicated array clock

s2 = Fixed number of clock loads on the dedicated I/O clock

C_{EQM} = Equivalent capacitance of logic modules in pF

C_{EQI} = Equivalent capacitance of input buffers in pF

C_{EQO} = Equivalent capacitance of output buffers in pF

C_{EQCR} = Equivalent capacitance of routed array clock in pF

C_{EQCD} = Equivalent capacitance of dedicated array clock in pF

C_{EQCI} = Equivalent capacitance of dedicated I/O clock in pF

C_L = Output lead capacitance in pF

f_m = Average logic module switching rate in MHz

f_n = Average input buffer switching rate in MHz

f_p = Average output buffer switching rate in MHz

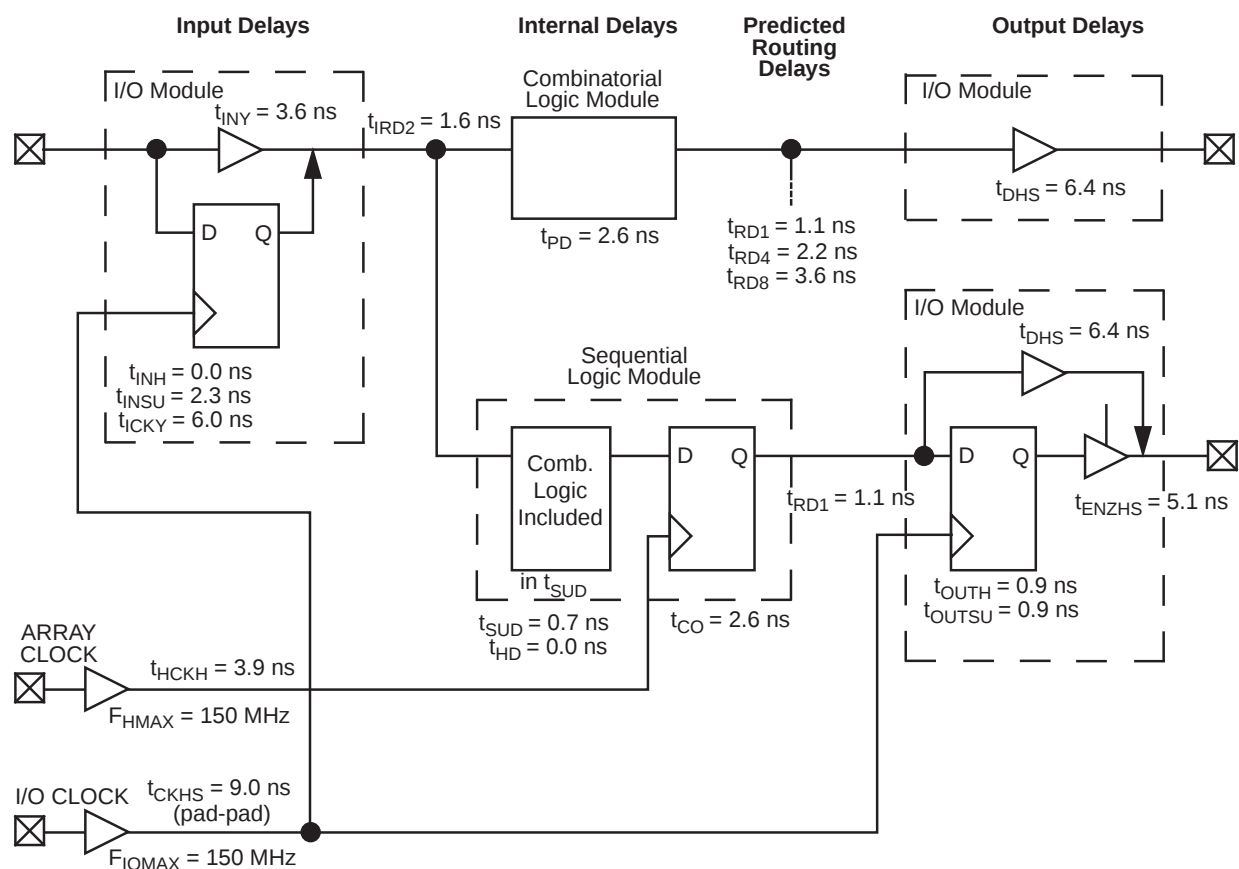
f_{q1} = Average first routed array clock rate in MHz

f_{q2} = Average second routed array clock rate in MHz

f_{s1} = Average dedicated array clock rate in MHz

f_{s2} = Average dedicated I/O clock rate in MHz

ACT 3 Timing Model



Note: Values shown for A1425A –1 speed grade device.

Figure 2-10 • Timing Model

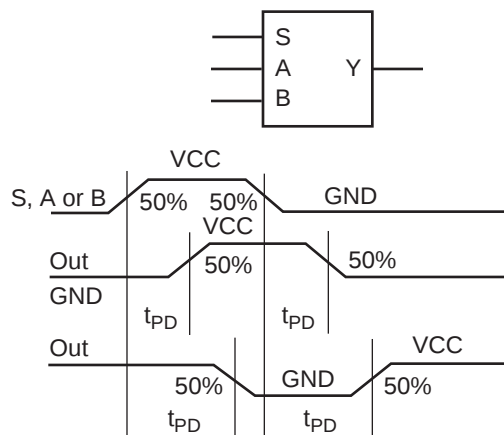


Figure 2-14 • Module Delays

Flip-Flops

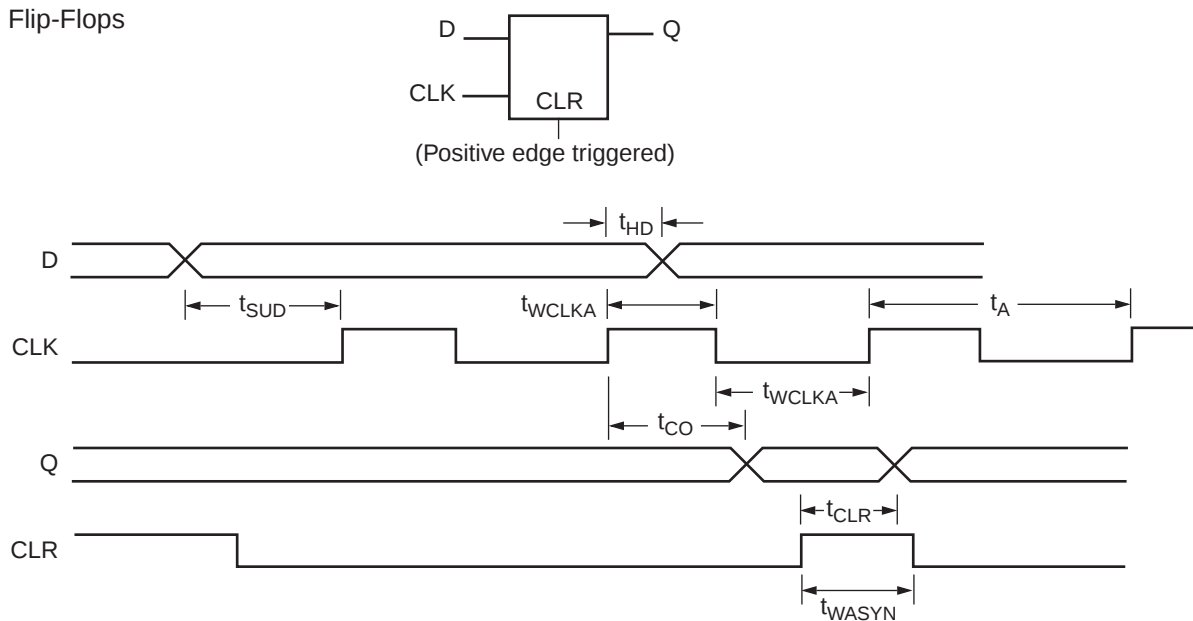


Figure 2-15 • Sequential Module Timing Characteristics

A1415A, A14V15A Timing Characteristics (continued)

Table 2-20 • A1415A, A14V15A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C

I/O Module – TTL Output Timing ¹		–3 Speed ²		–2 Speed ²		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{DHS}	Data to Pad, High Slew		5.0		5.6		6.4		7.5		9.8	ns
t _{DLS}	Data to Pad, Low Slew		8.0		9.0		10.2		12.0		15.6	ns
t _{ENZHS}	Enable to Pad, Z to H/L, High Slew		4.0		4.5		5.1		6.0		7.8	ns
t _{ENZLS}	Enable to Pad, Z to H/L, Low Slew		7.4		8.3		9.4		11.0		14.3	ns
t _{ENHSZ}	Enable to Pad, H/L to Z, High Slew		6.5		7.5		8.5		10.0		13.0	ns
t _{ENLSZ}	Enable to Pad, H/L to Z, Low Slew		6.5		7.5		8.5		10.0		13.0	ns
t _{CKHS}	IOCLK Pad to Pad H/L, High Slew		7.5		7.5		9.0		10.0		13.0	ns
t _{CKLS}	IOCLK Pad to Pad H/L, Low Slew		11.3		11.3		13.5		15.0		19.5	ns
d _{TLHHS}	Delta Low to High, High Slew		0.02		0.02		0.03		0.03		0.04	ns/pF
d _{TLHLS}	Delta Low to High, Low Slew		0.05		0.05		0.06		0.07		0.09	ns/pF
d _{THLHS}	Delta High to Low, High Slew		0.04		0.04		0.04		0.05		0.07	ns/pF
d _{THLLS}	Delta High to Low, Low Slew		0.05		0.05		0.06		0.07		0.09	ns/pF
I/O Module – CMOS Output Timing ¹												
t _{DHS}	Data to Pad, High Slew		6.2		7.0		7.9		9.3		12.1	ns
t _{DLS}	Data to Pad, Low Slew		11.7		13.1		14.9		17.5		22.8	ns
t _{ENZHS}	Enable to Pad, Z to H/L, High Slew		5.2		5.9		6.6		7.8		10.1	ns
t _{ENZLS}	Enable to Pad, Z to H/L, Low Slew		8.9		10.0		11.3		13.3		17.3	ns
t _{ENHSZ}	Enable to Pad, H/L to Z, High Slew		6.7		7.5		8.5		10.0		13.0	ns
t _{ENLSZ}	Enable to Pad, H/L to Z, Low Slew		6.7		7.5		9.0		10.0		13.0	ns
t _{CKHS}	IOCLK Pad to Pad H/L, High Slew		8.9		8.9		10.7		11.8		15.3	ns
t _{CKLS}	IOCLK Pad to Pad H/L, Low Slew		13.0		13.0		15.6		17.3		22.5	ns
d _{TLHHS}	Delta Low to High, High Slew		0.04		0.04		0.05		0.06		0.08	ns/pF
d _{TLHLS}	Delta Low to High, Low Slew		0.07		0.08		0.09		0.11		0.14	ns/pF
d _{THLHS}	Delta High to Low, High Slew		0.03		0.03		0.03		0.04		0.05	ns/pF
d _{THLLS}	Delta High to Low, Low Slew		0.04		0.04		0.04		0.05		0.07	ns/pF

Notes:

- Delays based on 35 pF loading.
- The –2 and –3 speed grades have been discontinued. Please refer to the Product Discontinuation Notices (PDNs) listed below:

[PDN March 2001](#)
[PDN 0104](#)
[PDN 0203](#)
[PDN 0604](#)
[PDN 1004](#)

A1425A, A14V25A Timing Characteristics (continued)

Table 2-24 • A1425A, A14V25A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C

I/O Module – TTL Output Timing ¹		–3 Speed ²		–2 Speed ²		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{DHS}	Data to Pad, High Slew		5.0		5.6		6.4		7.5		9.8	ns
t _{DLS}	Data to Pad, Low Slew		8.0		9.0		10.2		12.0		15.6	ns
t _{ENZHS}	Enable to Pad, Z to H/L, High Slew		4.0		4.5		5.1		6.0		7.8	ns
t _{ENZLS}	Enable to Pad, Z to H/L, Low Slew		7.4		8.3		9.4		11.0		14.3	ns
t _{ENHSZ}	Enable to Pad, H/L to Z, High Slew		6.5		7.5		8.5		10.0		13.0	ns
t _{ENLSZ}	Enable to Pad, H/L to Z, Low Slew		6.5		7.5		8.5		10.0		13.0	ns
t _{CKHS}	IOCLK Pad to Pad H/L, High Slew		7.5		7.5		9.0		10.0		13.0	ns
t _{CKLS}	IOCLK Pad to Pad H/L, Low Slew		11.3		11.3		13.5		15.0		19.5	ns
d _{TLHHS}	Delta Low to High, High Slew		0.02		0.02		0.03		0.03		0.04	ns/pF
d _{TLHLS}	Delta Low to High, Low Slew		0.05		0.05		0.06		0.07		0.09	ns/pF
d _{THLHS}	Delta High to Low, High Slew		0.04		0.04		0.04		0.05		0.07	ns/pF
d _{THLLS}	Delta High to Low, Low Slew		0.05		0.05		0.06		0.07		0.09	ns/pF
I/O Module – CMOS Output Timing ¹												
t _{DHS}	Data to Pad, High Slew		6.2		7.0		7.9		9.3		12.1	ns
t _{DLS}	Data to Pad, Low Slew		11.7		13.1		14.9		17.5		22.8	ns
t _{ENZHS}	Enable to Pad, Z to H/L, High Slew		5.2		5.9		6.6		7.8		10.1	ns
t _{ENZLS}	Enable to Pad, Z to H/L, Low Slew		8.9		10.0		11.3		13.3		17.3	ns
t _{ENHSZ}	Enable to Pad, H/L to Z, High Slew		6.7		7.5		8.5		10.0		13.0	ns
t _{ENLSZ}	Enable to Pad, H/L to Z, Low Slew		6.7		7.5		9.0		10.0		13.0	ns
t _{CKHS}	IOCLK Pad to Pad H/L, High Slew		8.9		8.9		10.7		11.8		15.3	ns
t _{CKLS}	IOCLK Pad to Pad H/L, Low Slew		13.0		13.0		15.6		17.3		22.5	ns
d _{TLHHS}	Delta Low to High, High Slew		0.04		0.04		0.05		0.06		0.08	ns/pF
d _{TLHLS}	Delta Low to High, Low Slew		0.07		0.08		0.09		0.11		0.14	ns/pF
d _{THLHS}	Delta High to Low, High Slew		0.03		0.03		0.03		0.04		0.05	ns/pF
d _{THLLS}	Delta High to Low, Low Slew		0.04		0.04		0.04		0.05		0.07	ns/pF

Notes: *

- Delays based on 35 pF loading.
- The –2 and –3 speed grades have been discontinued. Refer to [PDN 0104](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0203](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0604](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), and [PDN 1004](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn) at <http://www.microsemi.com/soc/support/notifications/default.aspx#pdn>.

A1425A, A14V25A Timing Characteristics (continued)

Table 2-25 • A1425A, A14V25A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C

Dedicated (hardwired) I/O Clock Network		–3 Speed ¹		–2 Speed ¹		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{IOCKH}	Input Low to High (pad to I/O module input)		2.0		2.3		2.6		3.0		3.5	ns
t _{IOPWH}	Minimum Pulse Width High	1.9		2.4		3.3		3.8		4.8		ns
t _{IPOWL}	Minimum Pulse Width Low	1.9		2.4		3.3		3.8		4.8		ns
t _{IOSAPW}	Minimum Asynchronous Pulse Width	1.9		2.4		3.3		3.8		4.8		ns
t _{IOCKSW}	Maximum Skew		0.4		0.4		0.4		0.4		0.4	ns
t _{IOP}	Minimum Period	4.0		5.0		6.8		8.0		10.0		ns
f _{IOMAX}	Maximum Frequency		250		200		150		125		100	MHz
Dedicated (hardwired) Array Clock												
t _{HCKH}	Input Low to High (pad to S-module input)		3.0		3.4		3.9		4.5		5.5	ns
t _{HCKL}	Input High to Low (pad to S-module input)		3.0		3.4		3.9		4.5		5.5	ns
t _{HPWH}	Minimum Pulse Width High	1.9		2.4		3.3		3.8		4.8		ns
t _{HPWL}	Minimum Pulse Width Low	1.9		2.4		3.3		3.8		4.8		ns
t _{HCKSW}	Delta High to Low, Low Slew		0.3		0.3		0.3		0.3		0.3	ns
t _{HP}	Minimum Period	4.0		5.0		6.8		8.0		10.0		ns
f _{HMAX}	Maximum Frequency		250		200		150		125		100	MHz
Routed Array Clock Networks												
t _{RCKH}	Input Low to High (FO = 64)		3.7		4.1		4.7		5.5		9.0	ns
t _{RCKL}	Input High to Low (FO = 64)		4.0		4.5		5.1		6.0		9.0	ns
t _{RPWH}	Min. Pulse Width High (FO = 64)	3.3		3.8		4.2		4.9		6.5		ns
t _{RPWL}	Min. Pulse Width Low (FO = 64)	3.3		3.8		4.2		4.9		6.5		ns
t _{RCKSW}	Maximum Skew (FO = 128)		0.7		0.8		0.9		1.0		1.0	ns
t _{RP}	Minimum Period (FO = 64)	6.8		8.0		8.7		10.0		13.4		ns
f _{RMAX}	Maximum Frequency (FO = 64)		150		125		115		100		75	MHz
Clock-to-Clock Skews												
t _{IOHCKSW}	I/O Clock to H-Clock Skew	0.0	1.7	0.0	1.8	0.0	2.0	0.0	2.2	0.0	3.0	ns
t _{IORCKSW}	I/O Clock to R-Clock Skew (FO = 64) (FO = 80)	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	3.0	ns
		0.0	3.0	0.0	3.0	0.0	3.0	0.0	3.0	0.0	3.0	
t _{HRCKSW}	H-Clock to R-Clock Skew (FO = 64) (FO = 80)	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	ns
		0.0	3.0	0.0	3.0	0.0	3.0	0.0	3.0	0.0	3.0	

Notes:

1. The –2 and –3 speed grades have been discontinued. Refer to [PDN 0104](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0203](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0604](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), and [PDN 1004](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn) at <http://www.microsemi.com/soc/support/notifications/default.aspx#pdn>.
2. Delays based on 35 pF loading.

A1440A, A14V40A Timing Characteristics

Table 2-26 • A1440A, A14V40A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C¹

Logic Module Propagation Delays ²		–3 Speed ³		–2 Speed ³		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{PD}	Internal Array Module		2.0		2.3		2.6		3.0		3.9	ns
t _{CO}	Sequential Clock to Q		2.0		2.3		2.6		3.0		3.9	ns
t _{CLR}	Asynchronous Clear to Q		2.0		2.3		2.6		3.0		3.9	ns
Predicted Routing Delays⁴												
t _{RD1}	FO = 1 Routing Delay		0.9		1.0		1.1		1.3		1.7	ns
t _{RD2}	FO = 2 Routing Delay		1.2		1.4		1.6		1.8		2.4	ns
t _{RD3}	FO = 3 Routing Delay		1.4		1.6		1.8		2.1		2.8	ns
t _{RD4}	FO = 4 Routing Delay		1.7		1.9		2.2		2.5		3.3	ns
t _{RD8}	FO = 8 Routing Delay		2.8		3.2		3.6		4.2		5.5	ns
Logic Module Sequential Timing												
t _{SUD}	Flip-Flop Data Input Setup	0.5		0.6		0.7		0.8		0.8		ns
t _{HD}	Flip-Flop Data Input Hold	0.0		0.0		0.0		0.0		0.0		ns
t _{SUD}	Latch Data Input Setup	0.5		0.6		0.7		0.8		0.8		ns
t _{HD}	Latch Data Input Hold	0.0		0.0		0.0		0.0		0.0		ns
t _{WASYN}	Asynchronous Pulse Width	1.9		2.4		3.2		3.8		4.8		ns
t _{WCLKA}	Flip-Flop Clock Pulse Width	1.9		2.4		3.2		3.8		4.8		ns
t _A	Flip-Flop Clock Input Period	4.0		5.0		6.8		8.0		10.0		ns
f _{MAX}	Flip-Flop Clock Frequency		250		200		150		125		100	MHz

Notes:

- VCC = 3.0 V for 3.3 V specifications.
- For dual-module macros, use t_{PD} + t_{RD1} + t_{PDn} + t_{CO} + t_{RD1} + t_{PDn} or t_{PD1} + t_{RD1} + t_{SUD}, whichever is appropriate.
- The –2 and –3 speed grades have been discontinued. Refer to [PDN 0104](#), [PDN 0203](#), [PDN 0604](#), and [PDN 1004](#) at <http://www.microsemi.com/soc/support/notifications/default.aspx#pdn>.
- Routing delays are for typical designs across worst-case operating conditions. These parameters should be used for estimating device performance. Post-route timing analysis or simulation is required to determine actual worst-case performance. Post-route timing is based on actual routing delay measurements performed on the device prior to shipment.

A1460A, A14V60A Timing Characteristics (continued)

Table 2-33 • A1460A, A14V60A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C

Dedicated (hardwired) I/O Clock Network		–3 Speed ¹		–2 Speed ¹		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{IOCKH}	Input Low to High (pad to I/O module input)		2.3		2.6		3.0		3.5		4.5	ns
t _{IOPWH}	Minimum Pulse Width High	2.4		3.2		3.8		4.8		6.5		ns
t _{IPOWL}	Minimum Pulse Width Low	2.4		3.2		3.8		4.8		6.5		ns
t _{IOSAPW}	Minimum Asynchronous Pulse Width	2.4		3.2		3.8		4.8		6.5		ns
t _{IOCKSW}	Maximum Skew		0.6		0.6		0.6		0.6		0.6	ns
t _{IOP}	Minimum Period	5.0		6.8		8.0		10.0		13.4		ns
f _{IOMAX}	Maximum Frequency		200		150		125		100		75	MHz
Dedicated (hardwired) Array Clock												
t _{HCKH}	Input Low to High (pad to S-module input)		3.7		4.1		4.7		5.5		7.0	ns
t _{HCKL}	Input High to Low (pad to S-module input)		3.7		4.1		4.7		5.5		7.0	ns
t _{HPWH}	Minimum Pulse Width High	2.4		3.2		3.8		4.8		6.5		ns
t _{HPWL}	Minimum Pulse Width Low	2.4		3.2		3.8		4.8		6.5		ns
t _{HCKSW}	Delta High to Low, Low Slew		0.6		0.6		0.6		0.6		0.6	ns
t _{HP}	Minimum Period	5.0		6.8		8.0		10.0		13.4		ns
f _{HMAX}	Maximum Frequency		200		150		125		100		75	MHz
Routed Array Clock Networks												
t _{RCKH}	Input Low to High (FO = 64)		6.0		6.8		7.7		9.0		11.8	ns
t _{RCKL}	Input High to Low (FO = 64)		6.0		6.8		7.7		9.0		11.8	ns
t _{RPWH}	Min. Pulse Width High (FO = 64)	4.1		4.5		5.4		6.1		8.2		ns
t _{RPWL}	Min. Pulse Width Low (FO = 64)	4.1		4.5		5.4		6.1		8.2		ns
t _{RCKSW}	Maximum Skew (FO = 128)		1.2		1.4		1.6		1.8		1.8	ns
t _{RP}	Minimum Period (FO = 64)	8.3		9.3		11.1		12.5		16.7		ns
f _{RMAX}	Maximum Frequency (FO = 64)		120		105		90		80		60	MHz
Clock-to-Clock Skews												
t _{IOHCKSW}	I/O Clock to H-Clock Skew	0.0	2.6	0.0	2.7	0.0	2.9	0.0	3.0	0.0	3.0	ns
t _{IORCKSW}	I/O Clock to R-Clock Skew (FO = 64) (FO = 216)	0.0	1.7	0.0	1.7	0.0	1.7	0.0	1.7	0.0	5.0	ns
		0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	
t _{HRCKSW}	H-Clock to R-Clock Skew (FO = 64) (FO = 216)	0.0	1.3	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	ns
		0.0	3.0	0.0	3.0	0.0	3.0	0.0	3.0	0.0	3.0	

Notes:

1. The –2 and –3 speed grades have been discontinued. Refer to [PDN 0104](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0203](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0604](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), and [PDN 1004](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn) at <http://www.microsemi.com/soc/support/notifications/default.aspx#pdn>.
2. Delays based on 35 pF loading.

A14100A, A14V100A Timing Characteristics (continued)

Table 2-35 • A14100A, A14V100A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C

I/O Module Input Propagation Delays		–3 Speed ¹		–2 Speed ¹		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{INY}	Input Data Pad to Y		2.8		3.2		3.6		4.2		5.5	ns
t _{ICKY}	Input Reg IOCLK Pad to Y		4.7		5.3		6.0		7.0		9.2	ns
t _{OCKY}	Output Reg IOCLK Pad to Y		4.7		5.3		6.0		7.0		9.2	ns
t _{ICLRY}	Input Asynchronous Clear to Y		4.7		5.3		6.0		7.0		9.2	ns
t _{OCLRY}	Output Asynchronous Clear to Y		4.7		5.3		6.0		7.0		9.2	ns
Predicted Input Routing Delays²												
t _{RD1}	FO = 1 Routing Delay		0.9		1.0		1.1		1.3		1.7	ns
t _{RD2}	FO = 2 Routing Delay		1.2		1.4		1.6		1.8		2.4	ns
t _{RD3}	FO = 3 Routing Delay		1.4		1.6		1.8		2.1		2.8	ns
t _{RD4}	FO = 4 Routing Delay		1.7		1.9		2.2		2.5		3.3	ns
t _{RD8}	FO = 8 Routing Delay		2.8		3.2		3.6		4.2		5.5	ns
I/O Module Sequential Timing (wrt IOCLK pad)												
t _{INH}	Input F-F Data Hold	0.0		0.0		0.0		0.0		0.0		ns
t _{INSU}	Input F-F Data Setup	1.2		1.4		1.5		1.8		1.8		ns
t _{IDEH}	Input Data Enable Hold	0.0		0.0		0.0		0.0		0.0		ns
t _{IDESU}	Input Data Enable Setup	5.8		6.5		7.5		8.6		8.6		ns
t _{OUTH}	Output F-F Data hold	0.7		0.8		1.0		1.0		1.0		ns
t _{OUTSU}	Output F-F Data Setup	0.7		0.8		1.0		1.0		1.0		ns
t _{ODEH}	Output Data Enable Hold	0.3		0.4		0.5		0.5		0.5		ns
f _{ODESU}	Output Data Enable Setup	1.3		1.5		2.0		2.0		2.0		ns

Notes: *

1. The –2 and –3 speed grades have been discontinued. Refer to [PDN 0104](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0203](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0604](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), and [PDN 1004](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn) at <http://www.microsemi.com/soc/support/notifications/default.aspx#pdn>.
2. Routing delays are for typical designs across worst-case operating conditions. These parameters should be used for estimating device performance. Post-route timing analysis or simulation is required to determine actual worst-case performance. Post-route timing is based on actual routing delay measurements performed on the device prior to shipment.

A14100A, A14V100A Timing Characteristics (continued)

Table 2-36 • A14100A, A14V100A Worst-Case Commercial Conditions, VCC = 4.75 V, T_J = 70°C

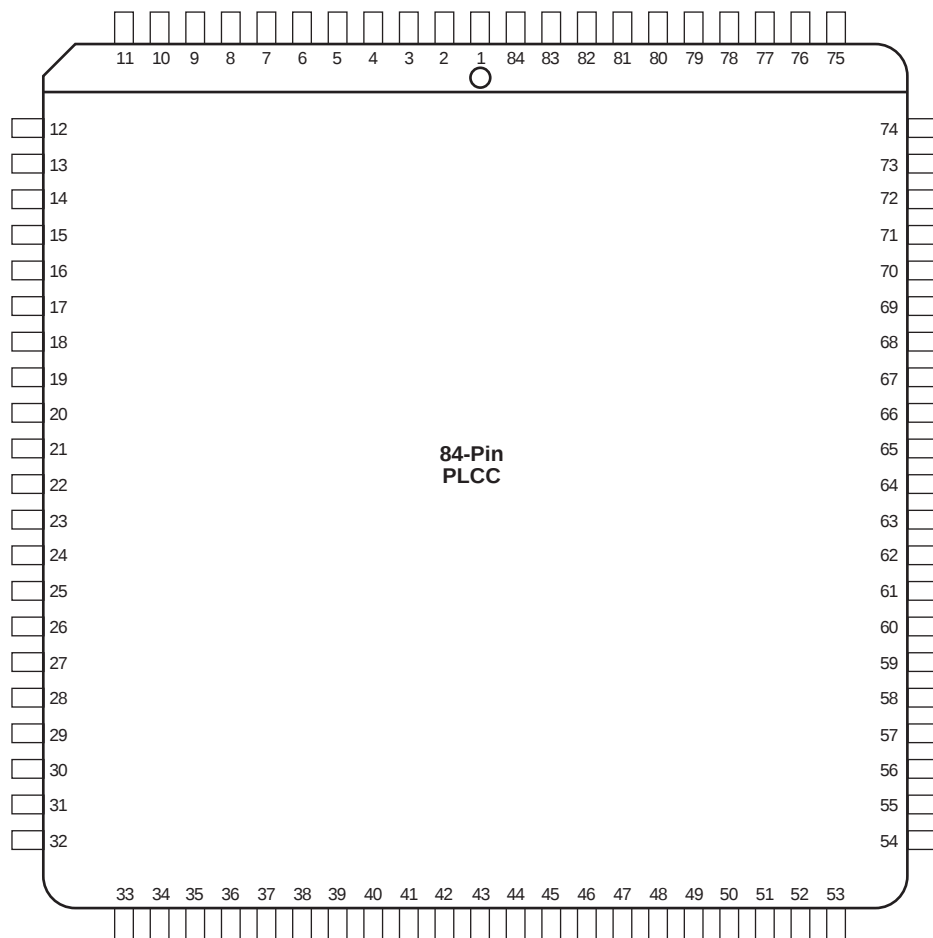
I/O Module – TTL Output Timing ¹		–3 Speed ²		–2 Speed ²		–1 Speed		Std. Speed		3.3 V Speed ¹		Units
Parameter/Description		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t _{DHS}	Data to Pad, High Slew		5.0		5.6		6.4		7.5		9.8	ns
t _{DLS}	Data to Pad, Low Slew		8.0		9.0		10.2		12.0		15.6	ns
t _{ENZHS}	Enable to Pad, Z to H/L, High Slew		4.0		4.5		5.1		6.0		7.8	ns
t _{ENZLS}	Enable to Pad, Z to H/L, Low Slew		7.4		8.3		9.4		11.0		14.3	ns
t _{ENHSZ}	Enable to Pad, H/L to Z, High Slew		8.0		9.0		10.2		12.0		15.6	ns
t _{ENLSZ}	Enable to Pad, H/L to Z, Low Slew		7.4		8.3		9.4		11.0		14.3	ns
t _{CKHS}	IOCLK Pad to Pad H/L, High Slew		9.5		9.5		10.5		12.0		15.6	ns
t _{CKLS}	IOCLK Pad to Pad H/L, Low Slew		12.8		12.8		15.3		17.0		22.1	ns
d _{TLHHS}	Delta Low to High, High Slew		0.02		0.02		0.03		0.03		0.04	ns/pF
d _{TLHLS}	Delta Low to High, Low Slew		0.05		0.05		0.06		0.07		0.09	ns/pF
d _{THLHS}	Delta High to Low, High Slew		0.04		0.04		0.04		0.05		0.07	ns/pF
d _{THLLS}	Delta High to Low, Low Slew		0.05		0.05		0.06		0.07		0.09	ns/pF
I/O Module – CMOS Output Timing ¹												
t _{DHS}	Data to Pad, High Slew		6.2		7.0		7.9		9.3		12.1	ns
t _{DLS}	Data to Pad, Low Slew		11.7		13.1		14.9		17.5		22.8	ns
t _{ENZHS}	Enable to Pad, Z to H/L, High Slew		5.2		5.9		6.6		7.8		10.1	ns
t _{ENZLS}	Enable to Pad, Z to H/L, Low Slew		8.9		10.0		11.3		13.3		17.3	ns
t _{ENHSZ}	Enable to Pad, H/L to Z, High Slew		8.0		9.0		10.0		12.0		15.6	ns
t _{ENLSZ}	Enable to Pad, H/L to Z, Low Slew		7.4		8.3		9.4		11.0		14.3	ns
t _{CKHS}	IOCLK Pad to Pad H/L, High Slew		10.4		10.4		12.4		13.8		17.9	ns
t _{CKLS}	IOCLK Pad to Pad H/L, Low Slew		14.5		14.5		17.4		19.3		25.1	ns
d _{TLHHS}	Delta Low to High, High Slew		0.04		0.04		0.05		0.06		0.08	ns/pF
d _{TLHLS}	Delta Low to High, Low Slew		0.07		0.08		0.09		0.11		0.14	ns/pF
d _{THLHS}	Delta High to Low, High Slew		0.03		0.03		0.03		0.04		0.05	ns/pF
d _{THLLS}	Delta High to Low, Low Slew		0.04		0.04		0.04		0.05		0.07	ns/pF

Notes: *

1. Delays based on 35 pF loading.
2. The –2 and –3 speed grades have been discontinued. Refer to [PDN 0104](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0203](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), [PDN 0604](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn), and [PDN 1004](http://www.microsemi.com/soc/support/notifications/default.aspx#pdn) at <http://www.microsemi.com/soc/support/notifications/default.aspx#pdn>.

3 – Package Pin Assignments

PL84

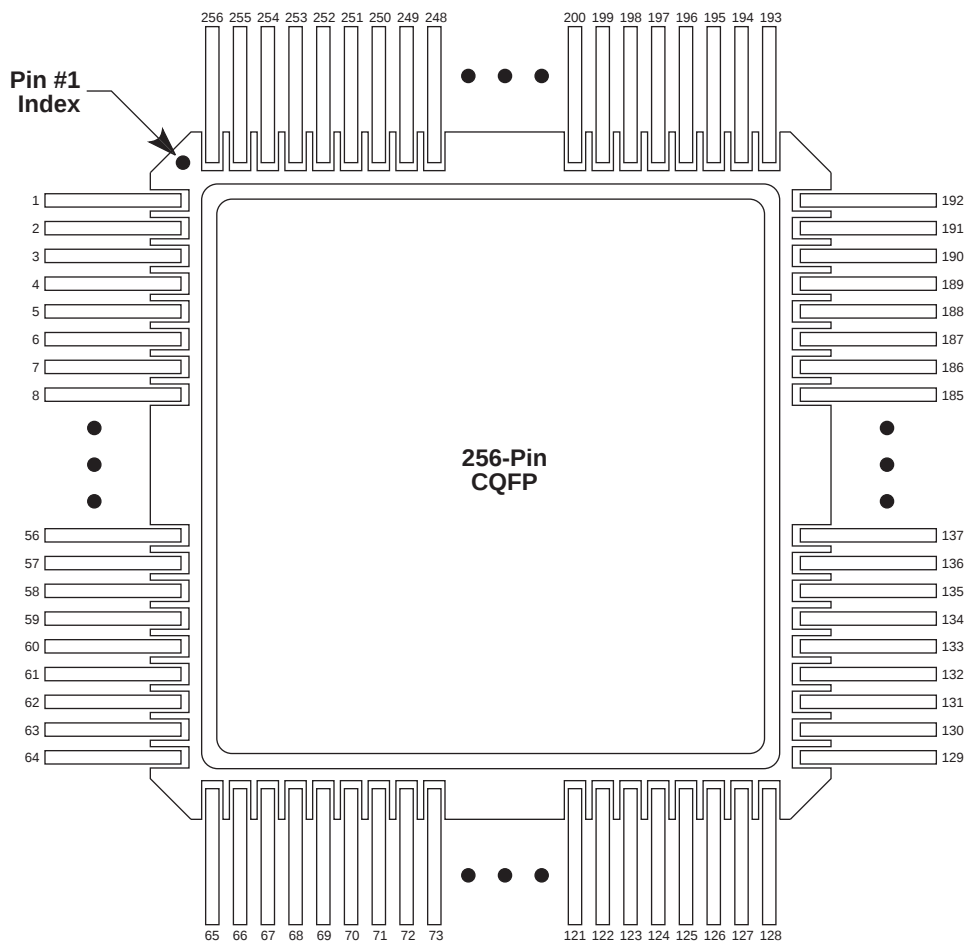


Note: This is the top view of the package.

Note

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.microsemi.com/soc/products/solutions/package/docs.aspx>.

CQ256

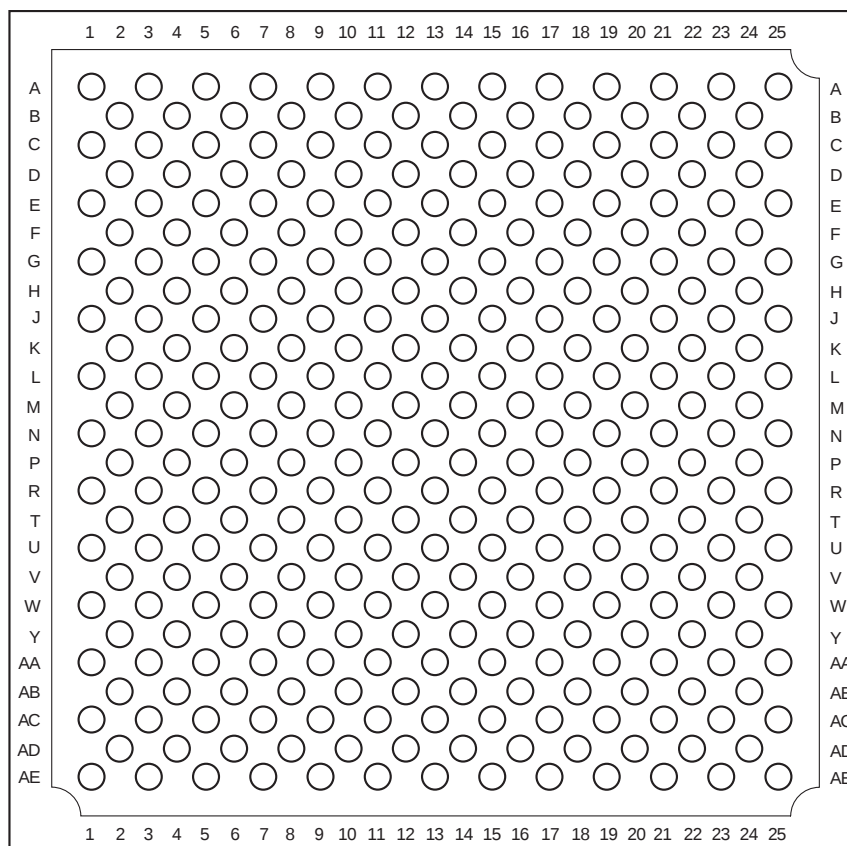


Note: This is the top view.

Note

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.microsemi.com/soc/products/solutions/package/docs.aspx>

BG313



Note: This is the top view.

Note

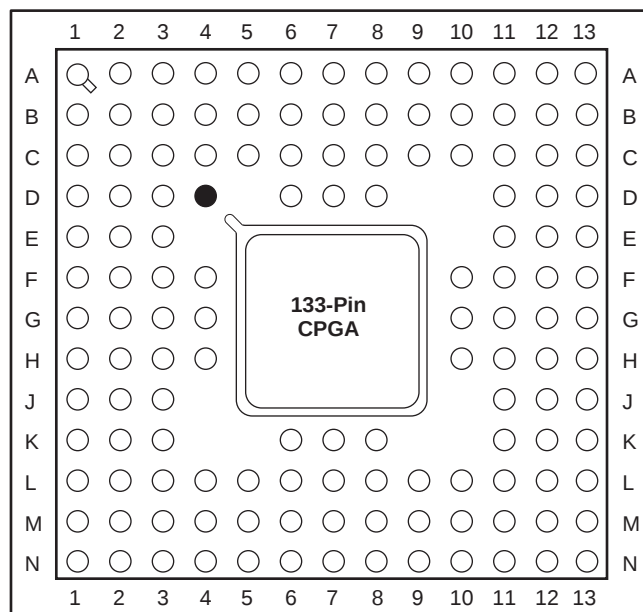
For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.microsemi.com/soc/products/solutions/package/docs.aspx>

BG313	
A14100, A14V100 Function	Location
CLKA or I/O	J13
CLKB or I/O	G13
DCLK or I/O	B2
GND	A1, A25, AD2, AE25, J21, L13, M12, M14, N11, N13, N15, P12, P14, R13
HCLK or I/O	T14
IOCLK or I/O	B24
IOPCL or I/O	AD24
MODE	G3
NC	A3, A13, A23, AA5, AA9, AA23, AB2, AB4, AB20, AC13, AC25, AD22, AE1, AE21, B14, C5, C25, D4, D24, E3, E21, F6, F10, F16, G1, G25, H18, H24, J1, J7, J25, K12, L15, L17, M6, N1, N5, N7, N21, N23, P20, R11, T6, T8, U9, U13, U21, V16, W7, Y20, Y24
PRA or I/O	H12
PRB or I/O	AD12
SDI or I/O	C1
SDO	AE23
VCC	AB18, AD6, AE13, C13, C19, E13, G9, H22, K8, K20, M16, N3, N9, N25, U5, W13, V2, V22, V24

Notes:

1. All unlisted pin numbers are user I/Os.
2. NC denotes no connection.
3. MODE should be terminated to GND through a 10K resistor to enable Actionprobe usage; otherwise it can be terminated directly to GND.

PG133



Note: This is the top view.

Note

For Package Manufacturing and Environmental information, visit the Resource Center at <http://www.microsemi.com/soc/products/solutions/package/docs.aspx>

Revision	Changes	Page
Revision 2 (continued)	In the " Package Pin Assignments " section, notes were added to the pin tables for the following packages, stating that they are discontinued: "BG225" "PG100" "PG133" "PG175"	3-20 3-24 3-26 3-28
Revision 1 (June 2006)	RoHS compliant information was added to the " Ordering Information " section.	II