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	-
Number of Logic Elements/Cells	-
Total RAM Bits	-
Number of I/O	69
Number of Gates	6000
Voltage - Supply	3V ~ 3.6V, 4.5V ~ 5.5V
Mounting Type	Surface Mount
Operating Temperature	-55°C ~ 125°C (TC)
Package / Case	84-LCC (J-Lead)
Supplier Device Package	84-PLCC (29.31x29.31)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/a40mx04-plg84m

2 40MX and 42MX FPGA Families

2.1 Features

The following sections list out various features of the 40MX and 42MX FPGA family devices.

2.1.1 High Capacity

- Single-Chip ASIC Alternative
- 3,000 to 54,000 System Gates
- Up to 2.5 kbits Configurable Dual-Port SRAM
- Fast Wide-Decode Circuitry
- Up to 202 User-Programmable I/O Pins

2.1.2 High Performance

- 5.6 ns Clock-to-Out
- 250 MHz Performance
- 5 ns Dual-Port SRAM Access
- 100 MHz FIFOs
- 7.5 ns 35-Bit Address Decode

2.1.3 HiRel Features

- Commercial, Industrial, Automotive, and Military Temperature Plastic Packages
- Commercial, Military Temperature, and MIL-STD-883 Ceramic Packages
- QML Certification
- Ceramic Devices Available to DSCC SMD

2.1.4 Ease of Integration

- Mixed-Voltage Operation (5.0 V or 3.3 V for core and I/Os), with PCI-Compliant I/Os
- Up to 100% Resource Utilization and 100% Pin Locking
- Deterministic, User-Controllable Timing
- Unique In-System Diagnostic and Verification Capability with Silicon Explorer II
- Low Power Consumption
- IEEE Standard 1149.1 (JTAG) Boundary Scan Testing

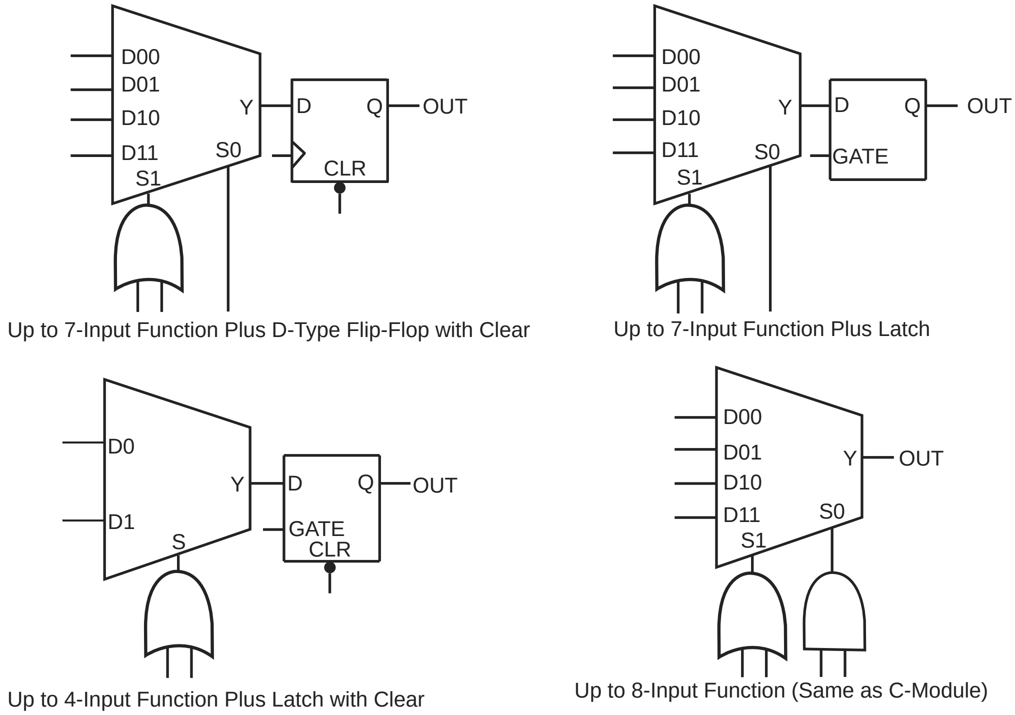
2.2 Product Profile

The following table gives the features of the products.

Table 1 • **Product profile**

Device	**A40MX02**	**A40MX04**	**A42MX09**	**A42MX16**	**A42MX24**	**A42MX36**
Capacity						
System Gates	3,000	6,000	14,000	24,000	36,000	54,000
SRAM Bits	–	–	–	–	–	2,560
Logic Modules						
Sequential	–	–	348	624	954	1,230
Combinatorial	295	547	336	608	912	1,184
Decode	–	–	–	–	24	24
Clock-to-Out	9.5 ns	9.5 ns	5.6 ns	6.1 ns	6.1 ns	6.3 ns
SRAM Modules (64x4 or 32x8)	–	–	–	–	–	10
Dedicated Flip-Flops	–	–	348	624	954	1,230

Figure 4 • **42MX S-Module Implementation**



A42MX24 and A42MX36 devices contain D-modules, which are arranged around the periphery of the device. D-modules contain wide-decode circuitry, providing a fast, wide-input AND function similar to that found in CPLD architectures (Figure 5, page 9). The D-module allows A42MX24 and A42MX36 devices to perform wide-decode functions at speeds comparable to CPLDs and PALs. The output of the D-module has a programmable inverter for active HIGH or LOW assertion. The D-module output is hardwired to an output pin, and can also be fed back into the array to be incorporated into other logic.

3.2.2 Dual-Port SRAM Modules

The A42MX36 device contains dual-port SRAM modules that have been optimized for synchronous or asynchronous applications. The SRAM modules are arranged in 256-bit blocks that can be configured as 32x8 or 64x4. SRAM modules can be cascaded together to form memory spaces of user-definable width and depth. A block diagram of the A42MX36 dual-port SRAM block is shown in Figure 6, page 9.

The A42MX36 SRAM modules are true dual-port structures containing independent read and write ports. Each SRAM module contains six bits of read and write addressing (RDAD[5:0] and WRAD[5:0], respectively) for 64x4-bit blocks. When configured in byte mode, the highest order address bits (RDAD5 and WRAD5) are not used. The read and write ports of the SRAM block contain independent clocks (RCLK and WCLK) with programmable polarities offering active HIGH or LOW implementation. The SRAM block contains eight data inputs (WD[7:0]), and eight outputs (RD[7:0]), which are connected to segmented vertical routing tracks.

The A42MX36 dual-port SRAM blocks provide an optimal solution for high-speed buffered applications requiring FIFO and LIFO queues. The ACTgen Macro Builder within Microsemi's designer software provides capability to quickly design memory functions with the SRAM blocks. Unused SRAM blocks can be used to implement registers for other user logic within the design.

Silicon Sculptor programs devices independently to achieve the fastest programming times possible. After being programmed, each fuse is verified to insure that it has been programmed correctly. Furthermore, at the end of programming, there are integrity tests that are run to ensure no extra fuses have been programmed. Not only does it test fuses (both programmed and non-programmed), Silicon Sculptor also allows self-test to verify its own hardware extensively.

The procedure for programming an MX device using Silicon Sculptor is as follows:

1. Load the *.AFM file
2. Select the device to be programmed
3. Begin programming

When the design is ready to go to production, Microsemi offers device volume-programming services either through distribution partners or via In-House Programming from the factory.

For more details on programming MX devices, see the *AC225: Programming Antifuse Devices* application note and the *Silicon Sculptor 3 Programmers User Guide*.

3.3.4 Power Supply

MX devices are designed to operate in both 5.0V and 3.3V environments. In particular, 42MX devices can operate in mixed 5.0 V/3.3 V systems. The following table describes the voltage support of MX devices.

Table 6 • **Voltage Support of MX Devices**

Device	VCC	VCCA	VCCI	Maximum Input Tolerance	Nominal Output Voltage
40MX	5.0 V	–	–	5.5 V	5.0 V
	3.3 V	–	–	3.6 V	3.3 V
42MX	–	5.0 V	5.0 V	5.5 V	5.0 V
	–	3.3 V	3.3 V	3.6 V	3.3 V
	–	5.0 V	3.3 V	5.5 V	3.3 V

For A42MX24 and A42MX36 devices the VCCA supply has to be monotonic during power up in order for the POR to issue reset to the JTAG state machine correctly. For more information, see the *AC291: 42MX Family Devices Power-Up Behavior*.

3.3.5 Power-Up/Down in Mixed-Voltage Mode

When powering up 42MX in mixed voltage mode (VCCA = 5.0 V and VCCI = 3.3 V), VCCA must be greater than or equal to VCCI throughout the power-up sequence. If VCCI exceeds VCCA during power-up, one of two things will happen:

- The input protection diode on the I/Os will be forward biased
- The I/Os will be at logical High

In either case, ICC rises to high levels. For power-down, any sequence with VCCA and VCCI can be implemented.

3.3.6 Transient Current

Due to the simultaneous random logic switching activity during power-up, a transient current may appear on the core supply (VCC). Customers must use a regulator for the VCC supply that can source a minimum of 100 mA for transient current during power-up. Failure to provide enough power can prevent the system from powering up properly and result in functional failure. However, there are no reliability concerns, since transient current is distributed across the die instead of confined to a localized spot.

Since the transient current is not due to I/O switching, its value and duration are independent of the VCCI.

3.4.9 JTAG Mode Activation

The JTAG test logic circuit is activated in the Designer software by selecting **Tools > Device Selection**. This brings up the Device Selection dialog box as shown in the following figure. The JTAG test logic circuit can be enabled by clicking the “Reserve JTAG Pins” check box. The following table explains the pins' behavior in either mode.

Figure 15 • **Device Selection Wizard**

Table 11 • **Boundary Scan Pin Configuration and Functionality**

Reserve JTAG	**Checked**	**Unchecked**
TCK	BST input; must be terminated to logical HIGH or LOW to avoid floating	User I/O
TDI, TMS	BST input; may float or be tied to HIGH	User I/O
TDO	BST output; may float or be connected to TDI of another device	User I/O

3.4.10 TRST Pin and TAP Controller Reset

An active reset (TRST) pin is not supported; however, MX devices contain power-on circuitry that resets the boundary scan circuitry upon power-up. Also, the TMS pin is equipped with an internal pull-up resistor. This allows the TAP controller to remain in or return to the Test-Logic-Reset state when there is no input or when a logical 1 is on the TMS pin. To reset the controller, TMS must be HIGH for at least five TCK cycles.

3.4.11 Boundary Scan Description Language (BSDL) File

Conforming to the IEEE Standard 1149.1 requires that the operation of the various JTAG components be documented. The BSDL file provides the standard format to describe the JTAG components that can be used by automatic test equipment software. The file includes the instructions that are supported, instruction bit pattern, and the boundary-scan chain order. For an in-depth discussion on BSDL files, see the *BSDL Files Format Description* application note.

BSDL files are grouped into two categories - generic and device-specific. The generic files assign all user I/Os as inouts. Device-specific files assign user I/Os as inputs, outputs or inouts.

Generic files for MX devices are available on the Microsemi SoC Product Group's website:

http://www.microsemi.com/soc/techdocs/models/bsdl.html.

3.5 Development Tool Support

The MX family of FPGAs is fully supported by Libero® Integrated Design Environment (IDE). Libero IDE is a design management environment, seamlessly integrating design tools while guiding the user through the design flow, managing all design and log files, and passing necessary design data among tools. Libero IDE allows users to integrate both schematic and HDL synthesis into a single flow and verify the entire design in a single environment. Libero IDE includes SynplifyPro from Synopsys, ModelSim® HDL Simulator from Mentor Graphics® and Viewdraw.

Libero IDE includes place-and-route and provides a comprehensive suite of backend support tools for FPGA development, including timing-driven place-and-route, and a world-class integrated static timing analyzer and constraints editor.

Note: *Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. Exposure to absolute maximum rated conditions for extended periods may affect device reliability. Devices should not be operated outside the recommended operating conditions.

Table 14 • **Recommended Operating Conditions**

Parameter	Commercial	Industrial	Military	Units
Temperature Range*	0 to +70	–40 to +85	–55 to +125	°C
VCC (40MX)	4.75 to 5.25	4.5 to 5.5	4.5 to 5.5	V
VCCA (42MX)	4.75 to 5.25	4.5 to 5.5	4.5 to 5.5	V
VCCI (42MX)	4.75 to 5.25	4.5 to 5.5	4.5 to 5.5	V

Note: * Ambient temperature (T_A) is used for commercial and industrial grades; case temperature (T_C) is used for military grades.

3.7.1 5 V TTL Electrical Specifications

The following tables show 5 V TTL electrical specifications.

Table 15 • **5V TTL Electrical Specifications**

		Commercial		**Commercial -F**		**Industrial**		**Military**		
Symbol	**Parameter**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
VOH[1]	IOH = –10 mA	2.4		2.4						V
	IOH = –4 mA					3.7		3.7		V
VOL[1]	IOL = 10 mA		0.5		0.5					V
	IOL = 6 mA						0.4		0.4	V
VIL		–0.3	0.8	–0.3	0.8	–0.3	0.8	–0.3	0.8	V
VIH (40MX)		2.0	VCC + 0.3	2.0	VCC + 0.3	2.0	VCC + 0.3	2.0	VCC + 0.3	V
VIH (42MX)[2]		2.0	VCCI + 0.3	2.0	VCCI + 0.3	2.0	VCCI + 0.3	2.0	VCCI + 0.3	V
IIL	VIN = 0.5 V		–10		–10		–10		–10	µA
IIH	VIN = 2.7 V		–10		–10		–10		–10	µA
Input Transition Time, T_R and T_F			500		500		500		500	ns
C_{IO} I/O Capacitance			10		10		10		10	pF
Standby Current, ICC[3]	A40MX02, A40MX04		3		25		10		25	mA
	A42MX09		5		25		25		25	mA
	A42MX16		6		25		25		25	mA
	A42MX24, A42MX36		20		25		25		25	mA
Low power mode Standby Current	42MX devices only		0.5		ICC – 5.0		ICC – 5.0		ICC – 5.0	mA
IIO, I/O source sink current	Can be derived from the *IBIS model* (http://www.microsemi.com/soc/techdocs/models/ibis.html)									

1. Only one output tested at a time. VCC/VCCI = min
2. VIH(Min) is 2.4V for A42MX36 family. This applies only to VCCI of 5V and is not applicable to VCCI of 3.3V

reliability. Devices should not be operated outside the recommended operating conditions.

Table 21 • **Recommended Operating Conditions**

Parameter	Commercial	Industrial	Military	Units
Temperature Range*	0 to +70	–40 to +85	–55 to +125	°C
VCCA	4.75 to 5.25	4.5 to 5.5	4.5 to 5.5	V
VCCI	3.14 to 3.47	3.0 to 3.6	3.0 to 3.6	V

Note: *Ambient temperature (T_A) is used for commercial and industrial grades; case temperature (T_C) is used for military grades.

3.9.3 Output Drive Characteristics for 3.3 V PCI Signaling

Table 25 • **DC Specification (3.3 V PCI Signaling)**[1]

			PCI		MX		
Symbol	**Parameter**	**Condition**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
VCCI	Supply Voltage for I/Os		3.0	3.6	3.0	3.6[2]	V
VIH	Input High Voltage		0.5	VCC + 0.5	0.5	VCCI + 0.3	V
VIL	Input Low Voltage		–0.5	0.8	–0.3	0.8	V
IIH	Input High Leakage Current	VIN = 2.7 V		70		10	µA
IIL	Input Leakage Current			–70		–10	µA
VOH	Output High Voltage	IOUT = –2 mA	0.9		3.3		V
VOL	Output Low Voltage	IOUT = 3 mA, 6 mA		0.1		0.1 VCCI	V
C_{IN}	Input Pin Capacitance			10		10	pF
C_{CLK}	CLK Pin Capacitance		5	12		10	pF
L_{PIN}	Pin Inductance			20		< 8 nH[3]	nH

1. PCI Local Bus Specification, Version 2.1, Section 4.2.2.1.
2. Maximum rating for VCCI –0.5 V to 7.0V.
3. Dependent upon the chosen package. PCI recommends QFP and BGA packaging to reduce pin inductance and capacitance.

Table 26 • **AC Specifications for (3.3 V PCI Signaling)***

			PCI		MX		
Symbol	**Parameter**	**Condition**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
ICL	Low Clamp Current	–5 < VIN ≤ –1	–25 + (VIN +1) /0.015		–60	–10	mA
Slew (r)	Output Rise Slew Rate	0.2 V to 0.6 V load	1	4	1.8	2.8	V/ns
Slew (f)	Output Fall Slew Rate	0.6 V to 0.2 V load	1	4	2.8	4.0	V/ns

Note: *PCI Local Bus Specification, Version 2.1, Section 4.2.2.2.

Table 39 • A42MX09 Timing Characteristics (Nominal 3.3 V Operation) *(continued)*(Worst-Case Commercial Conditions, VCCA = 3.0 V, T_J = 70°C)

Parameter / Description		–3 Speed		–2 Speed		–1 Speed		Std Speed		–F Speed		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units
CMOS Output Module Timing[5]												
t_{DLH}	Data-to-Pad HIGH		3.4		3.8		5.5		6.4		9.0	ns
t_{DHL}	Data-to-Pad LOW		4.1		4.5		4.2		5.0		7.0	ns
t_{ENZH}	Enable Pad Z to HIGH		3.7		4.1		4.6		5.5		7.6	ns
t_{ENZL}	Enable Pad Z to LOW		4.1		4.5		5.1		6.1		8.5	ns
t_{ENHZ}	Enable Pad HIGH to Z		6.9		7.6		8.6		10.2		14.2	ns
t_{ENLZ}	Enable Pad LOW to Z		7.5		8.3		9.4		11.1		15.5	ns
t_{GLH}	G-to-Pad HIGH		5.8		6.5		7.3		8.6		12.0	ns
t_{GHL}	G-to-Pad LOW		5.8		6.5		7.3		8.6		12.0	ns
t_{LSU}	I/O Latch Set-Up	0.7		0.8		0.9		1.0		1.4		ns
t_{LH}	I/O Latch Hold	0.0		0.0		0.0		0.0		0.0		ns
t_{LCO}	I/O Latch Clock-to-Out (Pad-to-Pad), 64 Clock Loading		8.7		9.7		10.9		12.9		18.0	ns
t_{ACO}	Array Clock-to-Out (Pad-to-Pad), 64 Clock Loading		12.2		13.5		15.4		18.1		25.3	ns
d_{TLH}	Capacity Loading, LOW to HIGH		0.04		0.04		0.05		0.06		0.08	ns/pF
d_{THL}	Capacity Loading, HIGH to LOW		0.05		0.05		0.06		0.07		0.10	ns/pF

1. *For dual-module macros, use $t_{PD1} + t_{RD1} + t_{PDn}$, $t_{CO} + t_{RD1} + t_{PDn}$, or $t_{PD1} + t_{RD1} + t_{SUD}$, whichever is appropriate.*
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 performance.*
3. *Data applies to macros based on the S-module. Timing parameters for sequential macros constructed from C-modules can be obtained from the Timer utility.*
4. *Set-up and hold timing parameters for the input buffer latch are defined with respect to the PAD and the D input. External setup/hold timing parameters must account for delay from an external PAD signal to the G inputs. Delay from an external PAD signal to the G input subtracts (adds) to the internal setup (hold) time.*
5. *Delays based on 35 pF loading.*

Table 40 • A42MX16 Timing Characteristics (Nominal 5.0 V Operation) (Worst-Case Commercial Conditions, VCCA = 4.75 V, T_J = 70°C)

Parameter / Description		–3 Speed		–2 Speed		–1 Speed		Std Speed		–F Speed		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units
Logic Module Propagation Delays[1]												
t_{PD1}	Single Module		1.4		1.5		1.7		2.0		2.8	ns
t_{CO}	Sequential Clock-to-Q		1.4		1.6		1.8		2.1		3.0	ns
t_{GO}	Latch G-to-Q		1.4		1.5		1.7		2.0		2.8	ns
t_{RS}	Flip-Flop (Latch) Reset-to-Q		1.6		1.7		2.0		2.3		3.3	ns
Logic Module Predicted Routing Delays[2]												
t_{RD1}	FO = 1 Routing Delay		0.8		0.9		1.0		1.2		1.6	ns
t_{RD2}	FO = 2 Routing Delay		1.0		1.2		1.3		1.5		2.1	ns

Table 43 • A42MX24 Timing Characteristics (Nominal 3.3 V Operation) *(continued)*(Worst-Case Commercial Conditions, VCCA = 3.0 V, T_J = 70°C)

Parameter / Description		–3 Speed		–2 Speed		–1 Speed		Std Speed		–F Speed		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units
Logic Module Sequential Timing[3, 4]												
t_{CO}	Flip-Flop Clock-to-Output		2.1		2.0		2.3		2.7		3.7	ns
t_{GO}	Latch Gate-to-Output		3.4		1.9		2.1		2.5		3.4	ns
t_{SUD}	Flip-Flop (Latch) Set-Up Time	0.4		0.5		0.6		0.7		0.9		ns
t_{HD}	Flip-Flop (Latch) Hold Time	0.0		0.0		0.0		0.0		0.0		ns
t_{RO}	Flip-Flop (Latch) Reset-to-Output		2.0		2.2		2.5		2.9		4.1	ns
t_{SUENA}	Flip-Flop (Latch) Enable Set-Up	0.6		0.6		0.7		0.8		1.2		ns
t_{HENA}	Flip-Flop (Latch) Enable Hold	0.0		0.0		0.0		0.0		0.0		ns
t_{WCLKA}	Flip-Flop (Latch) Clock Active Pulse Width	4.6		5.2		5.8		6.9		9.6		ns
t_{WASYN}	Flip-Flop (Latch) Asynchronous Pulse Width	6.1		6.8		7.7		9.0		12.6		ns
Input Module Propagation Delays												
t_{INPY}	Input Data Pad-to-Y		1.4		1.6		1.8		2.2		3.0	ns
t_{INGO}	Input Latch Gate-to-Output		1.8		1.9		2.2		2.6		3.6	ns
t_{INH}	Input Latch Hold	0.0		0.0		0.0		0.0		0.0		ns
t_{INSU}	Input Latch Set-Up	0.7		0.7		0.8		1.0		1.4		ns
t_{ILA}	Latch Active Pulse Width	6.5		7.3		8.2		9.7		13.5		ns

Table 44 • **A42MX36 Timing Characteristics (Nominal 5.0 V Operation)(Worst-Case Commercial Conditions, VCCA = 4.75 V, T_J = 70°C)**

			–3 Speed		–2 Speed		–1 Speed		Std Speed		–F Speed		
Parameter / Description			**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Units**
Asynchronous SRAM Operations													
t_{RPD}	Asynchronous Access Time			8.1		9.0		10.2		12.0		16.8	ns
t_{RDADV}	Read Address Valid		8.8		9.8		11.1		13.0		18.2		ns
t_{ADSU}	Address/Data Set-Up Time		1.6		1.8		2.0		2.4		3.4		ns
t_{ADH}	Address/Data Hold Time		0.0		0.0		0.0		0.0		0.0		ns
t_{RENSUA}	Read Enable Set-Up to Address Valid		0.6		0.7		0.8		0.9		1.3		ns
t_{RENHA}	Read Enable Hold		3.4		3.8		4.3		5.0		7.0		ns
t_{WENSU}	Write Enable Set-Up		2.7		3.0		3.4		4.0		5.6		ns
t_{WENH}	Write Enable Hold		0.0		0.0		0.0		0.0		0.0		ns
t_{DOH}	Data Out Hold Time			1.2		1.3		1.5		1.8		2.5	ns
Input Module Propagation Delays													
t_{INPY}	Input Data Pad-to-Y			1.0		1.1		1.3		1.5		2.1	ns
t_{INGO}	Input Latch Gate-to-Output			1.4		1.6		1.8		2.1		2.9	ns
t_{INH}	Input Latch Hold		0.0		0.0		0.0		0.0		0.0		ns
t_{INSU}	Input Latch Set-Up		0.5		0.5		0.6		0.7		1.0		ns
t_{ILA}	Latch Active Pulse Width		4.7		5.2		5.9		6.9		9.7		ns
Input Module Predicted Routing Delays[2]													
t_{IRD1}	FO = 1 Routing Delay			2.0		2.2		2.5		2.9		4.1	ns
t_{IRD2}	FO = 2 Routing Delay			2.3		2.6		2.9		3.4		4.8	ns
t_{IRD3}	FO = 3 Routing Delay			2.6		2.9		3.3		3.9		5.5	ns
t_{IRD4}	FO = 4 Routing Delay			3.0		3.3		3.8		4.4		6.2	ns
t_{IRD8}	FO = 8 Routing Delay			4.3		4.8		5.5		6.4		9.0	ns
Global Clock Network													
t_{CKH}	Input LOW to HIGH	FO = 32 FO = 635		2.7 3.0		3.0 3.3		3.4 3.8		4.0 4.4		5.6 6.2	ns ns
t_{CKL}	Input HIGH to LOW	FO = 32 FO = 635		3.8 4.9		4.2 5.4		4.8 6.1		5.6 7.2		7.8 10.1	ns ns
t_{PWH}	Minimum Pulse Width HIGH	FO = 32 FO = 635	1.8 2.0		2.0 2.2		2.2 2.5		2.6 2.9		3.6 4.1		ns ns
t_{PWL}	Minimum Pulse Width LOW	FO = 32 FO = 635	1.8 2.0		2.0 2.2		2.2 2.5		2.6 2.9		3.6 4.1		ns ns
t_{CKSW}	Maximum Skew	FO = 32 FO = 635		0.8 0.8		0.8 0.8		0.9 0.9		1.0 1.0		1.4 1.4	ns ns

Clock signal to shift the Boundary Scan Test (BST) data into the device. This pin functions as an I/O when "Reserve JTAG" is not checked in the Designer Software. BST pins are only available in A42MX24 and A42MX36 devices.

TDI, I/OTest Data In

Serial data input for BST instructions and data. Data is shifted in on the rising edge of TCK. This pin functions as an I/O when "Reserve JTAG" is not checked in the Designer Software. BST pins are only available in A42MX24 and A42MX36 devices.

TDO, I/OTest Data Out

Serial data output for BST instructions and test data. This pin functions as an I/O when "Reserve JTAG" is not checked in the Designer Software. BST pins are only available in A42MX24 and A42MX36 devices.

TMS, I/OTest Mode Select

The TMS pin controls the use of the IEEE 1149.1 Boundary Scan pins (TCK, TDI, TDO). In flexible mode when the TMS pin is set LOW, the TCK, TDI and TDO pins are boundary scan pins. Once the boundary scan pins are in test mode, they will remain in that mode until the internal boundary scan state machine reaches the "logic reset" state. At this point, the boundary scan pins will be released and will function as regular I/O pins. The "logic reset" state is reached 5 TCK cycles after the TMS pin is set HIGH. In dedicated test mode, TMS functions as specified in the IEEE 1149.1 specifications. IEEE JTAG specification recommends a 10kΩ pull-up resistor on the pin. BST pins are only available in A42MX24 and A42MX36 devices.

VCC, Supply Voltage

Input supply voltage for 40MX devices

VCCA, Supply Voltage

Supply voltage for array in 42MX devices

VCCI, Supply Voltage

Supply voltage for I/Os in 42MX devices

WD, I/OWide Decode Output

When a wide decode module is used in a 42MX device this pin can be used as a dedicated output from the wide decode module. This direct connection eliminates additional interconnect delays associated with regular logic modules. To implement the direct I/O connection, connect an output buffer of any type to the output of the wide decode macro and place this output on one of the reserved WD pins.

Figure 39 • **PL68**

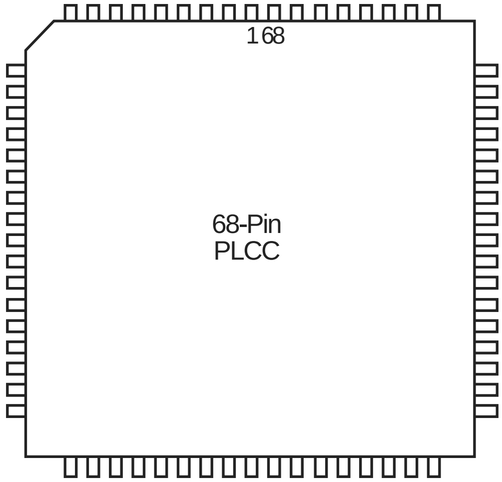


Table 48 • **PL68**

PL68		
Pin Number	**A40MX02 Function**	**A40MX04 Function**
1	I/O	I/O
2	I/O	I/O
3	I/O	I/O
4	VCC	VCC
5	I/O	I/O
6	I/O	I/O
7	I/O	I/O
8	I/O	I/O
9	I/O	I/O
10	I/O	I/O
11	I/O	I/O
12	I/O	I/O
13	I/O	I/O
14	GND	GND
15	GND	GND
16	I/O	I/O
17	I/O	I/O
18	I/O	I/O
19	I/O	I/O
20	I/O	I/O
21	VCC	VCC
22	I/O	I/O
23	I/O	I/O

Table 49 • **PL84**

PL84				
Pin Number	**A40MX04 Function**	**A42MX09 Function**	**A42MX16 Function**	**A42MX24 Function**
47	I/O	I/O	I/O	WD, I/O
48	I/O	I/O	I/O	I/O
49	I/O	GND	GND	GND
50	I/O	I/O	I/O	WD, I/O
51	I/O	I/O	I/O	WD, I/O
52	I/O	SDO, I/O	SDO, I/O	SDO, TDO, I/O
53	I/O	I/O	I/O	I/O
54	I/O	I/O	I/O	I/O
55	I/O	I/O	I/O	I/O
56	I/O	I/O	I/O	I/O
57	I/O	I/O	I/O	I/O
58	I/O	I/O	I/O	I/O
59	I/O	I/O	I/O	I/O
60	GND	I/O	I/O	I/O
61	GND	I/O	I/O	I/O
62	I/O	I/O	I/O	TCK, I/O
63	I/O	LP	LP	LP
64	CLK, I/O	VCCA	VCCA	VCCA
65	I/O	VCCI	VCCI	VCCI
66	MODE	I/O	I/O	I/O
67	VCC	I/O	I/O	I/O
68	VCC	I/O	I/O	I/O
69	I/O	I/O	I/O	I/O
70	I/O	GND	GND	GND
71	I/O	I/O	I/O	I/O
72	SDI, I/O	I/O	I/O	I/O
73	DCLK, I/O	I/O	I/O	I/O
74	PRA, I/O	I/O	I/O	I/O
75	PRB, I/O	I/O	I/O	I/O
76	I/O	SDI, I/O	SDI, I/O	SDI, I/O
77	I/O	I/O	I/O	I/O
78	I/O	I/O	I/O	WD, I/O
79	I/O	I/O	I/O	WD, I/O
80	I/O	I/O	I/O	WD, I/O
81	I/O	PRA, I/O	PRA, I/O	PRA, I/O
82	GND	I/O	I/O	I/O
83	I/O	CLKA, I/O	CLKA, I/O	CLKA, I/O

Table 51 • **PQ144**

PQ144	
Pin Number	**A42MX09 Function**
117	GNDI
118	NC
119	I/O
120	I/O
121	I/O
122	I/O
123	PROBA
124	I/O
125	CLKA
126	VCC
127	VCCI
128	NC
129	I/O
130	CLKB
131	I/O
132	PROBB
133	I/O
134	I/O
135	I/O
136	GND
137	GNDI
138	NC
139	I/O
140	I/O
141	I/O
142	I/O
143	I/O
144	DCLK

Table 52 • **PQ160**

PQ160			
Pin Number	**A42MX09 Function**	**A42MX16 Function**	**A42MX24 Function**
21	CLKA, I/O	CLKA, I/O	CLKA, I/O
22	I/O	I/O	I/O
23	PRA, I/O	PRA, I/O	PRA, I/O
24	NC	I/O	WD, I/O
25	I/O	I/O	WD, I/O
26	I/O	I/O	I/O
27	I/O	I/O	I/O
28	NC	I/O	I/O
29	I/O	I/O	WD, I/O
30	GND	GND	GND
31	NC	I/O	WD, I/O
32	I/O	I/O	I/O
33	I/O	I/O	I/O
34	I/O	I/O	I/O
35	NC	VCCI	VCCI
36	I/O	I/O	WD, I/O
37	I/O	I/O	WD, I/O
38	SDI, I/O	SDI, I/O	SDI, I/O
39	I/O	I/O	I/O
40	GND	GND	GND
41	I/O	I/O	I/O
42	I/O	I/O	I/O
43	I/O	I/O	I/O
44	GND	GND	GND
45	I/O	I/O	I/O
46	I/O	I/O	I/O
47	I/O	I/O	I/O
48	I/O	I/O	I/O
49	GND	GND	GND
50	I/O	I/O	I/O
51	I/O	I/O	I/O
52	NC	I/O	I/O
53	I/O	I/O	I/O
54	NC	VCCA	VCCA
55	I/O	I/O	I/O
56	I/O	I/O	I/O
57	VCCA	VCCA	VCCA

Table 56 • **VQ100**

VQ100		
Pin Number	**A42MX09 Function**	**A42MX16 Function**
21	I/O	I/O
22	I/O	I/O
23	I/O	I/O
24	I/O	I/O
25	I/O	I/O
26	I/O	I/O
27	I/O	I/O
28	I/O	I/O
29	I/O	I/O
30	I/O	I/O
31	I/O	I/O
32	GND	GND
33	I/O	I/O
34	I/O	I/O
35	I/O	I/O
36	I/O	I/O
37	I/O	I/O
38	VCCA	VCCA
39	I/O	I/O
40	I/O	I/O
41	I/O	I/O
42	I/O	I/O
43	I/O	I/O
44	GND	GND
45	I/O	I/O
46	I/O	I/O
47	I/O	I/O
48	I/O	I/O
49	I/O	I/O
50	SDO, I/O	SDO, I/O
51	I/O	I/O
52	I/O	I/O
53	I/O	I/O
54	I/O	I/O
55	GND	GND
56	I/O	I/O

Table 60 • **BG272**

BG272	
Pin Number	**A42MX36 Function**
C3	GND
C4	I/O
C5	WD, I/O
C6	I/O
C7	QCLKC, I/O
C8	I/O
C9	I/O
C10	CLKB
C11	PRA, I/O
C12	WD, I/O
C13	I/O
C14	QCLKD, I/O
C15	I/O
C16	WD, I/O
C17	SDI, I/O
C18	I/O
C19	I/O
C20	I/O
D1	I/O
D2	I/O
D3	I/O
D4	I/O
D5	VCCI
D6	I/O
D7	I/O
D8	VCCA
D9	WD, I/O
D10	VCCI
D11	I/O
D12	VCCI
D13	I/O
D14	VCCI
D15	I/O
D16	VCCA
D17	GND
D18	I/O
D19	I/O

Table 60 • **BG272**

BG272	
Pin Number	**A42MX36 Function**
T19	I/O
T20	I/O
U1	I/O
U2	I/O
U3	I/O
U4	I/O
U5	VCCI
U6	WD, I/O
U7	I/O
U8	I/O
U9	WD, I/O
U10	VCCA
U11	VCCI
U12	I/O
U13	I/O
U14	QCLKB, I/O
U15	I/O
U16	VCCI
U17	I/O
U18	GND
U19	I/O
U20	I/O
V1	I/O
V2	I/O
V3	GND
V4	GND
V5	I/O
V6	I/O
V7	I/O
V8	WD, I/O
V9	I/O
V10	I/O
V11	I/O
V12	I/O
V13	WD, I/O
V14	I/O
V15	WD, I/O

Table 60 • **BG272**

BG272	
Pin Number	**A42MX36 Function**
Y13	I/O
Y14	I/O
Y15	I/O
Y16	I/O
Y17	I/O
Y18	WD, I/O
Y19	GND
Y20	GND

Figure 52 • **PG132**

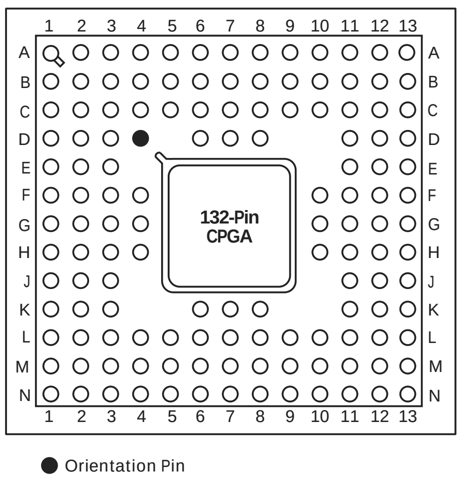


Table 61 • **PG132**

PG132	
Pin Number	**A42MX09 Function**
–	PMPOUT
B2	I/O
A1	MODE
B1	I/O
D3	I/O
C2	I/O
C1	I/O
D2	I/O
D1	I/O
E2	I/O
E1	I/O
F3	I/O

Figure 53 • **CQ172**

Table 62 • **CQ172**

CQ172	
Pin Number	**A42MX16 Function**
1	MODE
2	I/O
3	I/O
4	I/O
5	I/O
6	I/O
7	GND
8	I/O
9	I/O
10	I/O
11	I/O
12	VCC
13	I/O
14	I/O
15	I/O
16	I/O
17	GND
18	I/O
19	I/O
20	I/O