AMD Xilinx - XCV800-6BG560C Datasheet

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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	4704
Number of Logic Elements/Cells	21168
Total RAM Bits	114688
Number of I/O	404
Number of Gates	888439
Voltage - Supply	2.375V ~ 2.625V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 85°C (TJ)
Package / Case	560-LBGA Exposed Pad, Metal
Supplier Device Package	560-MBGA (42.5x42.5)
Purchase URL	https://www.e-xfl.com/product-detail/xilinx/xcv800-6bg560c

Virtex Architecture

Virtex devices feature a flexible, regular architecture that comprises an array of configurable logic blocks (CLBs) surrounded by programmable input/output blocks (IOBs), all interconnected by a rich hierarchy of fast, versatile routing resources. The abundance of routing resources permits the Virtex family to accommodate even the largest and most complex designs.

Virtex FPGAs are SRAM-based, and are customized by loading configuration data into internal memory cells. In some modes, the FPGA reads its own configuration data from an external PROM (master serial mode). Otherwise, the configuration data is written into the FPGA (SelectMAP™, slave serial, and JTAG modes).

The standard Xilinx Foundation™ and Alliance Series™ Development systems deliver complete design support for Virtex, covering every aspect from behavioral and schematic entry, through simulation, automatic design translation and implementation, to the creation, downloading, and readback of a configuration bit stream.

Higher Performance

Virtex devices provide better performance than previous generations of FPGA. Designs can achieve synchronous system clock rates up to 200 MHz including I/O. Virtex inputs and outputs comply fully with PCI specifications, and interfaces can be implemented that operate at 33 MHz or 66 MHz. Additionally, Virtex supports the hot-swapping requirements of Compact PCI.

Xilinx thoroughly benchmarked the Virtex family. While performance is design-dependent, many designs operated internally at speeds in excess of 100 MHz and can achieve 200 MHz. Table 2 shows performance data for representative circuits, using worst-case timing parameters.

Table 2: **Performance for Common Circuit Functions**

Function	Bits	Virtex -6
Register-to-Register		
Adder	16 64	5.0 ns 7.2 ns
Pipelined Multiplier	8 x 8 16 x 16	5.1 ns 6.0 ns
Address Decoder	16 64	4.4 ns 6.4 ns
16:1 Multiplexer		5.4 ns
Parity Tree	9 18 36	4.1 ns 5.0 ns 6.9 ns
Chip-to-Chip		
HSTL Class IV		200 MHz
LVTTL,16mA, fast slew		180 MHz

Virtex™ 2.5 V
Field Programmable Gate Arrays

DS003-2 (v4.0) March 1, 2013 **Product Specification**

Architectural Description

Virtex Array

The Virtex user-programmable gate array, shown in Figure 1, comprises two major configurable elements: configurable logic blocks (CLBs) and input/output blocks (IOBs).

- CLBs provide the functional elements for constructing logic
- IOBs provide the interface between the package pins and the CLBs

CLBs interconnect through a general routing matrix (GRM). The GRM comprises an array of routing switches located at the intersections of horizontal and vertical routing channels. Each CLB nests into a VersaBlock™ that also provides local routing resources to connect the CLB to the GRM.

The VersaRing™ I/O interface provides additional routing resources around the periphery of the device. This routing improves I/O routability and facilitates pin locking.

The Virtex architecture also includes the following circuits that connect to the GRM.

- Dedicated block memories of 4096 bits each
- Clock DLLs for clock-distribution delay compensation and clock domain control
- 3-State buffers (BUFTs) associated with each CLB that drive dedicated segmentable horizontal routing resources

Values stored in static memory cells control the configurable logic elements and interconnect resources. These values load into the memory cells on power-up, and can reload if necessary to change the function of the device.

Input/Output Block

The Virtex IOB, Figure 2, features SelectIO™ inputs and outputs that support a wide variety of I/O signalling standards, see Table 1.

The three IOB storage elements function either as edge-triggered D-type flip-flops or as level sensitive latches. Each IOB has a clock signal (CLK) shared by the three flip-flops and independent clock enable signals for each flip-flop.

In addition to the CLK and CE control signals, the three flip-flops share a Set/Reset (SR). For each flip-flop, this signal can be independently configured as a synchronous Set, a synchronous Reset, an asynchronous Preset, or an asynchronous Clear.

The output buffer and all of the IOB control signals have independent polarity controls.

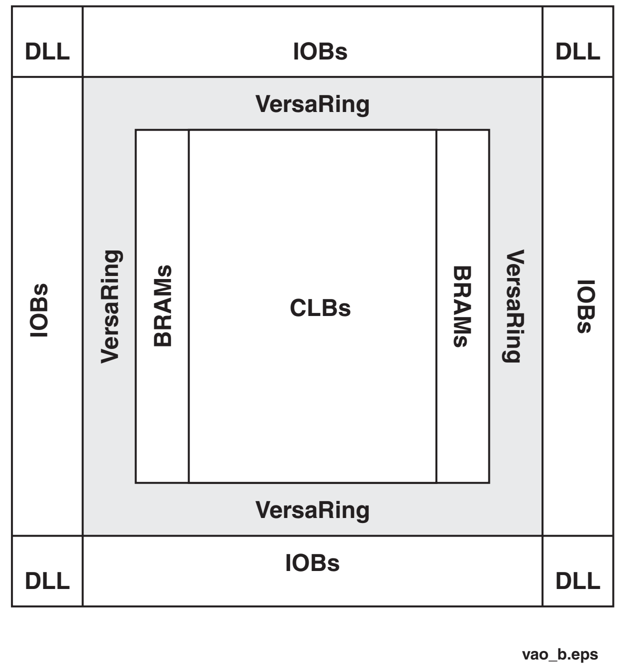

Figure 1: **Virtex Architecture Overview**

All pads are protected against damage from electrostatic discharge (ESD) and from over-voltage transients. Two forms of over-voltage protection are provided, one that permits 5 V compliance, and one that does not. For 5 V compliance, a Zener-like structure connected to ground turns on when the output rises to approximately 6.5 V. When PCI 3.3 V compliance is required, a conventional clamp diode is connected to the output supply voltage, V_{CCO}.

Optional pull-up and pull-down resistors and an optional weak-keeper circuit are attached to each pad. Prior to configuration, all pins not involved in configuration are forced into their high-impedance state. The pull-down resistors and the weak-keeper circuits are inactive, but inputs can optionally be pulled up.

The activation of pull-up resistors prior to configuration is controlled on a global basis by the configuration mode pins. If the pull-up resistors are not activated, all the pins will float. Consequently, external pull-up or pull-down resistors must be provided on pins required to be at a well-defined logic level prior to configuration.

All Virtex IOBs support IEEE 1149.1-compatible boundary scan testing.

Each block SelectRAM cell, as illustrated in Figure 6, is a fully synchronous dual-ported 4096-bit RAM with independent control signals for each port. The data widths of the two ports can be configured independently, providing built-in bus-width conversion.

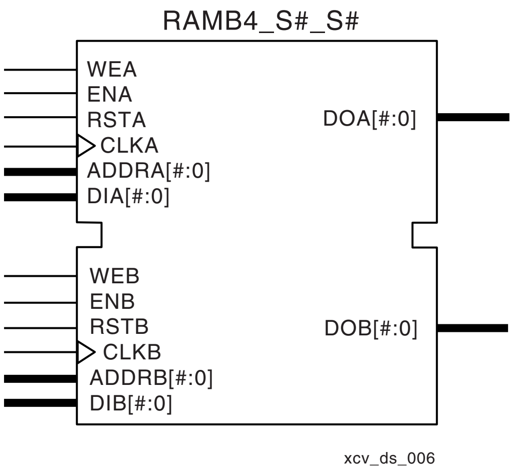

Figure 6: **Dual-Port Block SelectRAM**

Table 4 shows the depth and width aspect ratios for the block SelectRAM.

Table 4: **Block SelectRAM Port Aspect Ratios**

Width	Depth	ADDR Bus	Data Bus
1	4096	ADDR<11:0>	DATA<0>
2	2048	ADDR<10:0>	DATA<1:0>
4	1024	ADDR<9:0>	DATA<3:0>
8	512	ADDR<8:0>	DATA<7:0>
16	256	ADDR<7:0>	DATA<15:0>

The Virtex block SelectRAM also includes dedicated routing to provide an efficient interface with both CLBs and other block SelectRAMs. Refer to XAPP130 for block SelectRAM timing waveforms.

Programmable Routing Matrix

It is the longest delay path that limits the speed of any worst-case design. Consequently, the Virtex routing architecture and its place-and-route software were defined in a single optimization process. This joint optimization minimizes long-path delays, and consequently, yields the best system performance.

The joint optimization also reduces design compilation times because the architecture is software-friendly. Design cycles are correspondingly reduced due to shorter design iteration times.

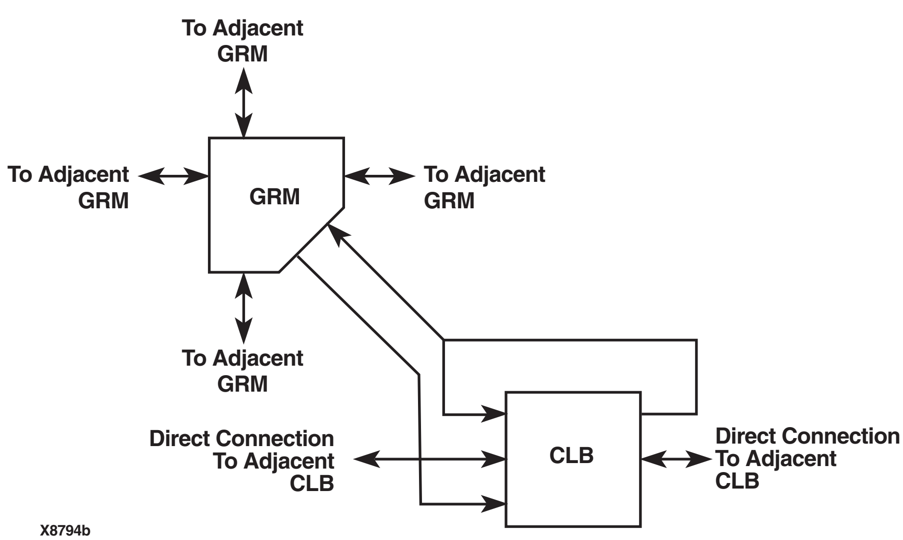

Figure 7: **Virtex Local Routing**

Local Routing

The VersaBlock provides local routing resources, as shown in Figure 7, providing the following three types of connections.

- Interconnections among the LUTs, flip-flops, and GRM
- Internal CLB feedback paths that provide high-speed connections to LUTs within the same CLB, chaining them together with minimal routing delay
- Direct paths that provide high-speed connections between horizontally adjacent CLBs, eliminating the delay of the GRM.

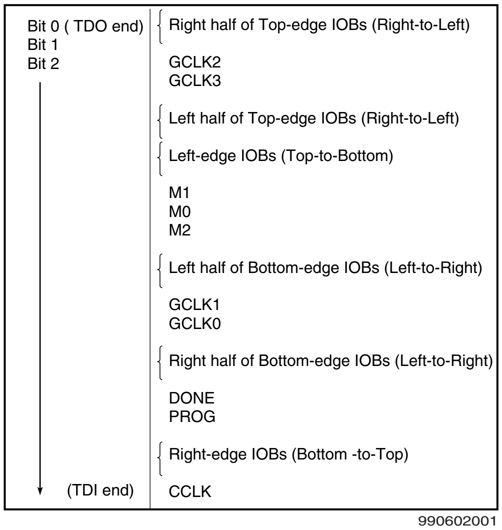

Figure 11: **Boundary Scan Bit Sequence**

Table 5: **Boundary Scan Instructions**

Boundary-Scan Command	Binary Code(4:0)	Description
EXTEST	00000	Enables boundary-scan EXTEST operation
SAMPLE/PRELOAD	00001	Enables boundary-scan SAMPLE/PRELOAD operation
USER 1	00010	Access user-defined register 1
USER 2	00011	Access user-defined register 2
CFG_OUT	00100	Access the configuration bus for read operations.
CFG_IN	00101	Access the configuration bus for write operations.
INTEST	00111	Enables boundary-scan INTEST operation
USERCODE	01000	Enables shifting out USER code
IDCODE	01001	Enables shifting out of ID Code
HIGHZ	01010	3-states output pins while enabling the Bypass Register
JSTART	01100	Clock the start-up sequence when StartupClk is TCK
BYPASS	11111	Enables BYPASS
RESERVED	All other codes	Xilinx reserved instructions

Identification Registers

The IDCODE register is supported. By using the IDCODE, the device connected to the JTAG port can be determined.

The IDCODE register has the following binary format:

vvvv:ffff:fffa:aaaa:aaaa:cccc:cccc:ccc1

where

v = the die version number

f = the family code (03h for Virtex family)

a = the number of CLB rows (ranges from 010h for XCV50 to 040h for XCV1000)

c = the company code (49h for Xilinx)

The USERCODE register is supported. By using the USERCODE, a user-programmable identification code can be loaded and shifted out for examination. The identification code is embedded in the bitstream during bitstream generation and is valid only after configuration.

Table 6: **IDCODEs Assigned to Virtex FPGAs**

FPGA	IDCODE
XCV50	v0610093h
XCV100	v0614093h
XCV150	v0618093h
XCV200	v061C093h
XCV300	v0620093h
XCV400	v0628093h
XCV600	v0630093h
XCV800	v0638093h
XCV1000	v0640093h

Including Boundary Scan in a Design

Since the boundary scan pins are dedicated, no special element needs to be added to the design unless an internal data register (USER1 or USER2) is desired.

If an internal data register is used, insert the boundary scan symbol and connect the necessary pins as appropriate.

Development System

Virtex FPGAs are supported by the Xilinx Foundation and Alliance CAE tools. The basic methodology for Virtex design consists of three interrelated steps: design entry, implementation, and verification. Industry-standard tools are used for design entry and simulation (for example, Synopsys FPGA Express), while Xilinx provides proprietary architecture-specific tools for implementation.

The Xilinx development system is integrated under the Xilinx Design Manager (XDM™) software, providing design-

Master-Serial Mode

In master-serial mode, the CCLK output of the FPGA drives a Xilinx Serial PROM that feeds bit-serial data to the DIN input. The FPGA accepts this data on each rising CCLK edge. After the FPGA has been loaded, the data for the next device in a daisy-chain is presented on the DOUT pin after the rising CCLK edge.

The interface is identical to slave-serial except that an internal oscillator is used to generate the configuration clock (CCLK). A wide range of frequencies can be selected for CCLK which always starts at a slow default frequency. Configuration bits then switch CCLK to a higher frequency for the remainder of the configuration. Switching to a lower frequency is prohibited.

The CCLK frequency is set using the ConfigRate option in the bitstream generation software. The maximum CCLK frequency that can be selected is 60 MHz. When selecting a CCLK frequency, ensure that the serial PROM and any daisy-chained FPGAs are fast enough to support the clock rate.

On power-up, the CCLK frequency is 2.5 MHz. This frequency is used until the ConfigRate bits have been loaded when the frequency changes to the selected ConfigRate. Unless a different frequency is specified in the design, the default ConfigRate is 4 MHz.

Figure 12 shows a full master/slave system. In this system, the left-most device operates in master-serial mode. The remaining devices operate in slave-serial mode. The SPROM RESET pin is driven by INIT, and the CE input is driven by DONE. There is the potential for contention on the DONE pin, depending on the start-up sequence options chosen.

Figure 14 shows the timing of master-serial configuration. Master-serial mode is selected by a <000> or <100> on the mode pins (M2, M1, M0). Table 8 shows the timing information for Figure 14.

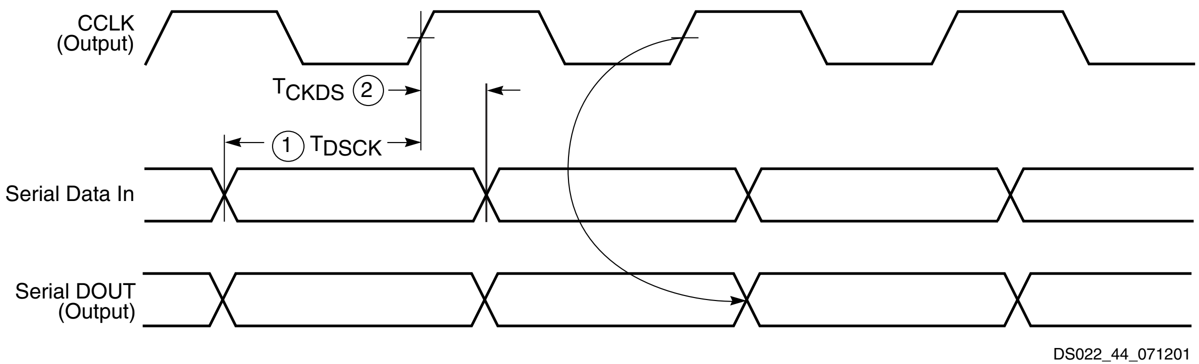

Figure 14: **Master-Serial Mode Programming Switching Characteristics**

At power-up, V_{CC} must rise from 1.0 V to V_{CC} min in less than 50 ms, otherwise delay configuration by pulling PROGRAM Low until V_{CC} is valid.

The sequence of operations necessary to configure a Virtex FPGA serially appears in Figure 15.

SelectMAP Mode

The SelectMAP mode is the fastest configuration option. Byte-wide data is written into the FPGA with a BUSY flag controlling the flow of data.

An external data source provides a byte stream, CCLK, a Chip Select (CS) signal and a Write signal (WRITE). If BUSY is asserted (High) by the FPGA, the data must be held until BUSY goes Low.

Data can also be read using the SelectMAP mode. If WRITE is not asserted, configuration data is read out of the FPGA as part of a readback operation.

In the SelectMAP mode, multiple Virtex devices can be chained in parallel. DATA pins (D7:D0), CCLK, WRITE, BUSY, PROGRAM, DONE, and INIT can be connected in parallel between all the FPGAs. Note that the data is organized with the MSB of each byte on pin DO and the LSB of each byte on D7. The CS pins are kept separate, insuring that each FPGA can be selected individually. WRITE should be Low before loading the first bitstream and returned High after the last device has been programmed. Use CS to select the appropriate FPGA for loading the bitstream and sending the configuration data. at the end of the bitstream, deselect the loaded device and select the next target FPGA by setting its CS pin High. A free-running oscillator or other externally generated signal can be used for CCLK. The BUSY signal can be ignored for frequencies below 50 MHz. For details about frequencies above 50 MHz, see XAPP138, Virtex Configuration and Readback. Once all the devices have been programmed, the DONE pin goes High.

3. At the rising edge of CCLK: If BUSY is Low, the data is accepted on this clock. If BUSY is High (from a previous write), the data is not accepted. Acceptance will instead occur on the first clock after BUSY goes Low, and the data must be held until this has happened.
4. Repeat steps 2 and 3 until all the data has been sent.
5. De-assert $\overline{CS}$ and $\overline{WRITE}$.

A flowchart for the write operation appears in Figure 17. Note that if CCLK is slower than f_{CCNH}, the FPGA never asserts BUSY. In this case, the above handshake is unnecessary, and data can simply be entered into the FPGA every CCLK cycle.

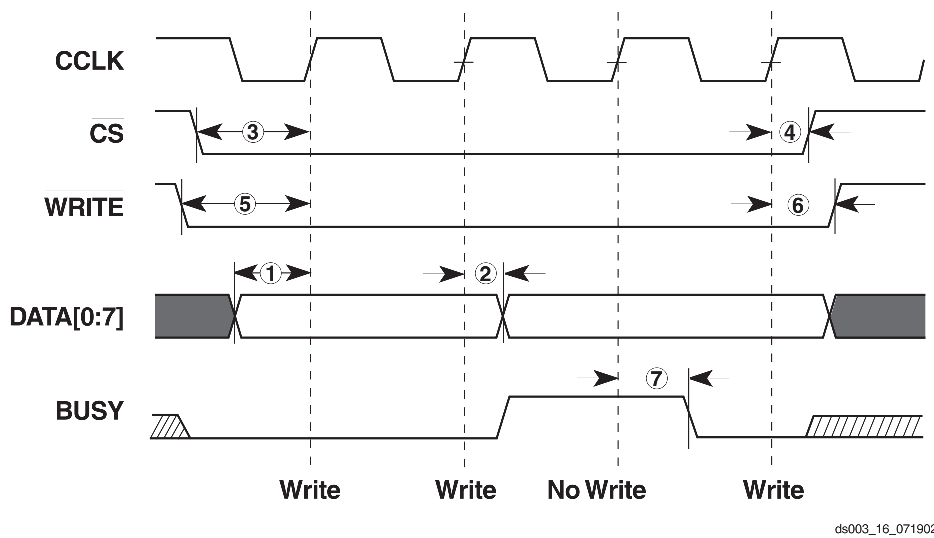

Figure 16: **Write Operations**

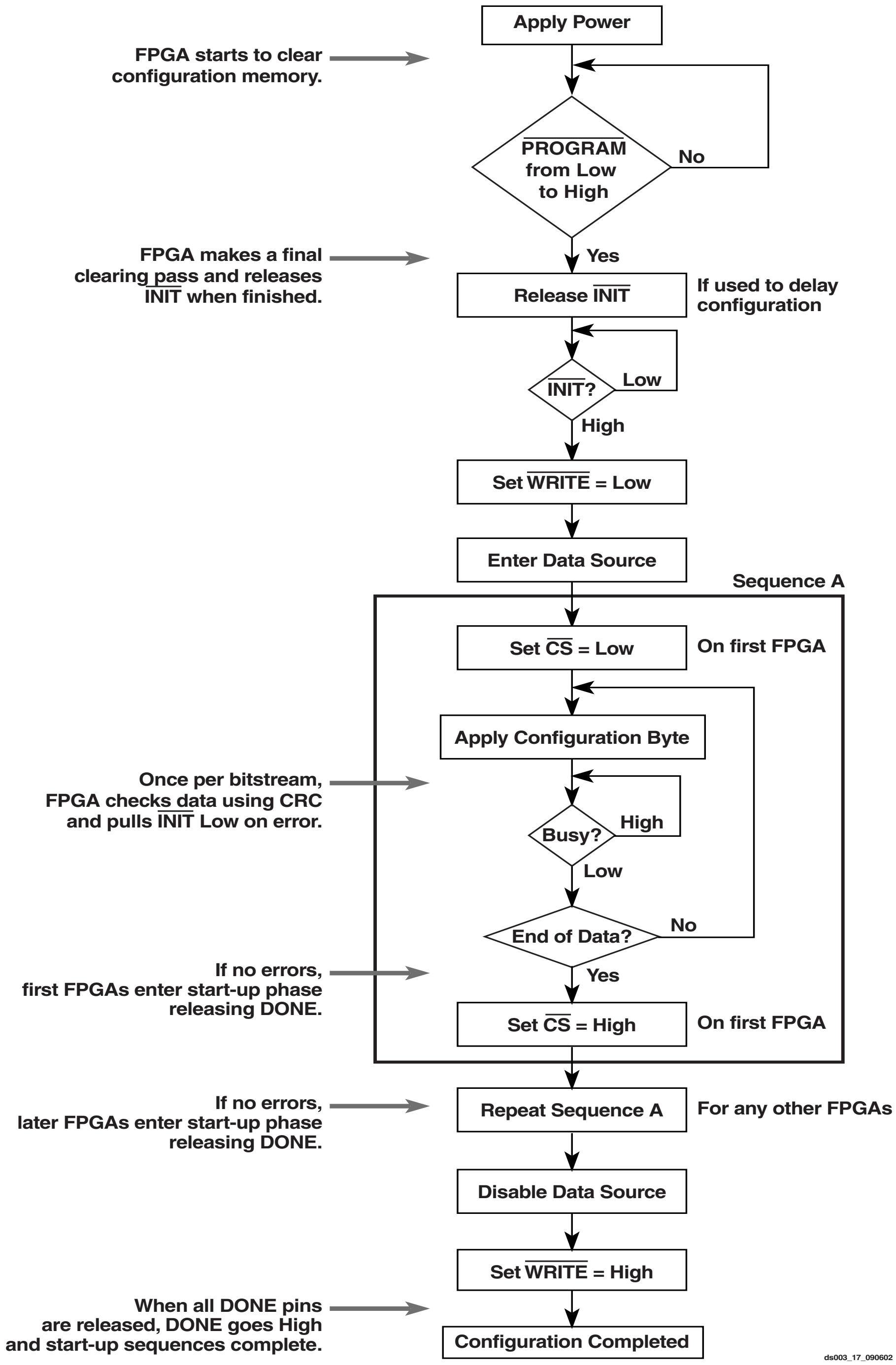

Figure 17: **SelectMAP Flowchart for Write Operation**

Abort

During a given assertion of $\overline{CS}$, the user cannot switch from a write to a read, or vice-versa. This action causes the current packet command to be aborted. The device will remain BUSY until the aborted operation has completed. Following an abort, data is assumed to be unaligned to word boundaries, and the FPGA requires a new synchronization word prior to accepting any new packets.

To initiate an abort during a write operation, de-assert $\overline{WRITE}$. At the rising edge of CCLK, an abort is initiated, as shown in Figure 18.

Virtex DC Characteristics

Absolute Maximum Ratings

Symbol	Description(1)			Units
V_{CCINT}	Supply voltage relative to GND(2)		–0.5 to 3.0	V
V_{CCO}	Supply voltage relative to GND(2)		–0.5 to 4.0	V
V_{REF}	Input Reference Voltage		–0.5 to 3.6	V
V_{IN}	Input voltage relative to GND(3)	Using V_{REF}	–0.5 to 3.6	V
		Internal threshold	–0.5 to 5.5	V
V_{TS}	Voltage applied to 3-state output		–0.5 to 5.5	V
V_{CC}	Longest Supply Voltage Rise Time from 1V-2.375V		50	ms
T_{STG}	Storage temperature (ambient)		–65 to +150	°C
T_J	Junction temperature(4)	Plastic Packages	+125	°C

Notes:
1. Stresses beyond those listed under Absolute Maximum Ratings can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those listed under Operating Conditions is not implied. Exposure to Absolute Maximum Ratings conditions for extended periods of time can affect device reliability.
2. Power supplies can turn on in any order.
3. For protracted periods (e.g., longer than a day), V_{IN} should not exceed V_{CCO} by more than 3.6 V.
4. For soldering guidelines and thermal considerations, see the "Device Packaging" information on www.xilinx.com.

Recommended Operating Conditions

Symbol	Description		Min	Max	Units
V_{CCINT}(1)	Input Supply voltage relative to GND, T_J = 0 °C to +85°C	Commercial	2.5 – 5%	2.5 + 5%	V
	Input Supply voltage relative to GND, T_J = –40°C to +100°C	Industrial	2.5 – 5%	2.5 + 5%	V
V_{CCO}(4)	Supply voltage relative to GND, T_J = 0 °C to +85°C	Commercial	1.4	3.6	V
	Supply voltage relative to GND, T_J = –40°C to +100°C	Industrial	1.4	3.6	V
T_{IN}	Input signal transition time			250	ns

Notes:
1. Correct operation is guaranteed with a minimum V_{CCINT} of 2.375 V (Nominal V_{CCINT} –5%). Below the minimum value, all delay parameters increase by 3% for each 50-mV reduction in V_{CCINT} below the specified range.
2. At junction temperatures above those listed as Operating Conditions, delay parameters do increase. Please refer to the TRCE report.
3. Input and output measurement threshold is ~50% of V_{CC}.
4. Min and Max values for V_{CCO} are I/O Standard dependant.

Virtex Switching Characteristics

All devices are 100% functionally tested. Internal timing parameters are derived from measuring internal test patterns. Listed below are representative values. For more specific, more precise, and worst-case guaranteed data, use the values reported by the static timing analyzer (TRCE in the Xilinx Development System) and back-annotated to the simulation net list. All timing parameters assume worst-case operating conditions (supply voltage and junction temperature). Values apply to all Virtex devices unless otherwise noted.

IOB Input Switching Characteristics

Input delays associated with the pad are specified for LVTTL levels. For other standards, adjust the delays with the values shown in , page 6.

Description	Device	Symbol	Speed Grade				Units
			Min	-6	-5	-4	
Propagation Delays							
Pad to I output, no delay	All	T_{IOPI}	0.39	0.8	0.9	1.0	ns, max
Pad to I output, with delay	XCV50	T_{IOPID}	0.8	1.5	1.7	1.9	ns, max
	XCV100		0.8	1.5	1.7	1.9	ns, max
	XCV150		0.8	1.5	1.7	1.9	ns, max
	XCV200		0.8	1.5	1.7	1.9	ns, max
	XCV300		0.8	1.5	1.7	1.9	ns, max
	XCV400		0.9	1.8	2.0	2.3	ns, max
	XCV600		0.9	1.8	2.0	2.3	ns, max
	XCV800		1.1	2.1	2.4	2.7	ns, max
	XCV1000		1.1	2.1	2.4	2.7	ns, max
Pad to output IQ via transparent latch, no delay	All	T_{IOPLI}	0.8	1.6	1.8	2.0	ns, max
Pad to output IQ via transparent latch, with delay	XCV50	T_{IOPLID}	1.9	3.7	4.2	4.8	ns, max
	XCV100		1.9	3.7	4.2	4.8	ns, max
	XCV150		2.0	3.9	4.3	4.9	ns, max
	XCV200		2.0	4.0	4.4	5.1	ns, max
	XCV300		2.0	4.0	4.4	5.1	ns, max
	XCV400		2.1	4.1	4.6	5.3	ns, max
	XCV600		2.1	4.2	4.7	5.4	ns, max
	XCV800		2.2	4.4	4.9	5.6	ns, max
	XCV1000		2.3	4.5	5.1	5.8	ns, max
Sequential Delays							
Clock CLK	All						
Minimum Pulse Width, High		T_{CH}	0.8	1.5	1.7	2.0	ns, min
Minimum Pulse Width, Low		T_{CL}	0.8	1.5	1.7	2.0	ns, min
Clock CLK to output IQ		T_{IOCKIQ}	0.2	0.7	0.7	0.8	ns, max

Description	Device	Symbol	Speed Grade				Units
			Min	-6	-5	-4	
Setup and Hold Times with respect to Clock CLK at IOB input register[(1)]			**Setup Time / Hold Time**				
Pad, no delay	All	T_{IOPICK}/T_{IOICKP}	0.8 / 0	1.6 / 0	1.8 / 0	2.0 / 0	ns, min
Pad, with delay	XCV50	$T_{IOPICKD}/T_{IOICKPD}$	1.9 / 0	3.7 / 0	4.1 / 0	4.7 / 0	ns, min
	XCV100		1.9 / 0	3.7 / 0	4.1 / 0	4.7 / 0	ns, min
	XCV150		1.9 / 0	3.8 / 0	4.3 / 0	4.9 / 0	ns, min
	XCV200		2.0 / 0	3.9 / 0	4.4 / 0	5.0 / 0	ns, min
	XCV300		2.0 / 0	3.9 / 0	4.4 / 0	5.0 / 0	ns, min
	XCV400		2.1 / 0	4.1 / 0	4.6 / 0	5.3 / 0	ns, min
	XCV600		2.1 / 0	4.2 / 0	4.7 / 0	5.4 / 0	ns, min
	XCV800		2.2 / 0	4.4 / 0	4.9 / 0	5.6 / 0	ns, min
	XCV1000		2.3 / 0	4.5 / 0	5.0 / 0	5.8 / 0	ns, min
ICE input	All	$T_{IOICECK}/T_{IOCKICE}$	0.37/ 0	0.8 / 0	0.9 / 0	1.0 / 0	ns, max
Set/Reset Delays							
SR input (IFF, synchronous)	All	$T_{IOSRCKI}$	0.49	1.0	1.1	1.3	ns, max
SR input to IQ (asynchronous)	All	T_{IOSRIQ}	0.70	1.4	1.6	1.8	ns, max
GSR to output IQ	All	T_{GSRQ}	4.9	9.7	10.9	12.5	ns, max

Notes:

1. A Zero "0" Hold Time listing indicates no hold time or a negative hold time. Negative values cannot be guaranteed "best-case", but if a "0" is listed, there is no positive hold time.
2. Input timing for LVTTL is measured at 1.4 V. For other I/O standards, see Table 3.

CLB Arithmetic Switching Characteristics

Setup times not listed explicitly can be approximated by decreasing the combinatorial delays by the setup time adjustment listed. Precise values are provided by the timing analyzer.

Description	Symbol	Speed Grade				Units
		Min	-6	-5	-4	
Combinatorial Delays						
F operand inputs to X via XOR	T_{OPX}	0.37	0.8	0.9	1.0	ns, max
F operand input to XB output	T_{OPXB}	0.54	1.1	1.3	1.4	ns, max
F operand input to Y via XOR	T_{OPY}	0.8	1.5	1.7	2.0	ns, max
F operand input to YB output	T_{OPYB}	0.8	1.5	1.7	2.0	ns, max
F operand input to COUT output	T_{OPCYF}	0.6	1.2	1.3	1.5	ns, max
G operand inputs to Y via XOR	T_{OPGY}	0.46	1.0	1.1	1.2	ns, max
G operand input to YB output	T_{OPGYB}	0.8	1.6	1.8	2.1	ns, max
G operand input to COUT output	T_{OPCYG}	0.7	1.3	1.4	1.6	ns, max
BX initialization input to COUT	T_{BXCY}	0.41	0.9	1.0	1.1	ns, max
CIN input to X output via XOR	T_{CINX}	0.21	0.41	0.46	0.53	ns, max
CIN input to XB	T_{CINXB}	0.02	0.04	0.05	0.06	ns, max
CIN input to Y via XOR	T_{CINY}	0.23	0.46	0.52	0.6	ns, max
CIN input to YB	T_{CINYB}	0.23	0.45	0.51	0.6	ns, max
CIN input to COUT output	T_{BYP}	0.05	0.09	0.10	0.11	ns, max
Multiplier Operation						
F1/2 operand inputs to XB output via AND	T_{FANDXB}	0.18	0.36	0.40	0.46	ns, max
F1/2 operand inputs to YB output via AND	T_{FANDYB}	0.40	0.8	0.9	1.1	ns, max
F1/2 operand inputs to COUT output via AND	T_{FANDCY}	0.22	0.43	0.48	0.6	ns, max
G1/2 operand inputs to YB output via AND	T_{GANDYB}	0.25	0.50	0.6	0.7	ns, max
G1/2 operand inputs to COUT output via AND	T_{GANDCY}	0.07	0.13	0.15	0.17	ns, max
Setup and Hold Times before/after Clock CLK(1)		Setup Time / Hold Time				
CIN input to FFX	T_{CCKX}/T_{CKCX}	0.50 / 0	1.0 / 0	1.2 / 0	1.3 / 0	ns, min
CIN input to FFY	T_{CCKY}/T_{CKCY}	0.53 / 0	1.1 / 0	1.2 / 0	1.4 / 0	ns, min

Notes:
1. A Zero "0" Hold Time listing indicates no hold time or a negative hold time. Negative values can not be guaranteed "best-case", but if a "0" is listed, there is no positive hold time.

Block RAM Switching Characteristics

Description	Symbol	Speed Grade				Units
		Min	-6	-5	-4	
Sequential Delays						
Clock CLK to DOUT output	T_{BCKO}	1.7	3.4	3.8	4.3	ns, max
Setup and Hold Times before/after Clock CLK(1)	Setup Time / Hold Time					
ADDR inputs	T_{BACK}/T_{BCKA}	0.6 / 0	1.2 / 0	1.3 / 0	1.5 / 0	ns, min
DIN inputs	T_{BDCK}/T_{BCKD}	0.6 / 0	1.2 / 0	1.3 / 0	1.5 / 0	ns, min
EN input	T_{BECK}/T_{BCKE}	1.3 / 0	2.6 / 0	3.0 / 0	3.4 / 0	ns, min
RST input	T_{BRCK}/T_{BCKR}	1.3 / 0	2.5 / 0	2.7 / 0	3.2 / 0	ns, min
WEN input	T_{BWCK}/T_{BCKW}	1.2 / 0	2.3 / 0	2.6 / 0	3.0 / 0	ns, min
Clock CLK						
Minimum Pulse Width, High	T_{BPWH}	0.8	1.5	1.7	2.0	ns, min
Minimum Pulse Width, Low	T_{BPWL}	0.8	1.5	1.7	2.0	ns, min
CLKA -> CLKB setup time for different ports	T_{BCCS}		3.0	3.5	4.0	ns, min

Notes:
1. A Zero "0" Hold Time listing indicates no hold time or a negative hold time. Negative values can not be guaranteed "best-case", but if a "0" is listed, there is no positive hold time.

TBUF Switching Characteristics

Description	Symbol	Speed Grade				Units
		Min	-6	-5	-4	
Combinatorial Delays						
IN input to OUT output	T_{IO}	0	0	0	0	ns, max
TRI input to OUT output high-impedance	T_{OFF}	0.05	0.09	0.10	0.11	ns, max
TRI input to valid data on OUT output	T_{ON}	0.05	0.09	0.10	0.11	ns, max

JTAG Test Access Port Switching Characteristics

Description	Symbol	Speed Grade			Units
		-6	-5	-4	
TMS and TDI Setup times before TCK	T_{TAPTCK}	4.0	4.0	4.0	ns, min
TMS and TDI Hold times after TCK	T_{TCKTAP}	2.0	2.0	2.0	ns, min
Output delay from clock TCK to output TDO	T_{TCKTDO}	11.0	11.0	11.0	ns, max
Maximum TCK clock frequency	F_{TCK}	33	33	33	MHz, max

DLL Timing Parameters

All devices are 100 percent functionally tested. Because of the difficulty in directly measuring many internal timing parameters, those parameters are derived from benchmark timing patterns. The following guidelines reflect worst-case values across the recommended operating conditions.

Description	Symbol	Speed Grade -6 Min	-6 Max	-5 Min	-5 Max	-4 Min	-4 Max	Units
Input Clock Frequency (CLKDLLHF)	FCLKINHF	60	200	60	180	60	180	MHz
Input Clock Frequency (CLKDLL)	FCLKINLF	25	100	25	90	25	90	MHz
Input Clock Pulse Width (CLKDLLHF)	$T_{DLLPWHF}$	2.0	-	2.4	-	2.4	-	ns
Input Clock Pulse Width (CLKDLL)	$T_{DLLPWLF}$	2.5	-	3.0		3.0	-	ns

Notes:

1. All specifications correspond to Commercial Operating Temperatures (0°C to + 85°C).

DLL Clock Tolerance, Jitter, and Phase Information

All DLL output jitter and phase specifications determined through statistical measurement at the package pins using a clock mirror configuration and matched drivers.

Description	Symbol	F_{CLKIN}	CLKDLLHF Min	CLKDLLHF Max	CLKDLL Min	CLKDLL Max	Units
Input Clock Period Tolerance	T_{IPTOL}		-	1.0	-	1.0	ns
Input Clock Jitter Tolerance (Cycle to Cycle)	T_{IJITCC}		-	± 150	-	± 300	ps
Time Required for DLL to Acquire Lock	T_{LOCK}	> 60 MHz	-	20	-	20	µs
		50 - 60 MHz	-	-	-	25	µs
		40 - 50 MHz	-	-	-	50	µs
		30 - 40 MHz	-	-	-	90	µs
		25 - 30 MHz	-	-	-	120	µs
Output Jitter (cycle-to-cycle) for any DLL Clock Output(1)	T_{OJITCC}			± 60		± 60	ps
Phase Offset between CLKIN and CLKO(2)	T_{PHIO}			± 100		± 100	ps
Phase Offset between Clock Outputs on the DLL(3)	T_{PHOO}			± 140		± 140	ps
Maximum Phase Difference between CLKIN and CLKO(4)	T_{PHIOM}			± 160		± 160	ps
Maximum Phase Difference between Clock Outputs on the DLL(5)	T_{PHOOM}			± 200		± 200	ps

Notes:

1. **Output Jitter** is cycle-to-cycle jitter measured on the DLL output clock, *excluding* input clock jitter.
2. **Phase Offset between CLKIN and CLKO** is the worst-case fixed time difference between rising edges of CLKIN and CLKO, *excluding* Output Jitter and input clock jitter.
3. **Phase Offset between Clock Outputs on the DLL** is the worst-case fixed time difference between rising edges of any two DLL outputs, *excluding* Output Jitter and input clock jitter.
4. **Maximum Phase Difference between CLKIN an CLKO** is the sum of Output Jitter and Phase Offset between CLKIN and CLKO, or the greatest difference between CLKIN and CLKO rising edges due to DLL alone (*excluding* input clock jitter).
5. **Maximum Phase DIfference between Clock Outputs on the DLL** is the sum of Output JItter and Phase Offset between any DLL clock outputs, or the greatest difference between any two DLL output rising edges sue to DLL alone (*excluding* input clock jitter).
6. All specifications correspond to Commercial Operating Temperatures (0°C to +85°C).

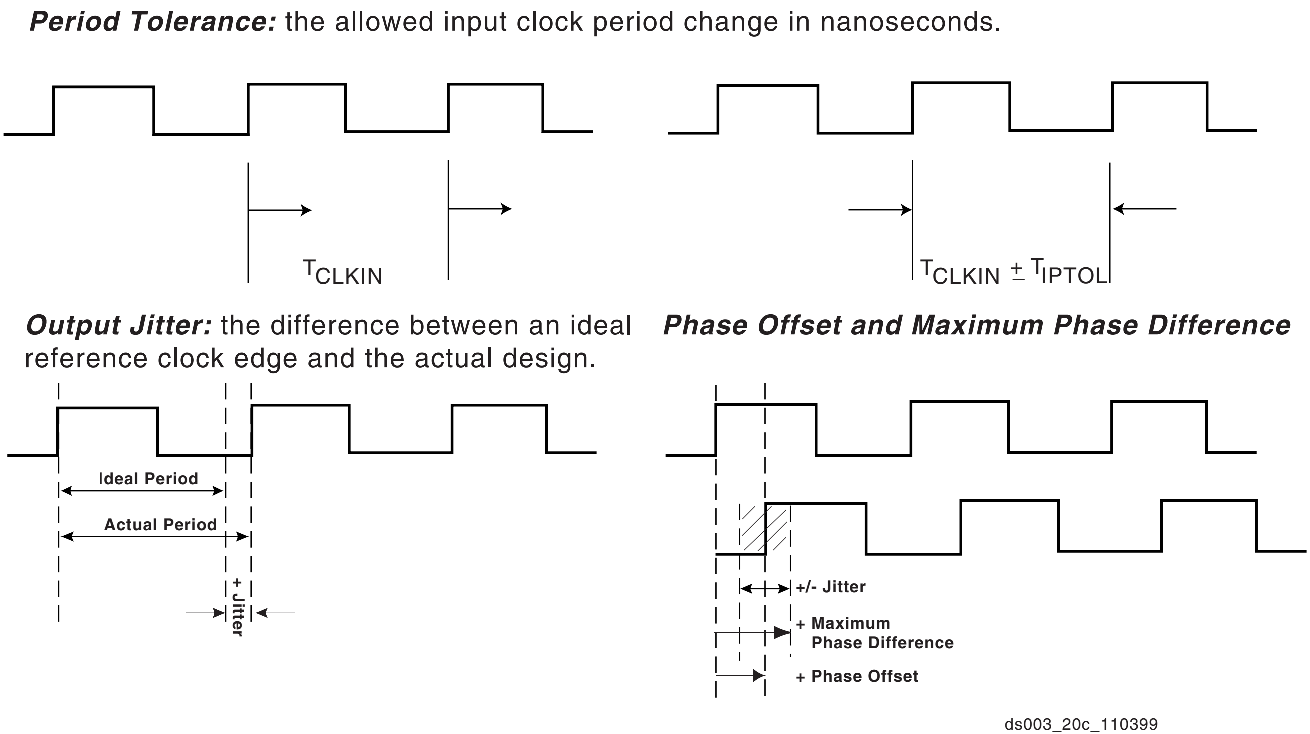

Figure 1: **Frequency Tolerance and Clock Jitter**

Revision History

Date	Version	Revision
11/98	1.0	Initial Xilinx release.
01/99	1.2	Updated package drawings and specs.
02/99	1.3	Update of package drawings, updated specifications.
05/99	1.4	Addition of package drawings and specifications.
05/99	1.5	Replaced FG 676 & FG680 package drawings.
07/99	1.6	Changed Boundary Scan Information and changed Figure 11, Boundary Scan Bit Sequence. Updated IOB Input & Output delays. Added Capacitance info for different I/O Standards. Added 5 V tolerant information. Added DLL Parameters and waveforms and new Pin-to-pin Input and Output Parameter tables for Global Clock Input to Output and Setup and Hold. Changed Configuration Information including Figures 12, 14, 17 & 19. Added device-dependent listings for quiescent currents ICCINTQ and ICCOQ. Updated IOB Input and Output Delays based on default standard of LVTTL, 12 mA, Fast Slew Rate. Added IOB Input Switching Characteristics Standard Adjustments.
09/99	1.7	Speed grade update to preliminary status, Power-on specification and Clock-to-Out Minimums additions, "0" hold time listing explanation, quiescent current listing update, and Figure 6 ADDRA input label correction. Added T_{IJITCC} parameter, changed T_{OJIT} to T_{OPHASE}.
01/00	1.8	Update to speed.txt file 1.96. Corrections for CRs 111036,111137, 112697, 115479, 117153, 117154, and 117612. Modified notes for Recommended Operating Conditions (voltage and temperature). Changed Bank information for V_{CCO} in CS144 package on p.43.

Table 4: **Virtex Pinout Tables (Fine-Pitch BGA)** ***(Continued)***

Pin Name	Device	FG256	FG456	FG676	FG680
V_{REF}, Bank 4 (V_{REF} pins are listed incrementally. Connect all pins listed for both the required device and all smaller devices listed in the same package.) Within each bank, if input reference voltage is not required, all V_{REF} pins are general I/O.	XCV50	P9, T12	N/A	N/A	N/A
	XCV100/150	... + T11	AA13, AB16, AB19	N/A	N/A
	XCV200/300	... + R13	... + AB20	N/A	N/A
	XCV400	N/A	N/A	AC15, AD18, AD21, AD22, AF15	N/A
	XCV600	N/A	N/A	... + AF20	AT19, AU7, AU17, AV8, AV10, AW11
	XCV800	N/A	N/A	... + AF17	... + AV14
	XCV1000	N/A	N/A	N/A	... + AU6
V_{REF}, Bank 5 (V_{REF} pins are listed incrementally. Connect all pins listed for both the required device and all smaller devices listed in the same package.) Within each bank, if input reference voltage is not required, all V_{REF} pins are general I/O.	XCV50	T4, P8	N/A	N/A	N/A
	XCV100/150	... + R5	W8, Y10, AA5	N/A	N/A
	XCV200/300	... + T2	... + Y6	N/A	N/A
	XCV400	N/A	N/A	AA10, AB8, AB12, AC7, AF12	N/A
	XCV600	N/A	N/A	... + AF8	AT27, AU29, AU31, AV35, AW21, AW23
	XCV800	N/A	N/A	... + AE10	... + AT25
	XCV1000	N/A	N/A	N/A	... + AV36
V_{REF}, Bank 6 (V_{REF} pins are listed incrementally. Connect all pins listed for both the required device and all smaller devices listed in the same package.) Within each bank, if input reference voltage is not required, all V_{REF} pins are general I/O.	XCV50	J3, N1	N/A	N/A	N/A
	XCV100/150	... + M1	N2, R4, T3	N/A	N/A
	XCV200/300	... + N2	... + Y1	N/A	N/A
	XCV400	N/A	N/A	AB3, R1, R4, U6, V5	N/A
	XCV600	N/A	N/A	... + Y1	AB35, AD37, AH39, AK39, AM39, AN36
	XCV800	N/A	N/A	... + U2	... + AE39
	XCV1000	N/A	N/A	N/A	... + AT39

Table 4: **Virtex Pinout Tables (Fine-Pitch BGA)** ***(Continued)***

Pin Name	Device	FG256	FG456	FG676	FG680
V_{REF}, Bank 7 (V_{REF} pins are listed incrementally. Connect all pins listed for both the required device and all smaller devices listed in the same package.) Within each bank, if input reference voltage is not required, all V_{REF} pins are general I/O.	XCV50	C1, H3	N/A	N/A	N/A
	XCV100/150	... + D1	E2, H4, K3	N/A	N/A
	XCV200/300	... + B1	... + D2	N/A	N/A
	XCV400	N/A	N/A	F4, G4, K6, M2, M5	N/A
	XCV600	N/A	N/A	... + H1	E38, G38, L36, N36, U36, U38
	XCV800	N/A	N/A	... + K1	... + N38
	XCV1000	N/A	N/A	N/A	... + F36
GND	All	A1, A16, B2, B15, F6, F7, F10, F11, G6, G7, G8, G9, G10, G11, H7, H8, H9, H10, J7, J8, J9, J10, K6, K7, K8, K9, K10, K11, L6, L7, L10, L11, R2, R15, T1, T16	A1, A22, B2, B21, C3, C20, J9, J10, J11, J12, J13, J14, K9, K10, K11, K12, K13, K14, L9, L10, L11, L12, L13, L14, M9, M10, M11, M12, M13, M14, N9, N10, N11, N12, N13, N14, P9, P10, P11, P12, P13, P14, Y3, Y20, AA2, AA21, AB1, AB22	A1, A26, B2, B9, B14, B18, B25, C3, C24, D4, D23, E5, E22, J2, J25, K10, K11, K12, K13, K14, K15, K16, K17, L10, L11, L12, L13, L14, L15, L16, L17, M10, M11, M12, M13, M14, M15, M16, M17, N2, N10, N11, N12, N13, N14, N15, N16, N17, P10, P11, P12, P13, P14, P15, P16, P17, P25, R10, R11, R12, R13, R14, R15, R16, R17, T10, T11, T12, T13, T14, T15, T16, T17, U10, U11, U12, U13, U14, U15, U16, U17, V2, V25, AB5, AB22, AC4, AC23, AD3, AD24, AE2, AE9, AE13, AE18, AE25, AF1, AF26	A1, A2, A3, A37, A38, A39, AA5, AA35, AH4, AH5, AH35, AH36, AR5, AR12, AR19, AR20, AR21, AR28, AR35, AT4, AT12, AT20, AT28, AT36, AU1, AU3, AU20, AU37, AU39, AV1, AV2, AV38, AV39, AW1, AW2, AW3, AW37, AW38, AW39, B1, B2, B38, B39, C1, C3, C20, C37, C39, D4, D12, D20, D28, D36, E5, E12, E19, E20, E21, E28, E35, M4, M5, M35, M36, W5, W35, Y3, Y4, Y5, Y35, Y36, Y37

BG256 Pin Function Diagram

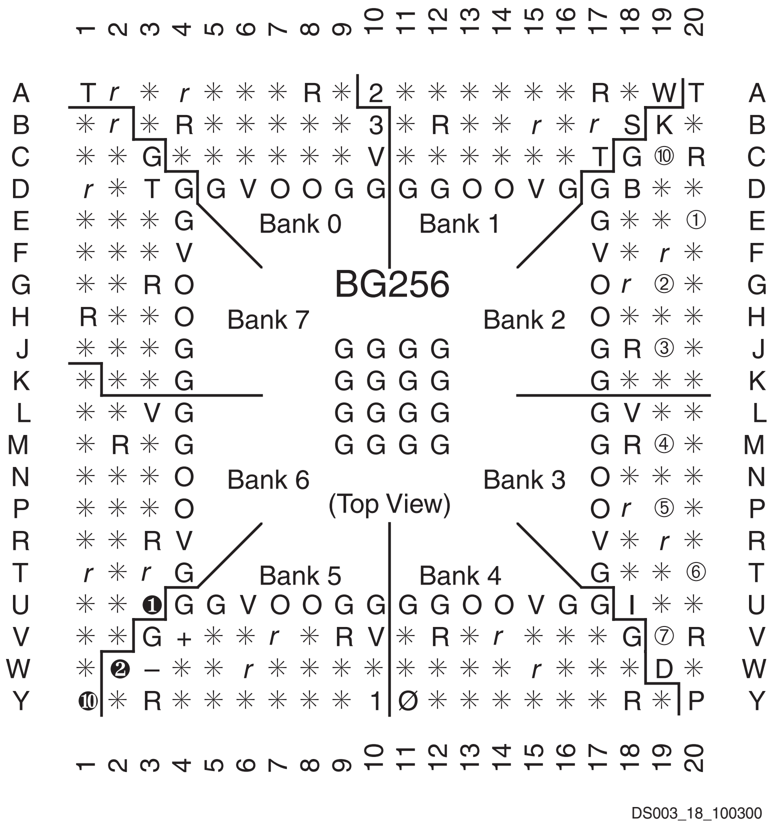

Figure 4: **BG256 Pin Function Diagram**

BG352 Pin Function Diagram

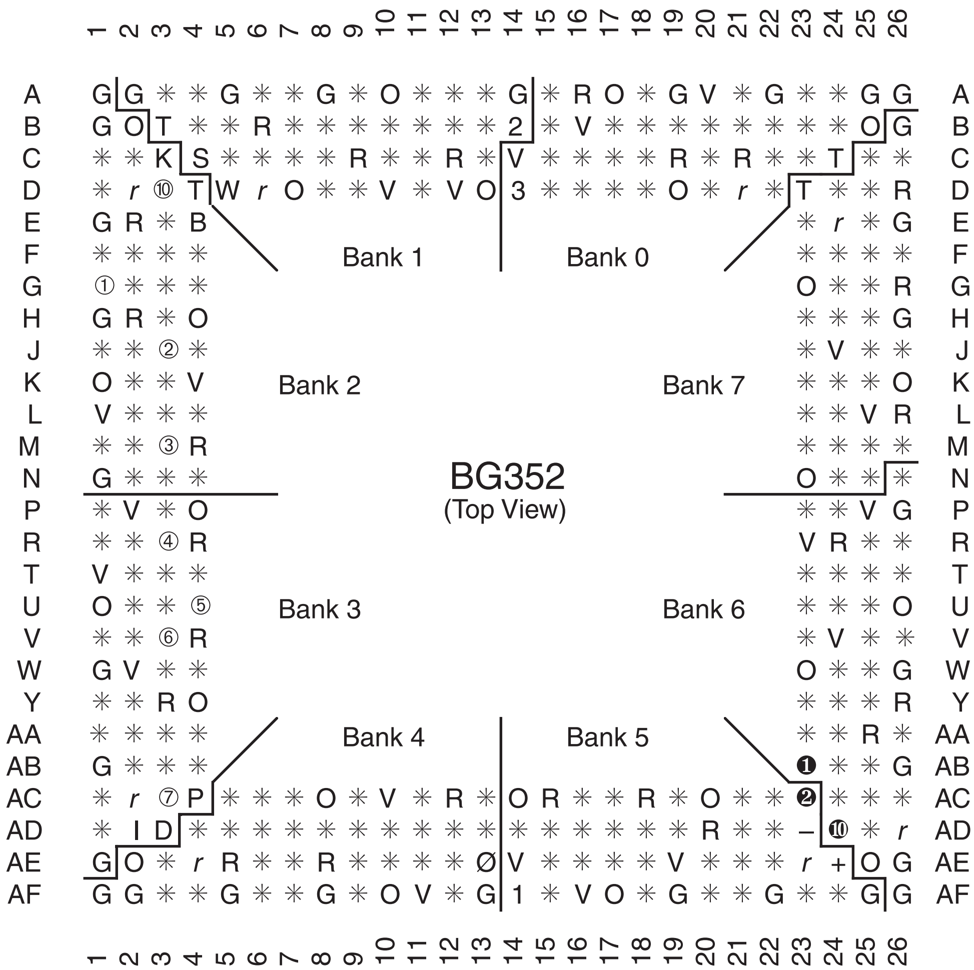

Figure 5: **BG352 Pin Function Diagram**

BG432 Pin Function Diagram

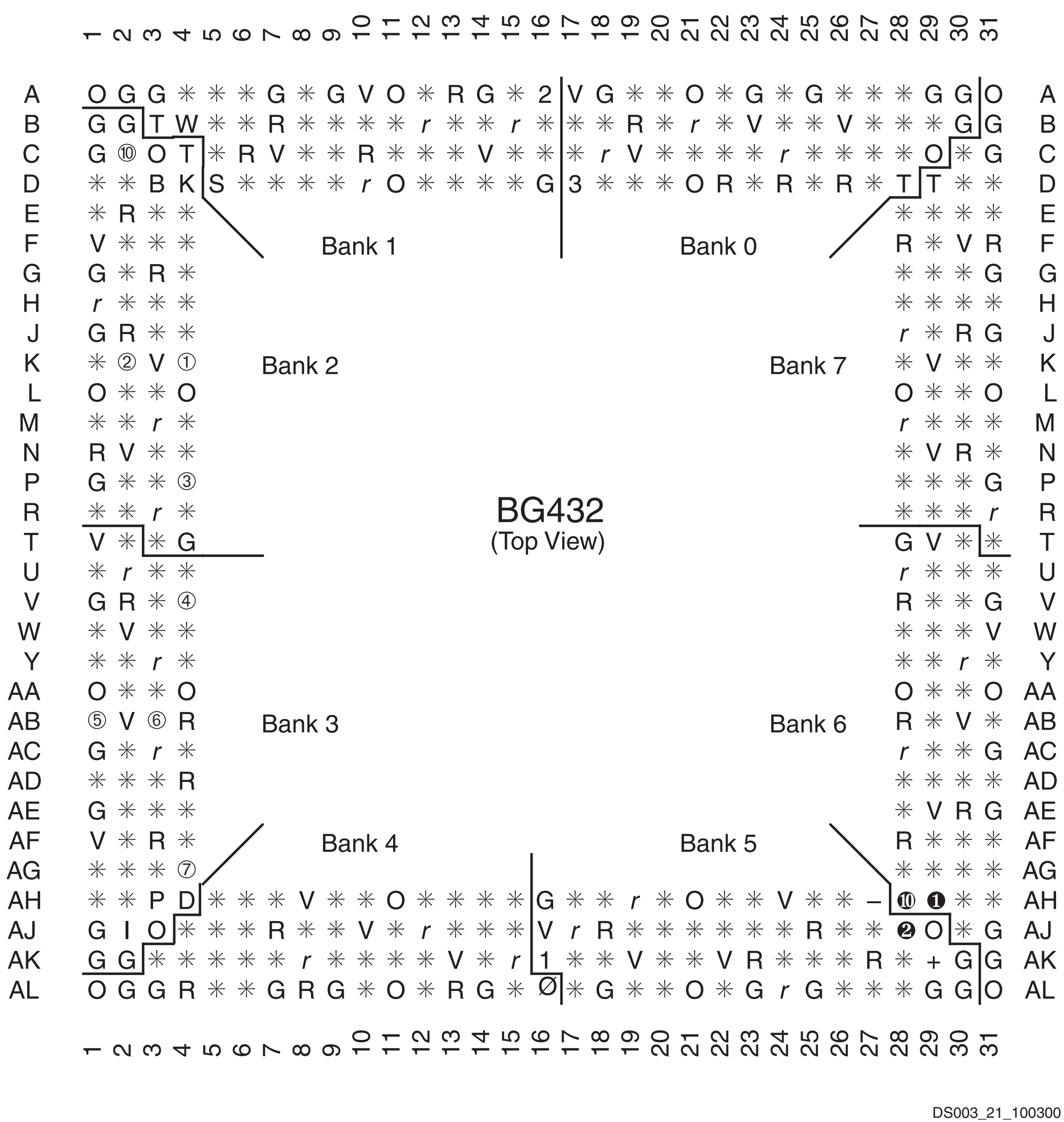

Figure 6: **BG432 Pin Function Diagram**

FG256 Pin Function Diagram

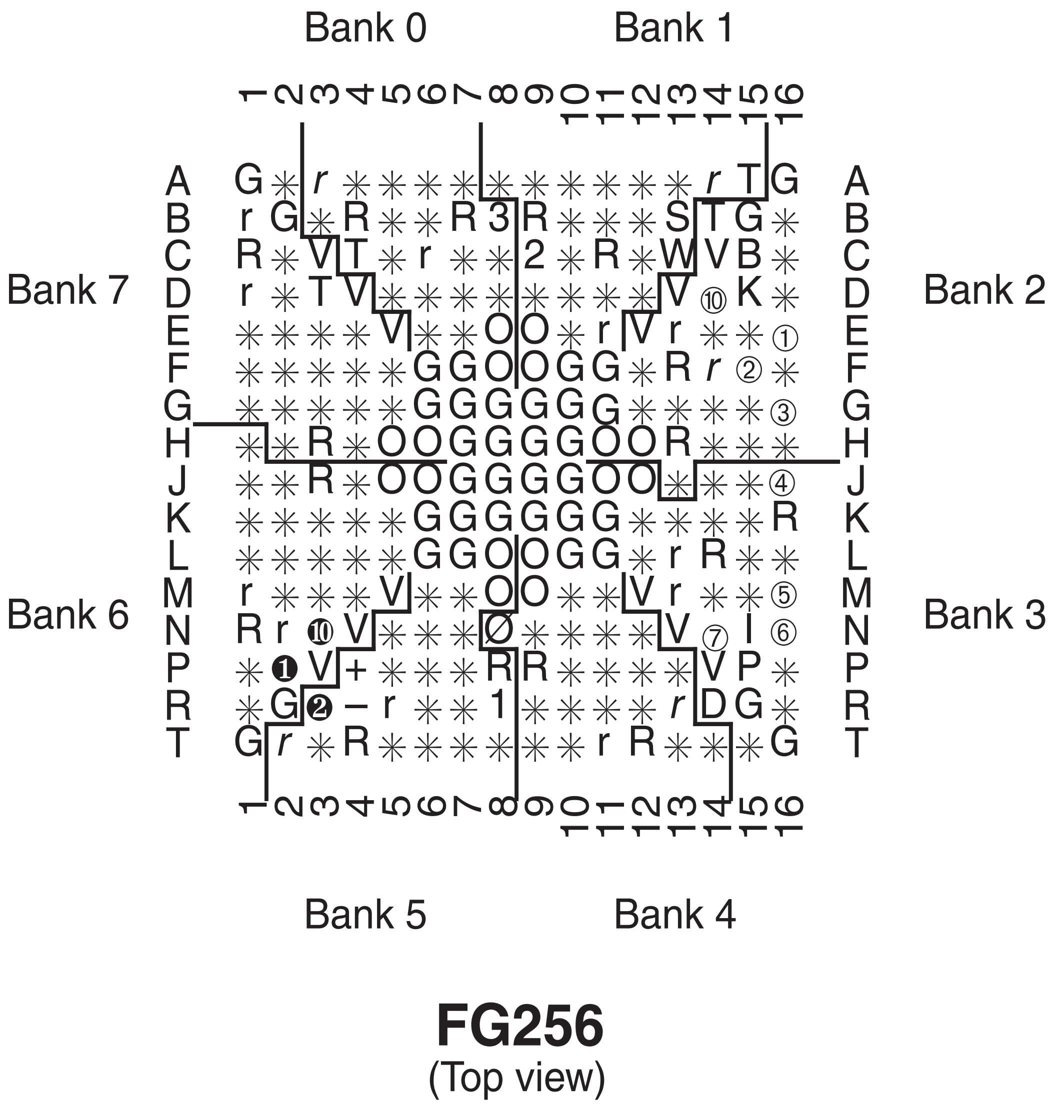

Figure 8: **FG256 Pin Function Diagram**