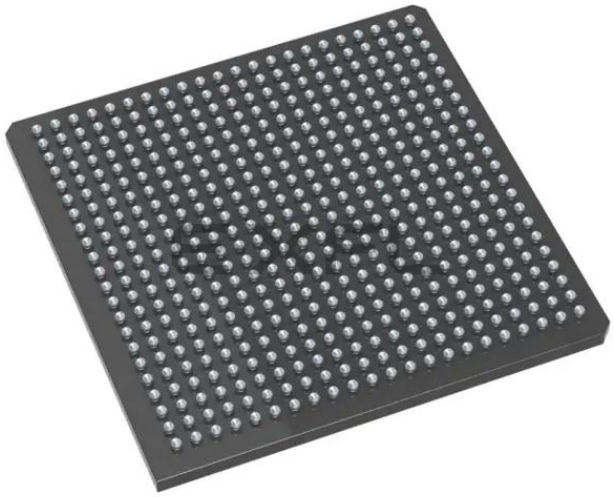

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Understanding Embedded - FPGAs (Field Programmable Gate Array)

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Applications of Embedded - FPGAs

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

Details	
Product Status	Active
Number of LABs/CLBs	8064
Number of Logic Elements/Cells	-
Total RAM Bits	73728
Number of I/O	317
Number of Gates	500000
Voltage - Supply	1.425V ~ 1.575V
Mounting Type	Surface Mount
Operating Temperature	-40°C ~ 85°C (TA)
Package / Case	484-BGA
Supplier Device Package	484-FPBGA (23x23)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/ax500-1fg484i

Calculating Power Dissipation

Table 2-3 • **Standby Current**

Device	Temperature	ICCA	ICCDA	ICCBANK		ICCPLL	ICCCP[1]		IIH, IIL, IOZ[2]	Units
		Standby Current (Core)	Standby Current, Differential I/O	Standby Current per I/O Bank		Standby Current per PLL	Standby Current, Charge Pump			
				2.5 V VCCI	3.3 V VCCI		Active	Bypassed Mode		
AX125	Typical at 25°C	1.5	1.5	0.2	0.3	0.2	0.3	0.01	±0.01	mA
	70°C	15	6	0.5	0.75	1	0.4	0.01	±0.01	mA
	85°C	25	6	0.6	0.8	1	0.4	0.2	±0.01	mA
	125°C	50	8	1	1.5	2	0.4	0.5	±0.01	mA
AX250	Typical at 25°C	1.5	1.4	0.25	0.4	0.2	0.3	0.01	±0.01	mA
	70°C	30	7	0.8	0.9	1	0.4	0.01	±0.01	mA
	85°C	40	7	0.8	1	1	0.4	0.2	±0.01	mA
	125°C	70	9	1.3	1.8	2	0.4	0.5	±0.01	mA
AX500	Typical at 25°C	5	1.4	0.4	0.75	0.2	0.3	0.01	±0.01	mA
	70°C	60	7	1	1.5	1	0.4	0.01	±0.01	mA
	85°C	80	7	1	1.9	1	0.4	0.2	±0.01	mA
	125°C	180	9	1.75	2.5	1.5	0.4	0.5	±0.01	mA
AX1000	Typical at 25°C	7.5	1.5	0.5	1.25	0.2	0.3	0.01	±0.01	mA
	70°C	80	8	1.5	3	1	0.4	0.01	±0.01	mA
	85°C	120	8	1.5	3.4	1	0.4	0.2	±0.01	mA
	125°C	200	10	3	4	1.5	0.4	0.5	±0.01	mA
AX2000	Typical at 25°C	20	1.6	0.7	1.5	0.2	0.3	0.01	±0.01	mA
	70°C	160	10	2	7	1	0.4	0.01	±0.01	mA
	85°C	200	10	3	8	1	0.4	0.2	±0.01	mA
	125°C	500	15	4	10	1.5	0.4	0.5	±0.01	mA

Notes:

1. *ICCCP Active is the ICCDA or the Internal Charge Pump current. ICCCP Bypassed mode is the External Charge Pump current IIH (VPUMP pin).*
2. *IIH, IIL, or IOZ values are measured with inputs at the same level as VCCI for IIH and GND for IIL and IOZ.*

Table 2-13 summarizes the different combinations of voltages and I/O standards that can be used together in the same I/O bank.

***Table 2-13* • Legal I/O Usage Matrix**

I/O Standard	LVTTL 3.3 V	LVCMOS 2.5 V	LVCMOS1.8 V	LVCMOS1.5 V (JESD8-11)	3.3V PCI/PCI-X	GTL + (3.3 V)	GTL + (2.5 V)	HSTL Class I (1. 5V)	SSTL2 Class I & II (2.5 V)	SSTL3 Class I & II (3.3 V)	LVDS (2.5 V)	LVPECL (3.3 V)
LVTTL 3.3 V (VREF=1.0 V)	✓	–	–	–	✓	✓	–	–	–	–	–	✓
LVTTL 3.3 V(VREF=1.5 V)	✓	–	–	–	✓	–	–	–	–	✓	–	✓
LVCMOS 2.5 V (VREF=1.0 V)	–	✓	–	–	–	–	✓	–	–	–	✓	–
LVCMOS 2.5 V (VREF=1.25V)	–	✓	–	–	–	–	–	–	✓	–	✓	–
LVCMOS1.8 V	–	–	✓	–	–	–	–	–	–	–	–	–
LVCMOS1.5 V (VREF = 1.75 V) (JESD8-11)	–	–	–	✓	–	–	–	✓	–	–	–	–
3.3 V PCI/PCI-X (VREF = 1.0 V)	✓	–	–	–	✓	✓	–	–	–	–	–	✓
3.3 V PCI/PCI-X (VREF= 1.5 V)	✓	–	–	–	✓	–	–	–	–	✓	–	✓
GTL + (3.3 V)	✓	–	–	–	✓	✓	–	–	–	–	–	✓
GTL + (2.5 V)	–	✓	–	–	–	–	✓	–	–	–	–	–
HSTL Class I	–	–	–	✓	–	–	–	✓	–	–	–	–
SSTL2 Class I & II	–	✓	–	–	–	–	–	–	✓	–	✓	–
SSTL3 Class I & II	✓	–	–	–	✓	–	–	–	–	✓	–	✓
LVDS (VREF = 1.0 V)	–	✓	–	–	–	–	✓	–	–	–	✓	–
LVDS (VREF = 1.25 V)	–	✓	–	–	–	–	–	–	✓	–	✓	–
LVPECL (VREF = 1.0 V)	✓	–	–	–	✓	✓	–	–	–	–	–	✓
LVPECL (VREF = 1.5 V)	✓	–	–	–	✓	–	–	–	–	✓	–	✓

Notes:

1. *Note that GTL+ 2.5 V is not supported across the full military temperature range.*
2. *A "✓" indicates whether standards can be used within a bank at the same time.*
   Examples:
   a) LVTTL can be used with 3.3V PCI and GTL+ (3.3V), when V_{REF} = 1.0V (GTL+ requirement).
   b) LVTTL can be used with 3.3V PCI and SSTL3 Class I and II, when V_{REF} = 1.5V (SSTL3 requirement).

Note that two I/O standards are compatible if:

- Their VCCI values are identical.
- Their VREF standards are identical (if applicable).

For example, if LVTTL 3.3 V (VREF= 1.0 V) is used, then the other available (i.e. compatible) I/O standards in the same bank are LVTTL 3.3 V PCI/PCI-X, GTL+, and LVPECL.

Also note that when multiple I/O standards are used within a bank, the voltage tolerance will be limited to the minimum tolerance of all I/O standards used in the bank.

I/O Clusters

Each I/O cluster incorporates two I/O modules, four RX modules, two TX modules, and a buffer module. In turn, each I/O module contains one Input Register (InReg), one Output Register (OutReg), and one Enable Register (EnReg) (Figure 2-5).

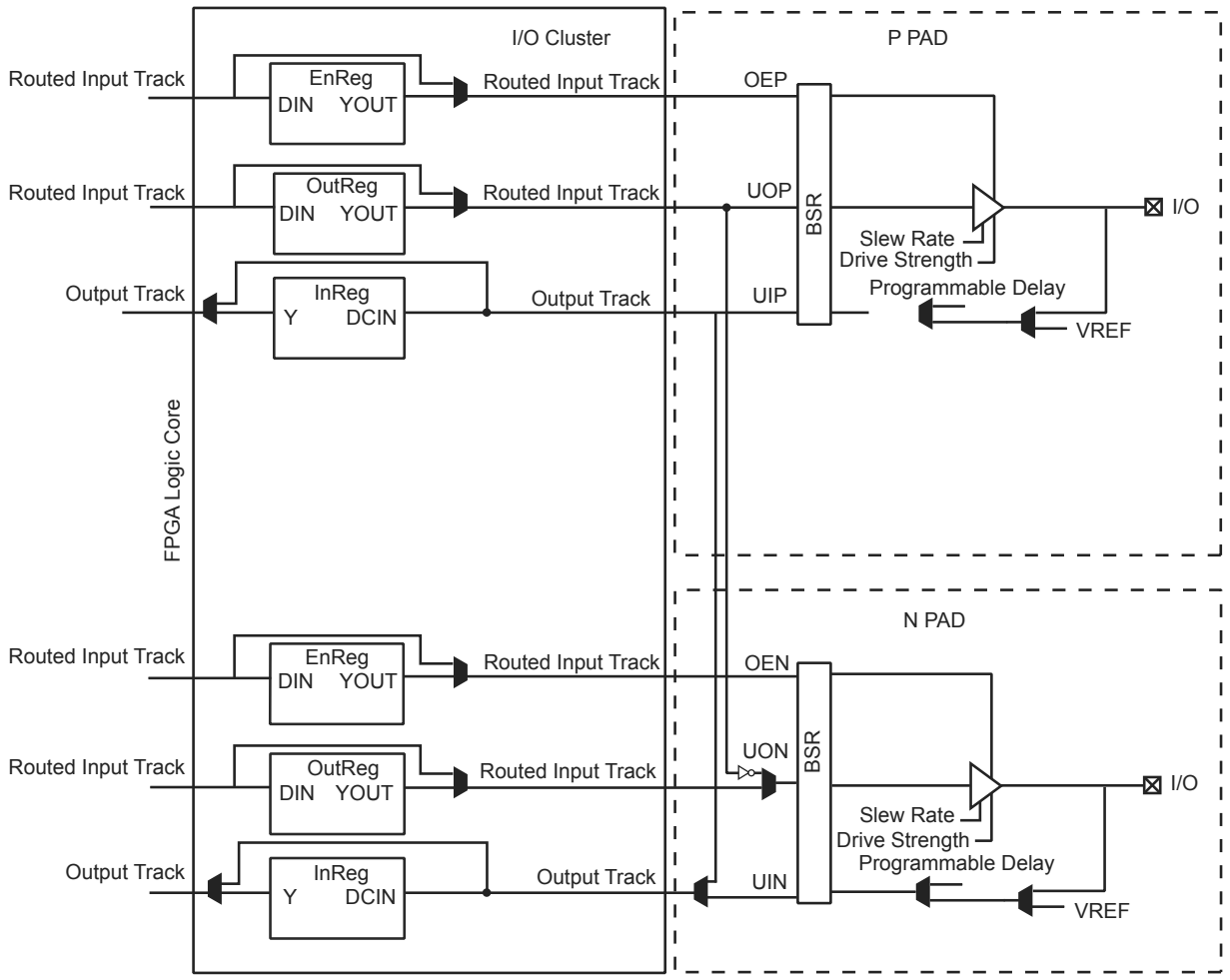


Figure 2-5 • **I/O Cluster Interface**

Using an I/O Register

To access the I/O registers, registers must be instantiated in the netlist and then connected to the I/Os. Usage of each I/O register (register combining) is individually controlled and can be selected/deselected using the PinEditor tool in the Designer software. I/O register combining can also be controlled at the device level, affecting all I/Os. Please note, the I/O register option is deselected by default in any given design.[4]

In addition, Designer software provides a global option to enable/disable the usage of registers in the I/Os. This option is design-specific. The setting for each individual I/O overrides this global option. Furthermore, the *global set fuse* option in the Designer software, when checked, causes all I/O registers to output logic High at device power-up.

4. Please note that register combining for multi fanout nets is not supported.

Timing Characteristics

***Table 2-28* • 1.8V LVCMOS I/O Module**
Worst-Case Commercial Conditions VCCA = 1.425 V, VCCI = 1.7 V, TJ = 70°C

		–2 Speed		–1 Speed		Std Speed		
Parameter	**Description**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
LVCMOS18 Output Module Timing								
t_{DP}	Input Buffer		3.26		3.71		4.37	ns
t_{PY}	Output Buffer		4.55		5.18		6.09	ns
t_{ENZL}	Enable to Pad Delay through the Output Buffer—Z to Low		2.82		2.83		2.84	ns
t_{ENZH}	Enable to Pad Delay through the Output Buffer—Z to High		3.43		3.45		3.46	ns
t_{ENLZ}	Enable to Pad Delay through the Output Buffer—Low to Z		6.01		6.85		8.05	ns
t_{ENHZ}	Enable to Pad Delay through the Output Buffer—High to Z		6.73		7.67		9.01	ns
t_{IOCLKQ}	Sequential Clock-to-Q for the I/O Input Register		0.67		0.77		0.90	ns
t_{IOCLKY}	Clock-to-output Y for the I/O Output Register and the I/O Enable Register		0.67		0.77		0.90	ns
t_{SUD}	Data Input Set-Up		0.23		0.27		0.31	ns
t_{SUE}	Enable Input Set-Up		0.26		0.30		0.35	ns
t_{HD}	Data Input Hold		0.00		0.00		0.00	ns
t_{HE}	Enable Input Hold		0.00		0.00		0.00	ns
t_{CPWHL}	Clock Pulse Width High to Low	0.39		0.39		0.39		ns
t_{CPWLH}	Clock Pulse Width Low to High	0.39		0.39		0.39		ns
t_{WASYN}	Asynchronous Pulse Width	0.37		0.37		0.37		ns
t_{REASYN}	Asynchronous Recovery Time		0.13		0.15		0.17	ns
t_{HASYN}	Asynchronous Removal Time		0.00		0.00		0.00	ns
t_{CLR}	Asynchronous Clear-to-Q		0.23		0.27		0.31	ns
t_{PRESET}	Asynchronous Preset-to-Q		0.23		0.27		0.31	ns

Timing Characteristics

***Table 2-35* • 3.3 V PCI I/O Module**
Worst-Case Commercial Conditions VCCA = 1.425 V, VCCI = 3.0 V, T_J = 70°C

		–2 Speed		–1 Speed		Std Speed		
Parameter	**Description**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
3.3 V PCI Output Module Timing								
t_{DP}	Input Buffer		1.57		1.79		2.10	ns
t_{PY}	Output Buffer		1.91		2.18		2.56	ns
t_{ENZL}	Enable to Pad Delay through the Output Buffer—Z to Low		1.61		1.62		1.63	ns
t_{ENZH}	Enable to Pad Delay through the Output Buffer—Z to High		1.45		1.47		1.47	ns
t_{ENLZ}	Enable to Pad Delay through the Output Buffer—Low to Z		2.55		2.90		3.41	ns
t_{ENHZ}	Enable to Pad Delay through the Output Buffer—High to Z		3.52		4.01		4.72	ns
t_{IOCLKQ}	Sequential Clock-to-Q for the I/O Input Register		0.67		0.77		0.90	ns
t_{IOCLKY}	Clock-to-output Y for the I/O Output Register and the I/O Enable Register		0.67		0.77		0.90	ns
t_{SUD}	Data Input Set-Up		0.23		0.27		0.31	ns
t_{SUE}	Enable Input Set-Up		0.26		0.30		0.35	ns
t_{HD}	Data Input Hold		0.00		0.00		0.00	ns
t_{HE}	Enable Input Hold		0.00		0.00		0.00	ns
t_{CPWHL}	Clock Pulse Width High to Low	0.39		0.39		0.39		ns
t_{CPWLH}	Clock Pulse Width Low to High	0.39		0.39		0.39		ns
t_{WASYN}	Asynchronous Pulse Width	0.37		0.37		0.37		ns
t_{REASYN}	Asynchronous Recovery Time		0.13		0.15		0.17	ns
t_{HASYN}	Asynchronous Removal Time		0.00		0.00		0.00	ns
t_{CLR}	Asynchronous Clear-to-Q		0.23		0.27		0.31	
t_{PRESET}	Asynchronous Preset-to-Q		0.23		0.27		0.31	ns

Differential Standards

Physical Implementation

Implementing differential I/O standards requires the configuration of a pair of external I/O pads, resulting in a single internal signal. To facilitate construction of the differential pair, a single I/O Cluster contains the resources for a pair of I/Os. Configuration of the I/O Cluster as a differential pair is handled by Designer software when the user instantiates a differential I/O macro in the design.

Differential I/Os can also be used in conjunction with the embedded Input Register (InReg), Output Register (OutReg), Enable Register (EnReg), and Double Data Rate (DDR). However, there is no support for bidirectional I/Os or tristates with these standards.

LVDS

Low-Voltage Differential Signal (ANSI/TIA/EIA-644) is a high-speed, differential I/O standard. It requires that one data bit is carried through two signal lines, so two pins are needed. It also requires an external resistor termination. The voltage swing between these two signal lines is approximately 350 mV.

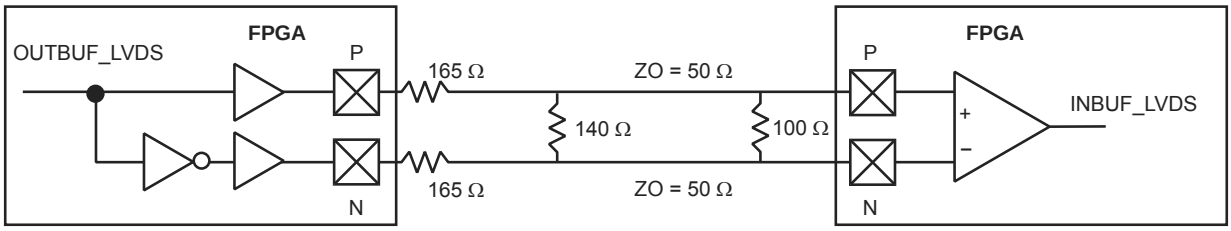


Figure 2-25 • **LVDS Board-Level Implementation**

The LVDS circuit consists of a differential driver connected to a terminated receiver through a constant-impedance transmission line. The receiver is a wide-common-mode-range differential amplifier. The common-mode range is from 0.2 V to 2.2 V for a differential input with 400 mV swing.

To implement the driver for the LVDS circuit, drivers from two adjacent I/O cells are used to generate the differential signals (note that the driver is not a current-mode driver). This driver provides a nominal constant current of 3.5 mA. When this current flows through a 100 Ω termination resistor on the receiver side, a voltage swing of 350 mV is developed across the resistor. The direction of the current flow is controlled by the data fed to the driver.

An external-resistor network (three resistors) is needed to reduce the voltage swing to about 350 mV. Therefore, four external resistors are required, three for the driver and one for the receiver.

Table 2-56 • **DC Input and Output Levels**

DC Parameter	Description	Min.	Typ.	Max.	Units
VCCI[1]	Supply Voltage	2.375	2.5	2.625	V
VOH	Output High Voltage	1.25	1.425	1.6	V
VOL	Output Low Voltage	0.9	1.075	1.25	V
VODIFF	Differential Output Voltage	250	350	450	mV
VOCM	Output Common Mode Voltage	1.125	1.25	1.375	V
VICM2	Input Common Mode Voltage	0.2	1.25	2.2	V

Notes:

1. *±5%*
2. *Differential input voltage = ±350 mV.*

Timing Characteristics

***Table 2-61* • LVPECL I/O Module**
Worst-Case Commercial Conditions VCCA = 1.425 V, VCCI = 3.0 V, T_J = 70°C

		–2 Speed		–1 Speed		Std Speed		
Parameter	**Description**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
LVPECL Output Module Timing								
t_{DP}	Input Buffer		1.66		1.89		2.22	ns
t_{PY}	Output Buffer		2.24		2.55		3.00	ns
t_{ICLKQ}	Clock-to-Q for the I/O input register		0.67		0.77		0.90	ns
t_{OCLKQ}	Clock-to-Q for the IO output register and the I/O enable register		0.67		0.77		0.90	ns
t_{SUD}	Data Input Set-Up		0.23		0.27		0.31	ns
t_{SUE}	Enable Input Set-Up		0.26		0.30		0.35	ns
t_{HD}	Data Input Hold		0.00		0.00		0.00	ns
t_{HE}	Enable Input Hold		0.00		0.00		0.00	ns
t_{CPWHL}	Clock Pulse Width High to Low	0.39		0.39		0.39		ns
t_{CPWLH}	Clock Pulse Width Low to High	0.39		0.39		0.39		ns
t_{WASYN}	Asynchronous Pulse Width	0.37		0.37		0.37		ns
t_{REASYN}	Asynchronous Recovery Time		0.13		0.15		0.17	ns
t_{HASYN}	Asynchronous Removal Time		0.00		0.00		0.00	ns
t_{CLR}	Asynchronous Clear-to-Q		0.23		0.27		0.31	ns
t_{PRESET}	Asynchronous Preset-to-Q		0.23		0.27		0.31	ns

R-Cell

Introduction

The R-cell, the sequential logic resource of the Axcelerator devices, is the second logic module type in the AX family architecture. It includes clock inputs for all eight global resources of the Axcelerator architecture as well as global presets and clears (Figure 2-31).

The main features of the R-cell include the following:

- Direct connection to the adjacent logic module through the hardwired connection DCIN. DCIN is driven by the DCOUT of an adjacent C-cell via the Direct-Connect routing resource, providing a connection with less than 0.1 ns of routing delay.
- The R-cell can be used as a standalone flip-flop. It can be driven by any C-cell or I/O modules through the regular routing structure (using DIN as a routable data input). This gives the option of using the R-Cell as a 2:1 MUXed flip-flop as well.
- Provision of data enable-input (S0).
- Independent active-low asynchronous clear (CLR).
- Independent active-low asynchronous preset (PSET). If both CLR and PSET are low, CLR has higher priority.
- Clock can be driven by any of the following (CKP selects clock polarity):
  - One of the four high performance hardwired fast clocks (HCLKs)
  - One of the four routed clocks (CLKs)
  - User signals
- Global power-on clear (GCLR) and preset (GPSET), which drive each flip-flop on a chip-wide basis.
  - When the Global Set Fuse option in the Designer software is unchecked (by default), GCLR = 0 and GPSET = 1 at device power-up. When the option is checked, GCLR = 1 and GPSET = 0. Both pins are pulled High when the device is in user mode. Refer to the "Simulation Support for GCLR/GPSET in Axcelerator" section of the *Antifuse Macro Library Guide* for information on simulation support for GCLR and GPSET.
- S0, S1, PSET, and CLR can be driven by routed clocks CLKE/F/G/H or user signals.
- DIN and S1 can be driven by user signals.

As with the C-cell, the configuration of the R-cell to perform various functions is handled automatically for the user through Microsemi's extensive macro library (see the *Antifuse Macro Library Guide* for a complete listing of available AX macros).

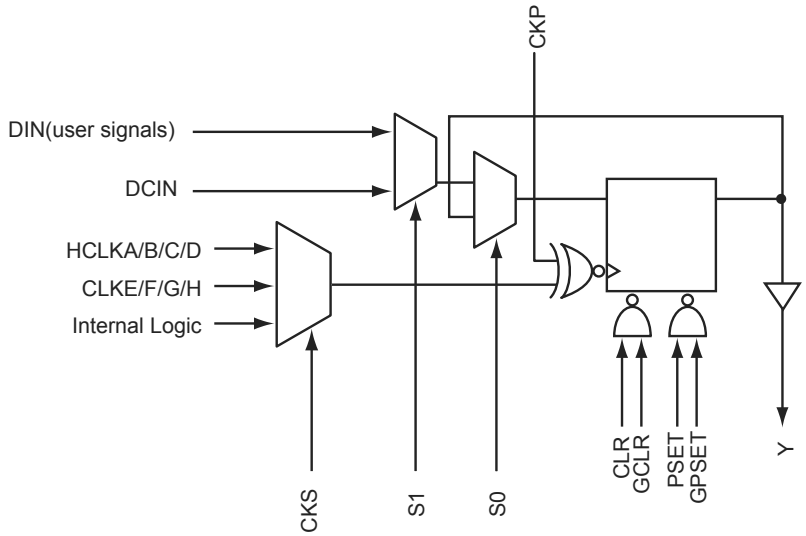


Figure 2-31 • **R-Cell**

***Table 2-69* • AX2000 Predicted Routing Delays**
Worst-Case Commercial Conditions VCCA = 1.425 V, T_J = 70°C

		–2 Speed	–1 Speed	Std Speed	
Parameter	**Description**	**Typical**	**Typical**	**Typical**	**Units**
Predicted Routing Delays					
t_{DC}	DirectConnect Routing Delay, FO1	0.12	0.13	0.15	ns
t_{FC}	FastConnect Routing Delay, FO1	0.35	0.39	0.46	ns
t_{RD1}	Routing delay for FO1	0.50	0.56	0.66	ns
t_{RD2}	Routing delay for FO2	0.59	0.67	0.79	ns
t_{RD3}	Routing delay for FO3	0.70	0.80	0.94	ns
t_{RD4}	Routing delay for FO4	0.76	0.87	1.02	ns
t_{RD5}	Routing delay for FO5	0.98	1.11	1.31	ns
t_{RD6}	Routing delay for FO6	1.48	1.68	1.97	ns
t_{RD7}	Routing delay for FO7	1.65	1.87	2.20	ns
t_{RD8}	Routing delay for FO8	1.73	1.96	2.31	ns
t_{RD16}	Routing delay for FO16	2.58	2.92	3.44	ns
t_{RD32}	Routing delay for FO32	4.24	4.81	5.65	ns

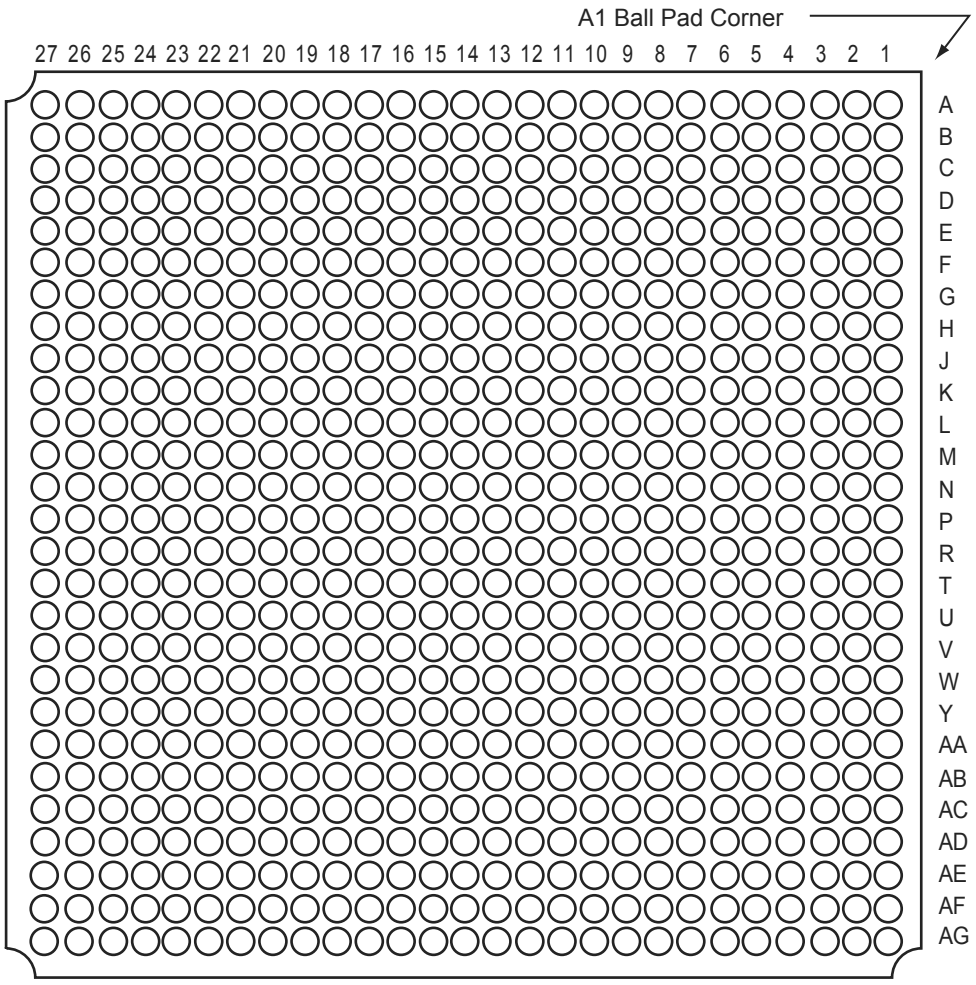
***Table 2-93* • Sixteen RAM Blocks Cascaded**
Worst-Case Commercial Conditions VCCA = 1.425 V, VCCI = 3.0 V, T_J = 70°C

		–2 Speed		–1 Speed		Std Speed		
Parameter	**Description**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
Write Mode								
t_{WDASU}	Write Data Setup vs. WCLK		16.54		18.84		22.15	ns
t_{WDAHD}	Write Data Hold vs. WCLK		0.00		0.00		0.00	ns
t_{WADSU}	Write Address Setup vs. WCLK		16.54		18.84		22.15	ns
t_{WADHD}	Write Address Hold vs. WCLK		0.00		0.00		0.00	ns
t_{WENSU}	Write Enable Setup vs. WCLK		16.54		18.84		22.15	ns
t_{WENHD}	Write Enable Hold vs. WCLK		0.00		0.00		0.00	ns
t_{WCKH}	WCLK Minimum High Pulse Width	0.75		0.75		0.75		ns
t_{WCLK}	WCLK Minimum Low Pulse Width	13.40		13.40		13.40		ns
t_{WCKP}	WCLK Minimum Period	14.15		14.15		14.15		ns
Read Mode								
t_{RADSU}	Read Address Setup vs. RCLK		18.13		20.65		24.27	ns
t_{RADHD}	Read Address Hold vs. RCLK		0.00		0.00		0.00	ns
t_{RENSU}	Read Enable Setup vs. RCLK		18.13		20.65		24.27	ns
t_{RENHD}	Read Enable Hold vs. RCLK		0.00		0.00		0.00	ns
$t_{RCK2RD1}$	RCLK-To-OUT (Pipelined)		12.08		13.76		16.17	ns
$t_{RCK2RD2}$	RCLK-To-OUT (Non-Pipelined)		12.83		14.62		17.18	ns
t_{RCLKH}	RCLK Minimum High Pulse Width	0.73		0.73		0.73		ns
t_{RCLKL}	RCLK Minimum Low Pulse Width	14.41		14.41		14.41		ns
t_{RCKP}	RCLK Minimum Period	15.14		15.14		15.14		ns

Note: Timing data for these sixteen cascaded RAM blocks uses a depth of 65,536. For all other combinations, use Microsemi's timing software.

3 – Package Pin Assignments

BG729



Note

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

BG729	
AX1000 Function	Pin Number
GND	B27
GND	B3
GND	C1
GND	C2
GND	C25
GND	C26
GND	C27
GND	C3
GND	E27
GND	L11
GND	L12
GND	L13
GND	L14
GND	L15
GND	L16
GND	L17
GND	M11
GND	M12
GND	M13
GND	M14
GND	M15
GND	M16
GND	M17
GND	N11
GND	N12
GND	N13
GND	N14
GND	N15
GND	N16
GND	N17
GND	P11
GND	P12
GND	P13
GND	P14
GND	P15
GND	P16
GND	P17

BG729	
AX1000 Function	Pin Number
GND	R11
GND	R12
GND	R13
GND	R14
GND	R15
GND	R16
GND	R17
GND	T11
GND	T12
GND	T13
GND	T14
GND	T15
GND	T16
GND	T17
GND	U11
GND	U12
GND	U13
GND	U14
GND	U15
GND	U16
GND	U17
GND/LP	J8
NC	U3
PRA	J14
PRB	D14
PRC	V14
PRD	AB14
TCK	E4
TDI	D4
TDO	J9
TMS	H8
TRST	E3
VCCA	AA21
VCCA	AD5
VCCA	E1
VCCA	G22
VCCA	K10

BG729	
AX1000 Function	Pin Number
VCCA	K11
VCCA	K17
VCCA	K18
VCCA	L10
VCCA	L18
VCCA	U10
VCCA	U18
VCCA	V10
VCCA	V11
VCCA	V17
VCCA	V18
VCCPLA	A13
VCCPLB	J13
VCCPLC	B15
VCCPLD	C15
VCCPLE	AG14
VCCPLF	AF14
VCCPLG	AB13
VCCPLH	AG13
VCCDA	A11
VCCDA	AB12
VCCDA	AC12
VCCDA	AC25
VCCDA	AD16
VCCDA	AD17
VCCDA	E16
VCCDA	E2
VCCDA	E24
VCCDA	F12
VCCDA	F16
VCCDA	F7
VCCDA	K14
VCCDA	P10
VCCDA	P18
VCCDA	W14
VCCDA	W9
VCCIB0	A4

FG324	
AX125 Function	Pin Number
Bank 0	
IO00NB0F0	C5
IO00PB0F0	C4
IO01NB0F0	A3
IO01PB0F0	A2
IO02NB0F0	C7
IO02PB0F0	C6
IO03NB0F0	B5
IO03PB0F0	B4
IO04NB0F0	A5
IO04PB0F0	A4
IO05NB0F0	A7
IO05PB0F0	A6
IO06NB0F0	B7
IO06PB0F0	B6
IO07NB0F0/HCLKAN	C9
IO07PB0F0/HCLKAP	C8
IO08NB0F0/HCLKBN	B10
IO08PB0F0/HCLKBP	B9
Bank 1	
IO09NB1F1/HCLKCN	D11
IO09PB1F1/HCLKCP	D10
IO10NB1F1/HCLKDN	C12
IO10PB1F1/HCLKDP	C11
IO11NB1F1	A15
IO11PB1F1	A14
IO12NB1F1	B14
IO12PB1F1	B13
IO13NB1F1	A17
IO13PB1F1	A16
IO14NB1F1	D13
IO14PB1F1	D12
IO15NB1F1	C14
IO15PB1F1	C13
IO16NB1F1	B16

FG324	
AX125 Function	Pin Number
IO16PB1F1	C15
IO17NB1F1	E14
IO17PB1F1	E13
Bank 2	
IO18NB2F2	G14
IO18PB2F2	F14
IO19NB2F2	D16
IO19PB2F2	D15
IO20NB2F2	C18
IO20PB2F2	B18
IO21NB2F2	D17
IO21PB2F2	C17
IO22NB2F2	F17
IO22PB2F2	E17
IO23NB2F2	G16
IO23PB2F2	F16
IO24NB2F2	E18
IO24PB2F2	D18
IO25NB2F2	G18
IO25PB2F2	F18
IO26NB2F2	H17
IO26PB2F2	G17
IO27NB2F2	J16
IO27PB2F2	H16
IO28NB2F2	J18
IO28PB2F2	H18
IO29NB2F2	K17
IO29PB2F2	J17
Bank 3	
IO30NB3F3	N18
IO30PB3F3	M18
IO31NB3F3	L18
IO31PB3F3	K18
IO32NB3F3	L16
IO32PB3F3	L17

FG324	
AX125 Function	Pin Number
IO33NB3F3	R18
IO33PB3F3	P18
IO34NB3F3	N15
IO34PB3F3	M15
IO35NB3F3	M16
IO35PB3F3	M17
IO36NB3F3	P16
IO36PB3F3	N16
IO37NB3F3	R17
IO37PB3F3	P17
IO38NB3F3	N14
IO38PB3F3	M14
IO39NB3F3	U18
IO39PB3F3	T18
IO40NB3F3	R16
IO40PB3F3	T17
IO41NB3F3	P13
IO41PB3F3	P14
Bank 4	
IO42NB4F4	T13
IO42PB4F4	T14
IO43NB4F4	U15
IO43PB4F4	T15
IO44NB4F4	U13
IO44PB4F4	U14
IO45NB4F4	V15
IO45PB4F4	V16
IO46NB4F4	V13
IO46PB4F4	V14
IO47NB4F4	V12
IO47PB4F4	U12
IO48NB4F4	V10
IO48PB4F4	V11
IO49NB4F4/CLKEN	T10
IO49PB4F4/CLKEP	T11

FG484	
AX500 Function	**Pin Number**
IO108PB5F10	AA10
IO110NB5F10	AB9
IO110PB5F10	AB10
IO111NB5F10	Y8
IO111PB5F10	Y9
IO112NB5F10	AB7
IO113NB5F10	W8
IO113PB5F10	W9
IO114NB5F11	AA7
IO114PB5F11	AA8
IO115NB5F11	AB5
IO115PB5F11	AB6
IO116NB5F11	Y6
IO116PB5F11	Y7
IO117NB5F11	U8
IO117PB5F11	U9
IO118NB5F11	AA5
IO118PB5F11	AA6
IO119NB5F11	AA4
IO119PB5F11	AB4
IO120NB5F11	Y4
IO120PB5F11	Y5
IO121NB5F11	W6
IO121PB5F11	W7
IO122NB5F11	V3
IO122PB5F11	W3
IO123NB5F11	T7
IO123PB5F11	T8
IO124NB5F11	V4
IO124PB5F11	W5
IO125NB5F11	V6
IO125PB5F11	V7
Bank 6	
IO126NB6F12	V2
IO126PB6F12	W2

FG484	
AX500 Function	**Pin Number**
IO127NB6F12	P7
IO127PB6F12	R7
IO128NB6F12	V1
IO128PB6F12	W1
IO129NB6F12	U5
IO129PB6F12	T5
IO130NB6F12	T1
IO130PB6F12	U1
IO131NB6F12	P6
IO131PB6F12	R6
IO132NB6F12	T4
IO132PB6F12	U4
IO133NB6F12	U2
IO134NB6F12	T3
IO134PB6F12	U3
IO135NB6F12	P5
IO135PB6F12	R5
IO136NB6F13	R2
IO136PB6F13	T2
IO138NB6F13	P4
IO138PB6F13	R4
IO139NB6F13	N2
IO139PB6F13	P2
IO140NB6F13	P3
IO140PB6F13	R3
IO141NB6F13	M6
IO141PB6F13	N6
IO142NB6F13	P1
IO142PB6F13	R1
IO143NB6F13	M5
IO143PB6F13	N5
IO144NB6F13	M4
IO144PB6F13	N4
IO145NB6F13	M7
IO145PB6F13	N7

FG484	
AX500 Function	**Pin Number**
IO146NB6F13	M3
IO146PB6F13	N3
Bank 7	
IO147NB7F14	K7
IO147PB7F14	L7
IO148NB7F14	M2
IO148PB7F14	N1
IO149NB7F14	K5
IO149PB7F14	L5
IO150NB7F14	L3
IO150PB7F14	L2
IO151NB7F14	K6
IO151PB7F14	L6
IO152NB7F14	K2
IO152PB7F14	K1
IO153NB7F14	K4
IO153PB7F14	K3
IO154NB7F14	H3
IO154PB7F14	J3
IO155NB7F14	H5
IO155PB7F14	J5
IO156NB7F14	H4
IO156PB7F14	J4
IO157NB7F14	H2
IO157PB7F14	J2
IO158NB7F15	H1
IO158PB7F15	J1
IO159NB7F15	F1
IO159PB7F15	G1
IO160NB7F15	F2
IO160PB7F15	G2
IO161NB7F15	H6
IO161PB7F15	J6
IO162NB7F15	F3
IO162PB7F15	G3

FG676	
AX1000 Function	**Pin Number**
NC	D13
NC	D14
PRA	E13
PRB	B14
PRC	Y14
PRD	AD14
TCK	E5
TDI	B3
TDO	G6
TMS	D4
TRST	A2
VCCA	AB4
VCCA	AF24
VCCA	C1
VCCA	C26
VCCA	J10
VCCA	J11
VCCA	J12
VCCA	J13
VCCA	J14
VCCA	J15
VCCA	J16
VCCA	J17
VCCA	K18
VCCA	K9
VCCA	L18
VCCA	L9
VCCA	M18
VCCA	M9
VCCA	N18
VCCA	N9
VCCA	P18
VCCA	P9
VCCA	R18
VCCA	R9
VCCA	T18

FG676	
AX1000 Function	**Pin Number**
VCCA	T9
VCCA	U18
VCCA	U9
VCCA	V10
VCCA	V11
VCCA	V12
VCCA	V13
VCCA	V14
VCCA	V15
VCCA	V16
VCCA	V17
VCCPLA	E12
VCCPLB	F13
VCCPLC	E15
VCCPLD	G14
VCCPLE	AF15
VCCPLF	AA14
VCCPLG	AF12
VCCPLH	AB13
VCCDA	A11
VCCDA	A3
VCCDA	AB22
VCCDA	AB5
VCCDA	AD10
VCCDA	AD11
VCCDA	AD13
VCCDA	AD16
VCCDA	AD17
VCCDA	B1
VCCDA	B11
VCCDA	B17
VCCDA	C16
VCCDA	D24
VCCDA	E14
VCCDA	P2
VCCDA	P23

FG676	
AX1000 Function	**Pin Number**
VCCIB0	G10
VCCIB0	G8
VCCIB0	G9
VCCIB0	H10
VCCIB0	H11
VCCIB0	H12
VCCIB0	H13
VCCIB0	H9
VCCIB1	G17
VCCIB1	G18
VCCIB1	G19
VCCIB1	H14
VCCIB1	H15
VCCIB1	H16
VCCIB1	H17
VCCIB1	H18
VCCIB2	H20
VCCIB2	J19
VCCIB2	J20
VCCIB2	K19
VCCIB2	K20
VCCIB2	L19
VCCIB2	M19
VCCIB2	N19
VCCIB3	P19
VCCIB3	R19
VCCIB3	T19
VCCIB3	U19
VCCIB3	U20
VCCIB3	V19
VCCIB3	V20
VCCIB3	W20
VCCIB4	W14
VCCIB4	W15
VCCIB4	W16
VCCIB4	W17

FG896	
AX1000 Function	Pin Number
IO206PB6F19	AB4
IO207NB6F19	W6
IO207PB6F19	W7
IO208NB6F19	AB3
IO208PB6F19	AC3
IO209NB6F19	V8
IO209PB6F19	V9
IO210NB6F19	AA2
IO210PB6F19	AA1
IO211NB6F19	V5
IO211PB6F19	W5
IO212NB6F19	Y3
IO212PB6F19	Y4
IO213NB6F19	V7
IO213PB6F19	V6
IO214NB6F20	W3
IO214PB6F20	W4
IO215NB6F20	U8
IO215PB6F20	U9
IO216NB6F20	W1
IO216PB6F20	W2
IO217NB6F20	U7
IO217PB6F20	U6
IO218NB6F20	U4
IO218PB6F20	V4
IO219NB6F20	T5
IO219PB6F20	U5
IO220NB6F20	U3
IO220PB6F20	V3
IO221NB6F20	T8
IO221PB6F20	T9
IO222NB6F20	U2
IO222PB6F20	V2
IO223NB6F20	T7
IO223PB6F20	T6

FG896	
AX1000 Function	Pin Number
IO224NB6F20	R2
IO224PB6F20	T2
Bank 7	
IO225NB7F21	R7
IO225PB7F21	R6
IO226NB7F21	R4
IO226PB7F21	R5
IO227NB7F21	R8
IO227PB7F21	R9
IO228NB7F21	P1
IO228PB7F21	R1
IO229NB7F21	P9
IO229PB7F21	P8
IO230NB7F21	N2
IO230PB7F21	P2
IO231NB7F21	P7
IO231PB7F21	P6
IO232NB7F21	N3
IO232PB7F21	P3
IO233NB7F21	P4
IO233PB7F21	P5
IO234NB7F21	L1
IO234PB7F21	M1
IO235NB7F21	M4
IO235PB7F21	N4
IO236NB7F22	N7
IO236PB7F22	N6
IO237NB7F22	N8
IO237PB7F22	N9
IO238NB7F22	M5
IO238PB7F22	N5
IO239NB7F22	L2
IO239PB7F22	M2
IO240NB7F22	L3
IO240PB7F22	M3

FG896	
AX1000 Function	Pin Number
IO241NB7F22	M8
IO241PB7F22	M7
IO242NB7F22	K4
IO242PB7F22	L4
IO243NB7F22	L6
IO243PB7F22	M6
IO244NB7F22	K5
IO244PB7F22	L5
IO245NB7F22	J4
IO245PB7F22	J3
IO246NB7F22	G2
IO246PB7F22	H2
IO247NB7F23	L8
IO247PB7F23	L7
IO248NB7F23	G3
IO248PB7F23	H3
IO249NB7F23	G4
IO249PB7F23	H4
IO250NB7F23	J6
IO250PB7F23	K6
IO251NB7F23	H5
IO251PB7F23	J5
IO252NB7F23	F2
IO252PB7F23	F1
IO253NB7F23	K8
IO253PB7F23	K7
IO254NB7F23	F4
IO254PB7F23	F3
IO255NB7F23	G6
IO255PB7F23	H6
IO256NB7F23	F5
IO256PB7F23	G5
IO257NB7F23	H7
IO257PB7F23	J7
Dedicated I/O	

FG896	
AX2000 Function	Pin Number
GND	W19
GND	Y11
GND	Y20
GND/LP	E4
PRA	G15
PRB	D16
PRC	AB16
PRD	AF16
TCK	G7
TDI	D5
TDO	J8
TMS	F6
TRST	C4
VCCA	AD6
VCCA	AH26
VCCA	E28
VCCA	E3
VCCA	L12
VCCA	L13
VCCA	L14
VCCA	L15
VCCA	L16
VCCA	L17
VCCA	L18
VCCA	L19
VCCA	M11
VCCA	M20
VCCA	N11
VCCA	N20
VCCA	P11
VCCA	P20
VCCA	R11
VCCA	R20
VCCA	T11
VCCA	T20

FG896	
AX2000 Function	Pin Number
VCCA	U11
VCCA	U20
VCCA	V11
VCCA	V20
VCCA	W11
VCCA	W20
VCCA	Y12
VCCA	Y13
VCCA	Y14
VCCA	Y15
VCCA	Y16
VCCA	Y17
VCCA	Y18
VCCA	Y19
VCCDA	AD24
VCCDA	AD7
VCCDA	AE15
VCCDA	AE16
VCCDA	AF12
VCCDA	AF13
VCCDA	AF15
VCCDA	AF18
VCCDA	AF19
VCCDA	AH27
VCCDA	AH4
VCCDA	C13
VCCDA	C27
VCCDA	C5
VCCDA	D13
VCCDA	D19
VCCDA	D3
VCCDA	E18
VCCDA	F15
VCCDA	F16
VCCDA	F26

FG896	
AX2000 Function	Pin Number
VCCDA	G16
VCCDA	T25
VCCDA	T4
VCCIB0	A3
VCCIB0	B3
VCCIB0	J10
VCCIB0	J11
VCCIB0	J12
VCCIB0	K11
VCCIB0	K12
VCCIB0	K13
VCCIB0	K14
VCCIB0	K15
VCCIB1	A28
VCCIB1	B28
VCCIB1	J19
VCCIB1	J20
VCCIB1	J21
VCCIB1	K16
VCCIB1	K17
VCCIB1	K18
VCCIB1	K19
VCCIB1	K20
VCCIB2	C29
VCCIB2	C30
VCCIB2	K22
VCCIB2	L21
VCCIB2	L22
VCCIB2	M21
VCCIB2	M22
VCCIB2	N21
VCCIB2	P21
VCCIB2	R21
VCCIB3	AA22
VCCIB3	AH29

*Note: *Not routed on the same package layer and to adjacent LGA pads as its differential pair complement. Recommended to be used as a single-ended I/O.*

FG1152	
AX2000 Function	**Pin Number**
IO311NB7F29	N3
IO311PB7F29	P3
IO312NB7F29	P7
IO312PB7F29	R7
IO313NB7F29	P6
IO313PB7F29	R6
IO314NB7F29	M2
IO314PB7F29	N2
IO315NB7F29	N4
IO315PB7F29	P4
IO316NB7F29	R9
IO316PB7F29	R8
IO317NB7F29	N5
IO317PB7F29	P5
IO318NB7F29	R10
IO318PB7F29	R11
IO319NB7F29	L2
IO319PB7F29	L1
IO320NB7F29	N8
IO320PB7F29	P8
IO321NB7F30	M6
IO321PB7F30	N6
IO322NB7F30	P10
IO322PB7F30	P9
IO323NB7F30	L3
IO323PB7F30	M3
IO324NB7F30	M7
IO324PB7F30	N7
IO325NB7F30	K2
IO325PB7F30	K1
IO326NB7F30	G2
IO326PB7F30	H2
IO327NB7F30	L6
IO327PB7F30	L5
IO328NB7F30	N10

FG1152	
AX2000 Function	**Pin Number**
IO328PB7F30	N9
IO329NB7F30	J4
IO329PB7F30	K4
IO330NB7F30	J5
IO330PB7F30	K5
IO331NB7F30	M10
IO331PB7F30	M9
IO332NB7F31	L8
IO332PB7F31	M8
IO333NB7F31	F2
IO333PB7F31	F1
IO334NB7F31	J6
IO334PB7F31	K6
IO335NB7F31	H4
IO335PB7F31	H3
IO336NB7F31	K7
IO336PB7F31	L7
IO337NB7F31	G4
IO337PB7F31	G3
IO338NB7F31	K9
IO338PB7F31	L9
IO339NB7F31	H6
IO339PB7F31	H5
IO340NB7F31	H7
IO340PB7F31	J7
IO341NB7F31	J8
IO341PB7F31	K8
Dedicated I/O	
GND	A13
GND	A2
GND	A22
GND	A27
GND	A3
GND	A31
GND	A32

FG1152	
AX2000 Function	**Pin Number**
GND	A33
GND	A4
GND	A8
GND	AA14
GND	AA15
GND	AA16
GND	AA17
GND	AA18
GND	AA19
GND	AA20
GND	AA21
GND	AB1
GND	AB13
GND	AB22
GND	AB34
GND	AC12
GND	AC23
GND	AC30
GND	AC5
GND	AD11
GND	AD24
GND	AD31
GND	AD4
GND	AE3
GND	AE32
GND	AF2
GND	AF33
GND	AG1
GND	AG27
GND	AG34
GND	AG8
GND	AH28
GND	AH7
GND	AJ29
GND	AJ6

PQ208	
AX500 Function	**Pin Number**
IO150PB7F14	19
IO152NB7F14	16
IO152PB7F14	17
IO161NB7F15	12
IO161PB7F15	13
IO163NB7F15	10
IO163PB7F15	11
IO165PB7F15	7
IO166NB7F15	5
IO166PB7F15	6
IO167NB7F15	3
IO167PB7F15	4
Dedicated I/O	
V_{CCDA}	1
V_{CCDA}	26
V_{CCDA}	53
V_{CCDA}	63
V_{CCDA}	78
V_{CCDA}	95
V_{CCDA}	105
V_{CCDA}	130
V_{CCDA}	157
V_{CCDA}	167
V_{CCDA}	182
V_{CCDA}	202
GND	104
GND	9
GND	15
GND	21
GND	32
GND	39
GND	46
GND	51
GND	59
GND	65
GND	69
GND	90

PQ208	
AX500 Function	**Pin Number**
GND	94
GND	99
GND	113
GND	119
GND	125
GND	143
GND	136
GND	150
GND	155
GND	164
GND	169
GND	173
GND	194
GND	196
GND	201
GND/LP	208
PRA	184
PRB	183
PRC	80
PRD	79
TCK	205
TDI	204
TDO	203
TMS	206
TRST	207
VCCA	2
VCCA	14
VCCA	38
VCCA	52
VCCA	64
VCCA	93
VCCA	118
VCCA	142
VCCA	156
VCCA	168
VCCA	195
VCCPLA	189

PQ208	
AX500 Function	**Pin Number**
VCCPLB	187
VCCPLC	178
VCCPLD	176
VCCPLE	85
VCCPLF	83
VCCPLG	74
VCCPLH	72
VCCIB0	200
VCCIB0	193
VCCIB1	172
VCCIB1	163
VCCIB2	149
VCCIB2	135
VCCIB3	124
VCCIB3	112
VCCIB4	98
VCCIB4	89
VCCIB5	68
VCCIB5	58
VCCIB6	45
VCCIB6	31
VCCIB7	20
VCCIB7	8
VCOMPLA	190
VCOMPLB	188
VCOMPLC	179
VCOMPLD	177
VCOMPLE	86
VCOMPLF	84
VCOMPLG	75
VCOMPLH	73
VPUMP	158

CQ256	
AX2000 Function	Pin Number
IO242NB5F22	74
IO242PB5F22	75
IO243NB5F22	70
IO243PB5F22	71
IO244NB5F22	68
IO244PB5F22	69
Bank 6	
IO257PB6F24	60
IO258NB6F24	58
IO258PB6F24	59
Bank 6	
IO279NB6F26	56
IO279PB6F26	57
IO280NB6F26	52
IO280PB6F26	53
IO281NB6F26	50
IO281PB6F26	51
IO282NB6F26	46
IO282PB6F26	47
IO284NB6F26	44
IO284PB6F26	45
IO285NB6F26	40
IO285PB6F26	41
IO286NB6F26	38
IO286PB6F26	39
IO287NB6F26	34
IO287PB6F26	35
Bank 7 9	
IO310NB7F29	30
IO310PB7F29	31
IO311NB7F29	26
IO311PB7F29	27
IO312NB7F29	24
IO312PB7F29	25
IO315NB7F29	20

CQ256	
AX2000 Function	Pin Number
IO315PB7F29	21
IO316NB7F29	18
IO316PB7F29	19
IO317NB7F29	14
IO317PB7F29	15
IO318NB7F29	12
IO318PB7F29	13
IO320NB7F29	8
IO320PB7F29	9
Bank 7	
IO341NB7F31	6
IO341PB7F31	7
Dedicated I/O	
GND	1
GND	5
GND	11
GND	17
GND	23
GND	29
GND	33
GND	37
GND	43
GND	49
GND	55
GND	62
GND	64
GND	65
GND	73
GND	79
GND	85
GND	91
GND	97
GND	103
GND	109
GND	115

CQ256	
AX2000 Function	Pin Number
GND	121
GND	128
GND	129
GND	132
GND	139
GND	145
GND	151
GND	157
GND	161
GND	165
GND	171
GND	177
GND	183
GND	190
GND	192
GND	193
GND	201
GND	207
GND	213
GND	219
GND	225
GND	231
GND	239
GND	245
GND	256
PRA	227
PRB	226
PRC	99
PRD	98
TCK	253
TDI	252
TDO	250
TMS	254
TRST	255
VCCA	3