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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	Active
Number of LABs/CLBs	4224
Number of Logic Elements/Cells	-
Total RAM Bits	55296
Number of I/O	138
Number of Gates	250000
Voltage - Supply	1.425V ~ 1.575V
Mounting Type	Surface Mount
Operating Temperature	-55°C ~ 125°C (TA)
Package / Case	256-LBGA
Supplier Device Package	256-FPBGA (17x17)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/ax250-fg256m

Axcelerator Family Device Status

Axcelerator® Devices	Status
AX125	Production
AX250	Production
AX500	Production
AX1000	Production
AX2000	Production

Temperature Grade Offerings

Package	AX125	AX250	AX500	AX1000	AX2000
PQ208	–	C, I, M	C, I, M	–	–
CQ208	–	M	M	–	–
CQ256	–	–	–	–	M
FG256	C, I	C, I, M	–	–	–
FG324	C, I	–	–	–	–
CQ352	–	M	M	M	M
FG484	–	C, I, M	C, I, M	C, I, M	–
CG624	–	–	–	M	M
FG676	–	–	C, I, M	C, I, M	–
BG729	–	–	–	C, I, M	–
FG896	–	–	–	C, I, M	C, I, M
FG1152	–	–	–	–	C, I, M

C = Commercial

I = Industrial

M = Military

Speed Grade and Temperature Grade Matrix

Temperature Grade	Std	–1	–2
C	✓	✓	✓
I	✓	✓	✓
M	✓	✓	–

C = Commercial

I = Industrial

M = Military

Packaging Data

Refer to the following documents located on the Microsemi SoC Products Group website for additional packaging information.

- Package Mechanical Drawings
- Package Thermal Characteristics and Weights
- Hermatic Package Mechanical Information

Contact your local Microsemi representative for device availability.

User I/Os[2]

Introduction

The Axcelerator family features a flexible I/O structure, supporting a range of mixed voltages (1.5 V, 1.8 V, 2.5 V, and 3.3 V) with its bank-selectable I/Os. Table 2-8 on page 2-12 contains the I/O standards supported by the Axcelerator family, and Table 2-10 on page 2-12 compares the features of the different I/O standards.

Each I/O provides programmable slew rates, drive strengths, and weak pull-up and weak pull-down circuits. The slew rate setting is effective for both rising and falling edges.

I/O standards, except 3.3 V PCI and 3.3 V PCI-X, are capable of hot insertion. 3.3 V PCI and 3.3 V PCI-X are 5 V tolerant with the aid of an external resistor.

The input buffer has an optional user-configurable delay element. The element can reduce or eliminate the hold time requirement for input signals registered within the I/O cell. The value for the delay is set on a bank-wide basis. Note that the delay WILL be a function of process variations as well as temperature and voltage changes.

Each I/O includes three registers: an input (InReg), an output (OutReg), and an enable register (EnReg). I/Os are organized into banks, and there are eight banks per device—two per side (Figure 2-6 on page 2-18). Each I/O bank has a common VCCI, the supply voltage for its I/Os.

For voltage-referenced I/Os, each bank also has a common reference-voltage bus, VREF. While VREF must have a common voltage for an entire I/O bank, its location is user-selectable. In other words, any user I/O in the bank can be selected to be a VREF.

The location of the VREF pin should be selected according to the following rules:

- Any pin that is assigned as a VREF can control a maximum of eight user I/O pad locations in each direction (16 total maximum) within the same I/O bank.
- I/O pad locations listed as no connects are counted as part of the 16 maximum. In many cases, this leads to fewer than eight user I/O package pins in each direction being controlled by a VREF pin.
- Dedicated I/O pins such as GND and VCCI are counted as part of the 16.
- The two user I/O pads immediately adjacent on each side of the VREF pin (four in total) may only be used as inputs. The exception is when there is a VCCI/GND pair separating the VREF pin and the user I/O pad location.
- The user does not need to assign VREF pins for OUTBUF and TRIBUF. VREF pins are needed only for input and bidirectional I/Os.

The differential amplifier supply voltage VCCDA should be connected to 3.3 V.

A user can gain access to the various I/O standards in three ways:

- Instantiate specific library macros that represent the desired specific standard.
- Use generic I/O macros and then use Designer's PinEditor to specify the desired I/O standards (please note that this is not applicable to differential standards).
- A combination of the first two methods.

Refer to the *I/O Features in Axcelerator Family Devices* application note and the *Antifuse Macro Library Guide* for more details.

2. *Do not use an external resister to pull the I/O above V_{CCI} for a higher logic "1" voltage level. The desired higher logic "1" voltage level will be degraded due to a small I/O current, which exists when the I/O is pulled up above V_{CCI}.*

5 V Tolerance

There are two schemes to achieve 5 V tolerance:

1. 3.3 V PCI and 3.3 V PCI-X are the only I/O standards that directly allow 5 V tolerance. To implement this, an internal clamp diode between the input pad and the VCCI pad is enabled so that the voltage at the input pin is clamped, as shown in EQ 3:

Vinput = VCCI + Vdiode = 3.3 V + 0.7 V = 4.0 V

EQ 3

The internal VCCI clamp diode is only enabled while the device is powered on, so the voltage at the input will not be clamped if the VCCI or VCCA are powered off. An external series resistor (~100 Ω) is required between the input pin and the 5 V signal source to limit the current to less than 20 mA (Figure 2-3). The 100 Ω resistor was chosen to meet the input Tr/Tf requirement (Table 2-19 on page 2-21). The GND clamp diode is available for all I/O standards and always enabled.

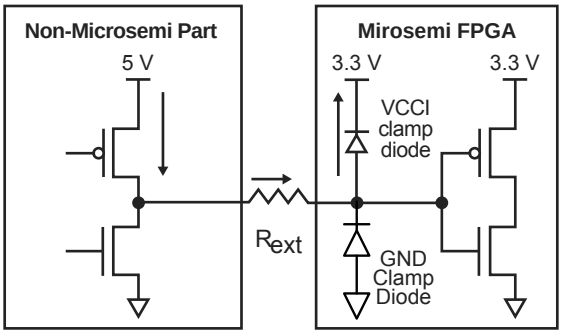


Figure 2-3 • **Use of an External Resistor for 5 V Tolerance**

2. 5 V tolerance can also be achieved with 3.3 V I/O standards (3.3 V PCI, 3.3 V PCI-X, and LVTTL) using a bus-switch product (e.g. IDTQS32X2384). This will convert the 5 V signal to a 3.3 V signal with minimum delay (Figure 2-4).

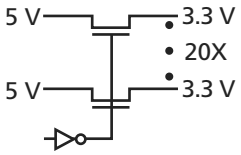


Figure 2-4 • **Bus Switch IDTQS32X2384**

Simultaneous Switching Outputs (SSO)

When multiple output drivers switch simultaneously, they induce a voltage drop in the chip/package power distribution. This simultaneous switching momentarily raises the ground voltage within the device relative to the system ground. This apparent shift in the ground potential to a non-zero value is known as simultaneous switching noise (SSN) or more commonly, ground bounce.

SSN becomes more of an issue in high pin count packages and when using high performance devices such as the Axcelerator family. Based upon testing, Microsemi recommends that users not exceed eight simultaneous switching outputs (SSO) per each VCCI/GND pair. To ease this potential burden on designers, Microsemi has designed all of the Axcelerator BGAs[3] to not exceed this limit with the exception of the CS180, which has an I/O to VCCI/GND pair ratio of nine to one.

Please refer to the *Simultaneous Switching Noise and Signal Integrity* application note for more information.

3. The user should note that in Bank 8 of both AX1000-FG484 and AX500-FG484, there are local violations of this 8:1 ratio.

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).

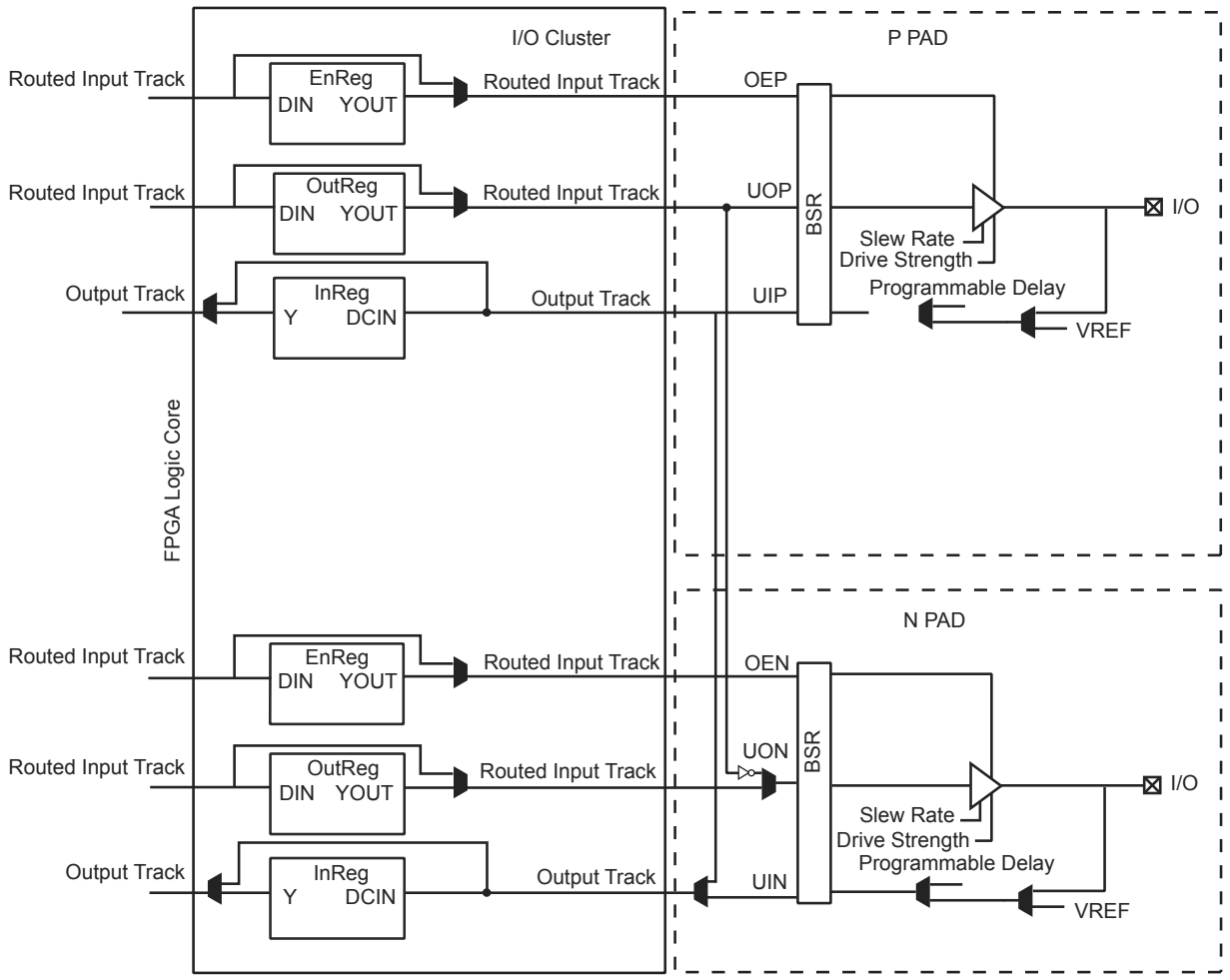


Figure 2-5 • **I/O Cluster Interface**

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.

User I/O Naming Conventions

Due to the complex and flexible nature of the Axcelerator family's user I/Os, a naming scheme is used to show the details of the I/O. The naming scheme explains to which bank an I/O belongs, as well as the pairing and pin polarity for differential I/Os (Figure 2-7).

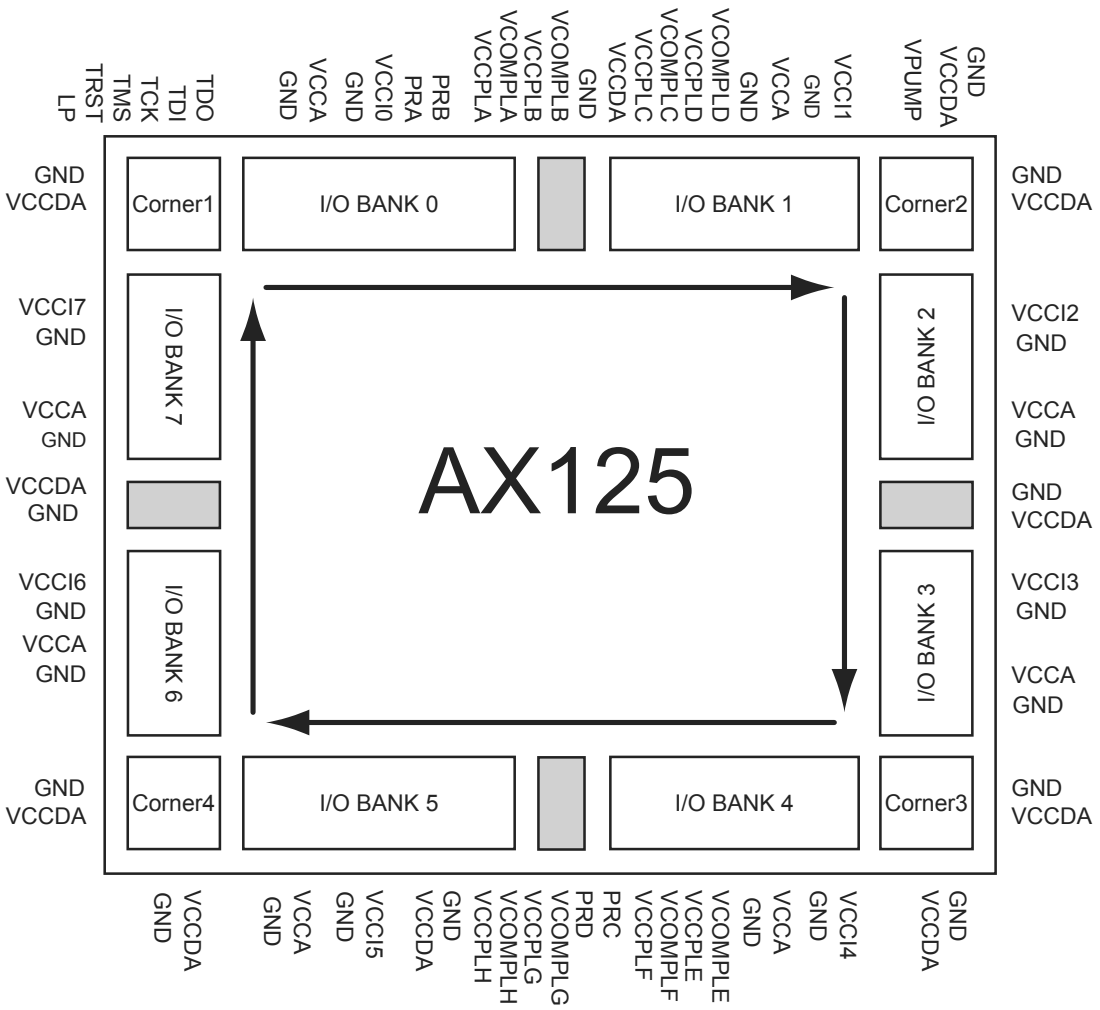
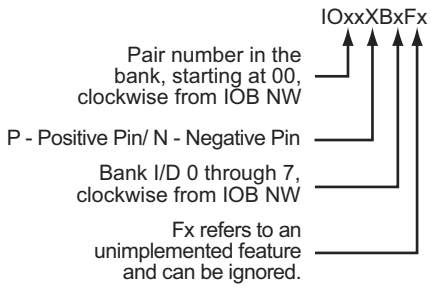


Figure 2-7 • **I/O Bank and Dedicated Pin Layout**



Examples:

IO12PB1F1 is the positive pin of the thirteenth pair of the first I/O bank (IOB NE). IO12PB1 combined with IO12NB1 form a differential pair.

For those I/Os that can be employed either as a user I/O or as a special function, the following nomenclature is used:

IOxxXBxFx/special_function_name

IOxxPB1Fx/xCLKx this pin can be configured as a clock input or as a user I/O.

Figure 2-8 • **General Naming Schemes**

I/O Standard Electrical Specifications

***Table 2-18* • Input Capacitance**

Symbol	Parameter	Conditions	Min.	Max.	Units
C_{IN}	Input Capacitance	VIN = 0, f = 1.0 MHz		10	pF
C_{INCLK}	Input Capacitance on HCLK and RCLK Pin	VIN = 0, f = 1.0 MHz		10	pF

Table 2-19* • I/O Input Rise Time and Fall Time

Input Buffer	Input Rise/Fall Time (min.)	Input Rise/Fall Time (max.)
LVTTL	No Requirement	50 ns
LVCMOS 2.5V	No Requirement	50 ns
LVCMOS 1.8V	No Requirement	50 ns
LVCMOS 1.5V	No Requirement	50 ns
PCI	No Requirement	50 ns
PCIX	No Requirement	50 ns
GTL+	No Requirement	50 ns
HSTL	No Requirement	50 ns
SSTL2	No Requirement	50 ns
HSTL3	No Requirement	50 ns
LVDS	No Requirement	50 ns
LVPECL	No Requirement	50 ns

*Note: *Input Rise/Fall time applies to all inputs, be it clock or data. Inputs have to ramp up/down linearly, in a monotonic way. Glitches or a plateau may cause double clocking. They must be avoided. For output rise/fall time, refer to the IBIS models for extraction.*

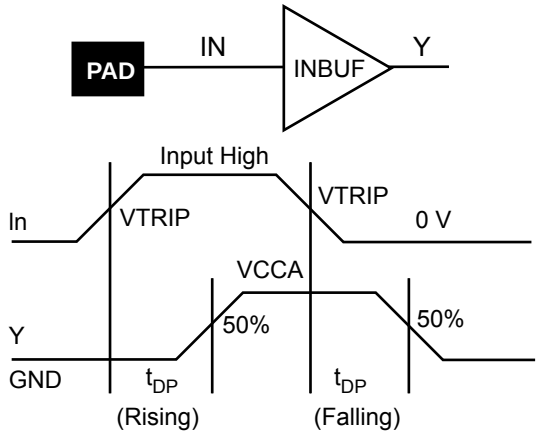


***Figure 2-9 •* Input Buffer Delays**

***Table 2-22* • 3.3 V LVTTL I/O Module**
Worst-Case Commercial Conditions VCCA = 1.425 V, VCCI = 3.0 V, T_J = 70°C (continued)

		–2 Speed		–1 Speed		Std Speed		
Parameter	**Description**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
LVTTL Output Drive Strength =3 (16 mA) / High Slew Rate								
t_{DP}	Input Buffer		1.68		1.92		2.26	ns
t_{PY}	Output Buffer		3.12		3.56		4.18	ns
t_{ENZL}	Enable to Pad Delay through the Output Buffer—Z to Low		3.54		4.04		4.75	ns
t_{ENZH}	Enable to Pad Delay through the Output Buffer—Z to High		2.78		3.17		3.72	ns
t_{ENLZ}	Enable to Pad Delay through the Output Buffer—Low to Z		1.91		1.93		1.93	ns
t_{ENHZ}	Enable to Pad Delay through the Output Buffer—High to Z		2.58		2.59		2.60	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

Routed Clocks

The routed clock (CLK) is a low-skew network that can drive the clock inputs of all sequential modules in the device (logically equivalent to the HCLK), but has the added flexibility in that it can drive the S0 (Enable), S1, PSET, and CLR input of a register (R-cells and I/O registers) as well as any of the inputs of any C-cell in the device. This allows CLKs to be used not only as clocks, but also for other global signals or high fanout nets. All four CLKs are available everywhere on the chip.

Timing Characteristics

Table 2-75 • **AX125 Routed Array Clock Networks**
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**
Routed Array Clock Networks								
t_{RCKL}	Input Low to High		3.08		3.50		4.12	ns
t_{RCKH}	Input High to Low		3.13		3.56		4.19	ns
t_{RPWH}	Minimum Pulse Width High	0.57		0.64		0.75		ns
t_{RPWL}	Minimum Pulse Width Low	0.52		0.59		0.69		ns
t_{RCKSW}	Maximum Skew		0.35		0.39		0.46	ns
t_{RP}	Minimum Period	1.15		1.31		1.54		ns
t_{RMAX}	Maximum Frequency		870		763		649	MHz

Table 2-76 • **AX250 Routed Array Clock Networks**
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**
Routed Array Clock Networks								
t_{RCKL}	Input Low to High		2.52		2.87		3.37	ns
t_{RCKH}	Input High to Low		2.59		2.95		3.47	ns
t_{RPWH}	Minimum Pulse Width High	0.57		0.64		0.75		ns
t_{RPWL}	Minimum Pulse Width Low	0.52		0.59		0.69		ns
t_{RCKSW}	Maximum Skew		0.35		0.39		0.46	ns
t_{RP}	Minimum Period	1.15		1.31		1.54		ns
t_{RMAX}	Maximum Frequency		870		763		649	MHz

Embedded Memory

The AX architecture provides extensive, high-speed memory resources to the user. Each 4,608 bit block of RAM contains its own embedded FIFO controller, allowing the user to configure each block as either RAM or FIFO.

To meet the needs of high performance designs, the memory blocks operate in synchronous mode for both read and write operations. However, the read and write clocks are completely independent, and each may operate up to and above 500 MHz.

No additional core logic resources are required to cascade the address and data buses when cascading different RAM blocks. Dedicated routing runs along each column of RAM to facilitate cascading.

The AX memory block includes dedicated FIFO control logic to generate internal addresses and external flag logic (FULL, EMPTY, AFULL, AEMPTY). Since read and write operations can occur asynchronously to one another, special control circuitry is included to prevent metastability, overflow, and underflow. A block diagram of the memory module is illustrated in Figure 2-57.

During RAM operation, read (RA) and write (WA) addresses are sourced by user logic and the FIFO controller is ignored. In FIFO mode, the internal addresses are generated by the FIFO controller and routed to the RAM array by internal MUXes. Enables with programmable polarity are provided to create upper address bits for cascading up to 16 memory blocks. When cascading memory blocks, the bussed signals WA, WD, WEN, RA, RD, and REN are internally linked to eliminate external routing congestion.

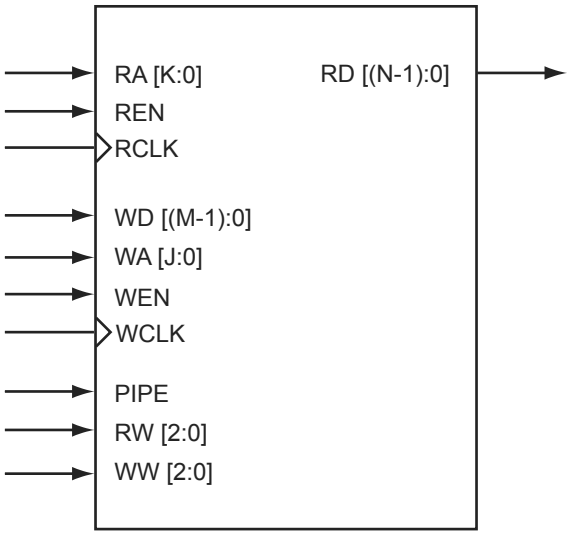


Figure 2-57 • **Axcelerator Memory Module**

***Table 2-89* • One RAM Block**
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		1.08		1.23		1.45	ns
t_{WDAHD}	Write Data Hold vs. WCLK		0.22		0.25		0.30	ns
t_{WADSU}	Write Address Setup vs. WCLK		1.08		1.23		1.45	ns
t_{WADHD}	Write Address Hold vs. WCLK		0.00		0.00		0.00	ns
t_{WENSU}	Write Enable Setup vs. WCLK		1.08		1.23		1.45	ns
t_{WENHD}	Write Enable Hold vs. WCLK		0.22		0.25		0.30	ns
t_{WCKH}	WCLK Minimum High Pulse Width	0.75		0.75		0.75		ns
t_{WCLK}	WCLK Minimum Low Pulse Width	0.88		0.88		0.88		ns
t_{WCKP}	WCLK Minimum Period	1.63		1.63		1.63		ns
Read Mode								
t_{RADSU}	Read Address Setup vs. RCLK		0.81		0.92		1.08	ns
t_{RADHD}	Read Address Hold vs. RCLK		0.00		0.00		0.00	ns
t_{RENSU}	Read Enable Setup vs. RCLK		0.81		0.92		1.08	ns
t_{RENHD}	Read Enable Hold vs. RCLK		0.00		0.00		0.00	ns
$t_{RCK2RD1}$	RCLK-to-OUT (Pipelined)		1.32		1.51		1.77	ns
$t_{RCK2RD2}$	RCLK-to-OUT (Non-Pipelined)		2.16		2.46		2.90	ns
t_{RCLKH}	RCLK Minimum High Pulse Width	0.77		0.77		0.77		ns
t_{RCLKL}	RCLK Minimum Low Pulse Width	0.93		0.93		0.93		ns
t_{RCKP}	RCLK Minimum Period	1.70		1.70		1.70		ns

Note: Timing data for this single block RAM has a depth of 4,096. For all other combinations, use Microsemi's timing software.

***Table 2-90* • Two 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		1.39		1.59		1.87	ns
t_{WDAHD}	Write Data Hold vs. WCLK		0.00		0.00		0.00	ns
t_{WADSU}	Write Address Setup vs. WCLK		1.39		1.59		1.87	ns
t_{WADHD}	Write Address Hold vs. WCLK		0.00		0.00		0.00	ns
t_{WENSU}	Write Enable Setup vs. WCLK		1.39		1.59		1.87	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	1.76		1.76		1.76		ns
t_{WCKP}	WCLK Minimum Period	2.51		2.51		2.51		ns
Read Mode								
t_{RADSU}	Read Address Setup vs. RCLK		1.71		1.94		2.28	ns
t_{RADHD}	Read Address Hold vs. RCLK		0.00		0.00		0.00	ns
t_{RENSU}	Read Enable Setup vs. RCLK		1.71		1.94		2.28	ns
t_{RENHD}	Read Enable Hold vs. RCLK		0.00		0.00		0.00	ns
$t_{RCK2RD1}$	RCLK-To-OUT (Pipelined)		1.43		1.63		1.92	ns
$t_{RCK2RD2}$	RCLK-To-OUT (Non-Pipelined)		2.26		2.58		3.03	ns
t_{RCLKH}	RCLK Minimum High Pulse Width	0.73		0.73		0.73		ns
t_{RCLKL}	RCLK Minimum Low Pulse Width	1.89		1.89		1.89		ns
t_{RCKP}	RCLK Minimum Period	2.62		2.62		2.62		ns

Note: Timing data for these two cascaded RAM blocks uses a depth of 8,192. For all other combinations, use Microsemi's timing software.

TDO

TDO is normally tristated, and it is active only when the TAP controller is in the "Shift_DR" state or "Shift_IR" state. The least significant bit of the selected register (i.e. IR or DR) is clocked out to TDO first by the falling edge of TCK.

TAP Controller

The TAP Controller is compliant with the IEEE Standard 1149.1. It is a state machine of 16 states that controls the Instruction Register (IR) and the Data Registers (such as BSR, IDCODE, USRCODE, BYPASS, etc.). The TAP Controller steps into one of the states depending on the sequence of TMS at the rising edges of TCK.

Instruction Register (IR)

The IR has five bits (IR4 to IR0). At the TRST state, IR is reset to IDCODE. Each time when IR is selected, it goes through "select IR-Scan," "Capture-IR," "Shift-IR," all the way through "Update-IR." When there is no test error, the first five data bits coming out of TDO during the "Shift-IR" will be "10111". If a test error occurs, the last three bits will contain one to three zeroes corresponding to negatively asserted signals: "TDO_ERRORB," "PROBA_ERRORB," and "PROBB_ERRORB." The error(s) will be erased when the TAP is at the "Update-IR" or the TRST state. When in user mode start-up sequence, if the micro-probe has not been used, the "PROBA_ERRORB" is used as a "Power-up done successfully" flag.

Data Registers (DRs)

Data registers are distributed throughout the chip. They store testing/programming vectors. The MSB of a data register is connected to TDI, while the LSB is connected to TDO. There are different types of data registers. Descriptions of the main registers are as follow:

1. IDCODE:

   The IDCODE is a 20-bit hard coded JTAG Silicon Signature. It is a hardwired device ID code, which contains the Microsemi identity, part number, and version number in a specific JTAG format.

2. USERCODE:

   The USERCODE is a 33-bit programmable register. However, only 20 bits are allocated to use as JTAG Silicon Signature. It is a supplementary identity code for the user to program information to distinguish different programmed parts. USERCODE fuses will read out as "zeroes" when not programmed, so only the "1" bits need to be programmed.

3. Boundary-Scan Register (BSR):

   Each I/O contains three Boundary-Scan Cells. Each cell has a shift register bit, a latch, and two MUXes. The boundary-scan cells are used for the Output-enable (E), Output (O), and Input (I) registers. The bit order of the boundary-scan cells for each of them is E-O-I. The boundary-scan cells are then chained serially to form the Boundary-Scan Register (BSR). The length of the BSR is the number of I/Os in the die multiplied by three.

4. Bypass Register (BYR):

   This is the "1-bit" register. It is used to shorten the TDI-TDO serial chain in board-level testing to only one bit per device not being tested. It is also selected for all "reserved" or unused instructions.

Probing

Internal activities of the JTAG interface can be observed via the Silicon Explorer II probes: "PRA," "PRB," "PRC," and "PRD."

Special Fuses

Security

Microsemi antifuse FPGAs, with FuseLock technology, offer the highest level of design security available in a programmable logic device. Since antifuse FPGAs are live-at power-up, there is no bitstream that can be intercepted, and no bitstream or programming data is ever downloaded to the device during power-up, thus protecting against device cloning. In addition, special security fuses are hidden

FG256	
AX250 Function	**Pin Number**
VCCA	L9
VCCA	N3
VCCA	P14
VCCPLA	C7
VCCPLB	D6
VCCPLC	A10
VCCPLD	D10
VCCPLE	P10
VCCPLF	N11
VCCPLG	T7
VCCPLH	N7
VCCDA	A11
VCCDA	A2
VCCDA	C13
VCCDA	D9
VCCDA	H1
VCCDA	J15
VCCDA	N14
VCCDA	N8
VCCDA	P4
VCCDA	R11
VCCDA	R5
VCCIB0	E6
VCCIB0	E7
VCCIB0	E8
VCCIB1	E10
VCCIB1	E11
VCCIB1	E9
VCCIB2	F12
VCCIB2	G12
VCCIB2	H12
VCCIB3	J12
VCCIB3	K12
VCCIB3	L12
VCCIB4	M10

FG256	
AX250 Function	**Pin Number**
VCCIB4	M11
VCCIB4	M9
VCCIB5	M6
VCCIB5	M7
VCCIB5	M8
VCCIB6	J5
VCCIB6	K5
VCCIB6	L5
VCCIB7	F5
VCCIB7	G5
VCCIB7	H5
VCOMPLA	A7
VCOMPLB	D7
VCOMPLC	B9
VCOMPLD	D11
VCOMPLE	T10
VCOMPLF	N10
VCOMPLG	R8
VCOMPLH	N6
VPUMP	A14

FG324	
AX125 Function	**Pin Number**
VCCIB5	N7
VCCIB5	N8
VCCIB5	N9
VCCIB6	K6
VCCIB6	L6
VCCIB6	M6
VCCIB7	G6
VCCIB7	H6
VCCIB7	J6
VCOMPLA	B8
VCOMPLB	E8
VCOMPLC	C10
VCOMPLD	E12
VCOMPLE	U11
VCOMPLF	P11
VCOMPLG	T9
VCOMPLH	P7
VPUMP	B15

FG484	
AX1000 Function	Pin Number
Bank 0	
IO01NB0F0	E3
IO01PB0F0	D3
IO02NB0F0	E7
IO02PB0F0	E6
IO05NB0F0	D2
IO05PB0F0	E2
IO06NB0F0	C5
IO06PB0F0	C4
IO12NB0F1	D7
IO12PB0F1	D6
IO13NB0F1	B5
IO13PB0F1	B4
IO14NB0F1	E9
IO14PB0F1	E8
IO15NB0F1	C7
IO15PB0F1	C6
IO16NB0F1	A5
IO16PB0F1	A4
IO17NB0F1	B7
IO17PB0F1	B6
IO18NB0F1	A7
IO18PB0F1	A6
IO19NB0F1	C9
IO19PB0F1	C8
IO20NB0F1	D9
IO20PB0F1	D8
IO21NB0F1	B9
IO21PB0F1	B8
IO22NB0F2	A9
IO22PB0F2	A8
IO23NB0F2	B10
IO23PB0F2	A10
IO26NB0F2	A14
IO26PB0F2	A13

FG484	
AX1000 Function	Pin Number
IO29NB0F2	B12
IO29PB0F2	B11
IO30NB0F2/HCLKAN	E11
IO30PB0F2/HCLKAP	E10
IO31NB0F2/HCLKBN	D12
IO31PB0F2/HCLKBP	D11
Bank 1	
IO32NB1F3/HCLKCN	F13
IO32PB1F3/HCLKCP	F12
IO33NB1F3/HCLKDN	E14
IO33PB1F3/HCLKDP	E13
IO34NB1F3	C13
IO34PB1F3	C12
IO37NB1F3	B14
IO37PB1F3	B13
IO38NB1F3	A16
IO38PB1F3	A15
IO40NB1F3	C15
IO42NB1F4	A18
IO42PB1F4	A17
IO43NB1F4	B16
IO43PB1F4	B15
IO44NB1F4	B18
IO44PB1F4	B17
IO45NB1F4	B19
IO45PB1F4	A19
IO46NB1F4	C19
IO46PB1F4	C18
IO48NB1F4	F15
IO48PB1F4	F14
IO49NB1F4	D16
IO49PB1F4	D15
IO50NB1F4	C17
IO50PB1F4	C16
IO51NB1F4	E22

FG484	
AX1000 Function	Pin Number
IO51PB1F4	D22
IO52NB1F4	E16
IO52PB1F4	E15
IO57NB1F5	E21
IO57PB1F5	D21
IO60NB1F5	G16
IO60PB1F5	G15
IO61NB1F5	D18
IO61PB1F5	E17
IO63NB1F5	E20
IO63PB1F5	D20
Bank 2	
IO64NB2F6	F18
IO64PB2F6	F17
IO67NB2F6	F19
IO67PB2F6	E19
IO68NB2F6	J16
IO68PB2F6	H16
IO70NB2F6	J17
IO70PB2F6	H17
IO74NB2F7	J18
IO74PB2F7	H18
IO75NB2F7	G20
IO75PB2F7	F20
IO79NB2F7	H19
IO79PB2F7	G19
IO80NB2F7	L16
IO80PB2F7	K16
IO84NB2F7	L17
IO84PB2F7	K17
IO85NB2F8	G21
IO85PB2F8	F21
IO86NB2F8	G22
IO86PB2F8	F22
IO87NB2F8	J20

FG1152	
AX2000 Function	Pin Number
IO51PB1F4	J20
IO52NB1F4	B20
IO52PB1F4	A20
IO53NB1F4	F20
IO53PB1F4	E20
IO54NB1F5	B21
IO54PB1F5	A21
IO55NB1F5	K21
IO55PB1F5	J21
IO56NB1F5	D21
IO56PB1F5	C21
IO57NB1F5	G22
IO57PB1F5	G21
IO58NB1F5	E22
IO58PB1F5	E21
IO59NB1F5	D22
IO59PB1F5	C22
IO60NB1F5	B23
IO60PB1F5	A23
IO61NB1F5	H22
IO61PB1F5	H21
IO62NB1F5	C24
IO62PB1F5	C23
IO63NB1F5	F23
IO63PB1F5	F22
IO64NB1F6	B24
IO64PB1F6	A24
IO65NB1F6	J22
IO65PB1F6	K22
IO66NB1F6	B25
IO66PB1F6	A25
IO67NB1F6	K23
IO67PB1F6	J23
IO68NB1F6	F24
IO68PB1F6	E24

FG1152	
AX2000 Function	Pin Number
IO69NB1F6	C27
IO69PB1F6	C26
IO70NB1F6	H24
IO70PB1F6	G24
IO71NB1F6	H23
IO71PB1F6	G23
IO72NB1F6	B28
IO72PB1F6	A28
IO73NB1F6	E26
IO73PB1F6	E25
IO74NB1F6	F26
IO74PB1F6	F25
IO75NB1F6	K25
IO75PB1F6	K24
IO76NB1F7	D27
IO76PB1F7	D26
IO77NB1F7	B29
IO77PB1F7	A29
IO78NB1F7	D28
IO78PB1F7	C28
IO79NB1F7	H25
IO79PB1F7	G25
IO80NB1F7	F27
IO80PB1F7	E27
IO81NB1F7	J25
IO81PB1F7	J24
IO82NB1F7	D29
IO82PB1F7	C29
IO83NB1F7	H26
IO83PB1F7	G26
IO84NB1F7	F28
IO84PB1F7	E28
IO85NB1F7	H27
IO85PB1F7	G27
Bank 2	

FG1152	
AX2000 Function	Pin Number
IO86NB2F8	J28
IO86PB2F8	J27
IO87NB2F8	M25
IO87PB2F8	L25
IO88NB2F8	L26
IO88PB2F8	K26
IO89NB2F8	G31
IO89PB2F8	F31
IO90NB2F8	H29
IO90PB2F8	G29
IO91NB2F8	K28
IO91PB2F8	K27
IO92NB2F8	J30
IO92PB2F8	H30
IO93NB2F8	L28
IO93PB2F8	L27
IO94NB2F8	K29
IO94PB2F8	J29
IO95NB2F8	K31
IO95PB2F8	J31
IO96NB2F9	J32
IO96PB2F9	H32
IO97NB2F9	M27
IO97PB2F9	M26
IO98NB2F9	L30
IO98PB2F9	K30
IO99NB2F9	N25
IO99PB2F9	N26
IO100NB2F9	M29
IO100PB2F9	L29
IO101NB2F9	L33
IO101PB2F9	L32
IO102NB2F9	K34
IO102PB2F9	K33
IO103NB2F9	N28

FG1152	
AX2000 Function	Pin Number
IO155PB3F14	AC29
IO156NB3F14	AE30
IO156PB3F14	AD30
IO157NB3F14	AC26
IO157PB3F14	AB26
IO158NB3F14	AH33
IO158PB3F14	AG33
IO159NB3F14	AD27
IO159PB3F14	AC27
IO160NB3F14	AG32
IO160PB3F14	AF32
IO161NB3F15	AG31
IO161PB3F15	AF31
IO162NB3F15	AF29
IO162PB3F15	AE29
IO163NB3F15	AE28
IO163PB3F15	AD28
IO164NB3F15	AG30
IO164PB3F15	AF30
IO165NB3F15	AE26
IO165PB3F15	AD26
IO166NB3F15	AJ30
IO166PB3F15	AH30
IO167NB3F15	AG28
IO167PB3F15	AF28
IO168NB3F15	AF27
IO168PB3F15	AE27
IO169NB3F15	AH29
IO169PB3F15	AG29
IO170NB3F15	AD25
IO170PB3F15	AC25
Bank 4	
IO171NB4F16	AP29
IO171PB4F16	AN29
IO172NB4F16	AH26

FG1152	
AX2000 Function	Pin Number
IO172PB4F16	AH27
IO173NB4F16	AJ27
IO173PB4F16	AJ28
IO174NB4F16	AL27
IO174PB4F16	AL28
IO175NB4F16	AM28
IO175PB4F16	AM29
IO176NB4F16	AG25
IO176PB4F16	AG26
IO177NB4F16	AK26
IO177PB4F16	AK27
IO178NB4F16	AF25
IO178PB4F16	AE25
IO179NB4F16	AP28
IO179PB4F16	AN28
IO180NB4F16	AJ25
IO180PB4F16	AJ26
IO181NB4F17	AM26
IO181PB4F17	AM27
IO182NB4F17	AF24
IO182PB4F17	AE24
IO183NB4F17	AH24
IO183PB4F17	AH25
IO184NB4F17	AG23
IO184PB4F17	AG24
IO185NB4F17	AL25
IO185PB4F17	AL26
IO186NB4F17	AP25
IO186PB4F17	AP26
IO187NB4F17	AK24
IO187PB4F17	AK25
IO188NB4F17	AF23
IO188PB4F17	AE23
IO189NB4F17	AN24
IO189PB4F17	AM24

FG1152	
AX2000 Function	Pin Number
IO190NB4F17	AH22
IO190PB4F17	AH23
IO191NB4F17	AJ23
IO191PB4F17	AJ24
IO192NB4F17	AG21
IO192PB4F17	AG22
IO193NB4F18	AP23
IO193PB4F18	AP24
IO194NB4F18	AN22
IO194PB4F18	AN23
IO195NB4F18	AM23
IO195PB4F18	AL23
IO196NB4F18	AF21
IO196PB4F18	AF22
IO197NB4F18	AL22
IO197PB4F18	AM22
IO198NB4F18	AE21
IO198PB4F18	AE22
IO199NB4F18	AJ21
IO199PB4F18	AJ22
IO200NB4F18	AK21
IO200PB4F18	AK22
IO201NB4F18	AM21
IO201PB4F18	AL21
IO202NB4F18	AE20
IO202PB4F18	AD20
IO203NB4F19	AN21
IO203PB4F19	AP21
IO204NB4F19	AP20
IO204PB4F19	AN20
IO205NB4F19	AN19
IO205PB4F19	AP19
IO206NB4F19	AG20
IO206PB4F19	AF20
IO207NB4F19	AL19

CQ352	
AX500 Function	Pin Number
VCCDA	346
VCCIB0	321
VCCIB0	333
VCCIB0	344
VCCIB1	273
VCCIB1	285
VCCIB1	297
VCCIB2	227
VCCIB2	239
VCCIB2	245
VCCIB2	257
VCCIB3	185
VCCIB3	197
VCCIB3	203
VCCIB3	215
VCCIB4	144
VCCIB4	156
VCCIB4	168
VCCIB5	96
VCCIB5	108
VCCIB5	120
VCCIB6	50
VCCIB6	62
VCCIB6	68
VCCIB6	80
VCCIB7	8
VCCIB7	20
VCCIB7	26
VCCIB7	38
VCCPLA	317
VCCPLB	315
VCCPLC	303
VCCPLD	301
VCCPLE	140
VCCPLF	138

CQ352	
AX500 Function	Pin Number
VCCPLG	126
VCCPLH	124
VCOMPLA	318
VCOMPLB	316
VCOMPLC	304
VCOMPLD	302
VCOMPLE	141
VCOMPLF	139
VCOMPLG	127
VCOMPLH	125
VPUMP	267

CG624	
AX1000 Function	Pin Number
IO194NB6F18	Y3
IO194PB6F18	AA3
IO195NB6F18	V6
IO195PB6F18	W4
IO197NB6F18	R5
IO197PB6F18	U3
IO198NB6F18	P6
IO199NB6F18	Y5
IO199PB6F18	W5
IO200NB6F18	V3
IO200PB6F18	W3
IO201NB6F18	T7
IO201PB6F18	U7
IO202NB6F18	V2
IO203NB6F19	W2
IO203PB6F19	Y2
IO204NB6F19	AA1
IO204PB6F19	AB1
IO205NB6F19	R6
IO205PB6F19	T6
IO206NB6F19	W1
IO206PB6F19	Y1
IO207NB6F19	T2
IO207PB6F19	U2
IO208NB6F19	T1
IO208PB6F19	U1
IO209NB6F19	AA2
IO209PB6F19	AB2
IO210NB6F19	P5
IO211NB6F19	M1
IO211PB6F19	N1
IO212NB6F19	P1
IO212PB6F19	R1
IO213NB6F19	R8
IO213PB6F19	T8
IO215NB6F20	U4

CG624	
AX1000 Function	Pin Number
IO215PB6F20	V4
IO216NB6F20	P8
IO216PB6F20	R3
IO217NB6F20	P7
IO217PB6F20	R7
IO219NB6F20	R4
IO219PB6F20	T4
IO220NB6F20	P2
IO220PB6F20	R2
IO221NB6F20	N4
IO221PB6F20	P4
IO223NB6F20	M2
IO223PB6F20	N2
IO224NB6F20	N3
IO224PB6F20	P3
Bank 7	
IO225NB7F21	J2
IO225PB7F21	J1
IO226PB7F21	G2
IO227NB7F21	H3
IO227PB7F21	H2
IO229NB7F21	K2
IO229PB7F21	L2
IO230NB7F21	K1
IO230PB7F21	L1
IO231NB7F21	E2
IO231PB7F21	F2
IO232NB7F21	F1
IO232PB7F21	G1
IO233NB7F21	L3
IO233PB7F21	M3
IO234NB7F21	D1
IO234PB7F21	E1
IO235NB7F21	K4
IO235PB7F21	L4
IO236NB7F22	M6

CG624	
AX1000 Function	Pin Number
IO237NB7F22	N8
IO237PB7F22	N7
IO238NB7F22	M5
IO239NB7F22	L6
IO239PB7F22	L5
IO240NB7F22	M4
IO241NB7F22	L7
IO241PB7F22	M7
IO242NB7F22	J3
IO243NB7F22	M9
IO243PB7F22	M8
IO244NB7F22	P9
IO244PB7F22	N6
IO245NB7F22	K8
IO245PB7F22	L8
IO246NB7F22	F3
IO246PB7F22	E3
IO247NB7F23	K7
IO247PB7F23	K6
IO248NB7F23	D2
IO249NB7F23	G4
IO249PB7F23	G3
IO251NB7F23	N10
IO251PB7F23	N9
IO253NB7F23	H4
IO253PB7F23	J4
IO255NB7F23	J6
IO255PB7F23	J5
IO257NB7F23	H5
IO257PB7F23	H6
Dedicated I/O	
GND	K5
GND	A18
GND	A2
GND	A24
GND	A25