

## General Description

The Virtex-4™ Family is the newest generation FPGA from Xilinx. The innovative Advanced Silicon Modular Block or ASMBL™ column-based architecture is unique in the programmable logic industry. Virtex-4 FPGAs contain three families (platforms): LX, FX, and SX. Choice and feature combinations are offered for all complex applications. A wide array of hard-IP core blocks complete the system solution. These cores include the PowerPC™ processors (with a new APU interface), Tri-Mode Ethernet MACs, 622 Mb/s to 11.1 Gb/s serial transceivers, dedicated DSP slices, high-speed clock management circuitry, and source-synchronous interface blocks. The basic Virtex-4 building blocks are an enhancement of those found in the popular Virtex-based product families: Virtex, Virtex-E, Virtex-II, Virtex-II Pro, and Virtex-II Pro X, allowing upward compatibility of existing designs. Virtex-4 devices are produced on a state-of-the-art 90-nm copper process, using 300 mm (12 inch) wafer technology. Combining a wide variety of flexible features, the Virtex-4 family enhances programmable logic design capabilities and is a powerful alternative to ASIC technology.

## Summary of Virtex-4 Features

- Three families LX/SX/FX
  - Virtex-4 LX: High-performance logic applications solution
  - Virtex-4 FX: High-performance, full-featured solution for embedded platform applications
  - Virtex-4 SX: High-performance solution for Digital Signal Processing (DSP) applications
- Xesium™ Clock Technology
  - Digital Clock Manager (DCM) blocks
  - Additional Phase-Matched Clock Dividers (PMCD)
  - Differential Global Clocks
- XtremeDSP™ Slice
  - 18x18, two's complement, signed Multiplier
  - Optional pipeline stages
  - Built-In Accumulator (48-bits) & Adder/Subtractor
- Smart RAM Memory Hierarchy
  - Distributed RAM
  - Dual-Port 18-Kbit RAM blocks
    - Optional pipeline stages
    - Optional programmable FIFO logic - Automatically remaps RAM signals as FIFO signals
  - High-speed memory interface support: DDR and DDR-2 SDRAM, QDR-II, RLDRAM-II, and FCRAM-II
- SelectIO Technology
  - 1.5 to 3.3 V I/O Operation
  - Built-In ChipSync™ Source-Synchronous Technology
  - Digitally-controlled impedance (DCI) active termination
  - Fine grained I/O banking (Configuration in one bank)
- Flexible Logic Resources
- Secure Chip AES Bitstream Encryption
- 90-nm copper CMOS process
- 1.2V core voltage
- Flip-Chip Packaging
- RocketIO™ 622 Mb/s to 11.1 Gb/s Multi-Gigabit Transceivers (MGT) (FX only)
- IBM PowerPC RISC Processor Core (FX only)
  - PowerPC 405 (PPC405) Core
  - Auxiliary Processor Unit Interface (User Coprocessor)
- Multiple Tri-Mode Ethernet MACs (FX only)

Table 1: Virtex-4 FPGA Family Members

Device	Configurable Logic Blocks (CLBs) <sup>(1)</sup>				XtremeDSP Slices <sup>(2)</sup>	Block RAM		DCMs	PMCDs	PowerPC Processor Blocks	Ethernet MACs	RocketIO Transceiver Blocks	Total I/O Banks	Max User I/O
	Array Row x Col	Logic Cells	Slices	Max Distributed RAM (Kb)		18 Kb Blocks	Max Block RAM (Kb)							
XC4VLX15	64 x 24	13,824	6,144	96	32	48	864	4	0	N/A	N/A	N/A	9	320
XC4VLX25	96 x 28	24,192	10,752	168	48	72	1,296	8	4	N/A	N/A	N/A	11	448
XC4VLX40	128 x 36	41,472	18,432	288	64	96	1,728	8	4	N/A	N/A	N/A	13	640
XC4VLX60	128 x 52	59,904	26,624	416	64	160	2,880	8	4	N/A	N/A	N/A	13	640
XC4VLX80	160 x 56	80,640	35,840	560	80	200	3,600	12	8	N/A	N/A	N/A	15	768
XC4VLX100	192 x 64	110,592	49,152	768	96	240	4,320	12	8	N/A	N/A	N/A	17	960
XC4VLX160	192 x 88	152,064	67,584	1056	96	288	5,184	12	8	N/A	N/A	N/A	17	960
XC4VLX200	192 x 116	200,448	89,088	1392	96	336	6,048	12	8	N/A	N/A	N/A	17	960

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Table 1: Virtex-4 FPGA Family Members (Continued)

Device	Configurable Logic Blocks (CLBs) <sup>(1)</sup>				XtremeDSP Slices <sup>(2)</sup>	Block RAM		DCMs	PMCDs	PowerPC Processor Blocks	Ethernet MACs	RocketIO Transceiver Blocks	Total I/O Banks	Max User I/O
	Array Row x Col	Logic Cells	Slices	Max Distributed RAM (Kb)		18 Kb Blocks	Max Block RAM (Kb)							
XC4VSX25	64 x 40	23,040	10,240	160	128	128	2,304	4	0	N/A	N/A	N/A	9	320
XC4VSX35	96 x 40	34,560	15,360	240	192	192	3,456	8	4	N/A	N/A	N/A	11	448
XC4VSX55	128 x 48	55,296	24,576	384	512	320	5,760	8	4	N/A	N/A	N/A	13	640
XC4VFX12	64 x 24	12,312	5,472	86	32	36	648	4	0	1	2	N/A	9	320
XC4VFX20	64 x 36	19,224	8,544	134	32	68	1,224	4	0	1	2	8	9	320
XC4VFX40	96 x 44	41,904	15,552	243	48	144	2,592	8	4	2	4	12	11	448
XC4VFX60	128 x 52	56,880	25,280	395	128	232	4,176	12	8	2	4	16	13	576
XC4VFX100	160 x 68	94,896	42,176	659	160	376	6,768	12	8	2	4	20	15	768
XC4VFX140	192 x 84	142,128	63,168	987	192	552	9,936	20	8	2	4	24	17	896

**Notes:**

1. One CLB = Four Slices = Maximum of 64 bits.
2. Each XtremeDSP slice contains one 18 x 18 multiplier, an adder, and an accumulator

## Xesium Clock Technology

- Up to twenty Digital Clock Manager (DCM) modules
  - Precision clock deskew and phase shift
  - Flexible frequency synthesis
  - Dual operating modes to ease performance trade-off decisions
  - Improved maximum input/output frequency
  - Improved phase shifting resolution
  - Reduced output jitter
  - Low-power operation
  - Enhanced phase detectors
  - Wide phase shift range
- Companion Phase-Matched Clock Divider (PMCD) blocks
- Differential clocking structure for optimized low-jitter clocking and precise duty cycle
- 32 Global Clock networks
- Regional I/O and Local clocks

## Flexible Logic Resources

- Up to 40% speed improvement over previous generation devices
- Up to 200,000 logic cells including:
  - Up to 178,176 internal registers with clock enable (XC4VLX200)
  - Up to 178,176 look-up tables (LUTs)
  - Logic expanding multiplexers and I/O registers
- Cascadable variable shift registers or distributed memory capability

## 500 MHz XtremeDSP Slices

- Dedicated 18-bit x 18-bit multiplier, multiply-accumulator, or multiply-adder blocks
- Optional pipeline stages for enhanced performance
- Optional 48-bit accumulator for multiply accumulate (MACC) operation
- Integrated adder for complex-multiply or multiply-add operation
- Cascadeable Multiply or MACC
- Up to 100% speed improvement over previous generation devices.

## 500 MHz Integrated Block Memory

- Up to 10Mb of integrated block memory
- Optional pipeline stages for higher performance
- Multi-rate FIFO support logic
  - Full and Empty Flag support
  - Fully programmable AF and AE Flags
  - Synchronous/ Asynchronous Operation
- Dual-port architecture
- Independent read and write port width selection (RAM only)
- 18 Kbit blocks (memory and parity/sideband memory support)
- Configurations from 16K x 1 to 512 x 36 (4K x 4 to 512 x 36 for FIFO operation)
- Byte-write capability (connection to PPC405, etc.)
- Dedicated cascade routing to form 32K x 1 memory without using FPGA routing
- Up to 100% speed improvement over previous generation devices.

## SelectIO Technology

- Up to 960 user I/Os
- Wide selections of I/O standards from 1.5V to 3.3V
- Extremely high-performance
  - 600 Mb/s HSTL & SSTL (on all single-ended I/O)
  - 1 Gb/s LVDS (on all differential I/O pairs)
- True differential termination
- Selected low-capacitance I/Os for improved signal integrity
- Same edge capture at input and output I/Os
- Memory interface support for DDR and DDR-2 SDRAM, QDR-II, RLDRAM-II, and FCRAM-II

## ChipSync Technology

- Integrated with SelectIO technology to simplify source-synchronous interfaces
- Per-bit deskew capability built in all I/O blocks (variable input delay line)
- Dedicated I/O and regional clocking resources (pin and trees)
- Built in data serializer/deserializer logic in all I/O and clock dividers
- Memory/Networking/Telecommunication interfaces up to 1 Gb/s+

## Digitally Controlled Impedance (DCI) Active I/O Termination

- Optional series or parallel termination
- Temperature compensation

## Configuration

- 256-bit AES bitstream decryption provides intellectual property (IP) security
- Improved bitstream error detection/correction capability
- Fast SelectMAP configuration
- JTAG support
- Readback capability

## 90 nm Copper CMOS Process

## 1.2V Core Voltage

## Flip-Chip Packaging

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## System Blocks Specific to the FX Family

### RocketIO Multi-Gigabit Transceiver (MGT)

- Full-duplex serial transceiver (MGT) capable of 622 Mb/s to 11.1 Gb/s baud rates
- 8b/10b, 64b/66b, user-defined FPGA logic, or no data encoding
- Channel bonding support
- CRC generation and checking
- Programmable pre-emphasis or pre-equalization for the transmitter
- Programmable continuous time equalization for the receiver
- Programmable discrete feedback equalization for the receiver
- On-chip AC coupled receiver
- Receiver signal detect and loss of signal indicator
- Transmit driver sleep mode
- User dynamic reconfiguration using secondary configuration bus

### PowerPC 405 RISC Core

- Embedded PowerPC 405 (PPC405) core
  - Up to 450 MHz operation
  - Five-stage data path pipeline
  - 16 KB instruction cache
  - 16 KB data cache
  - Enhanced instruction and data on-chip memory (OCM) controllers
  - Additional frequency ratio options between PPC405 and Processor Local Bus
- Auxiliary Processor Unit (APU) Interface for direct connection from PPC405 to coprocessors in fabric
  - APU can run at different clock rates
  - Supports autonomous instructions: no pipeline stalls
  - 32-bit instruction and 64-bit data
  - 4-cycle cache line transfer

## Tri-mode Ethernet Media Access Controller

- IEEE 802.3 compliant
- Operates at 10, 100, and 1,000 Mb/s
- Supports tri-mode auto-detect
- Receive address filter
- Fully monolithic 1000Base-X solution with RocketIO MGT
- Implements SGMII through RocketIO MGT to external PHY device
- Supports multiple PHY (MII, GMII, etc.) interfaces through an I/O resource
- Receive and transmit statistics available through separate interfaces
- Separate host and client interfaces
- Support for jumbo frames
- Flexible, user-configurable host interface

## Architectural Description

### Virtex-4 Array Overview

Virtex-4 devices are user-programmable gate arrays with various configurable elements and embedded cores optimized for high-density and high-performance system designs. Virtex-4 devices implement the following functionality:

- I/O blocks provide the interface between package pins and the internal configurable logic. Most popular and leading-edge I/O standards are supported by programmable I/O blocks (IOBs). The IOBs are enhanced for source-synchronous applications. Source-synchronous optimizations include per-bit skew, data serializer/deserializer, clock dividers, and dedicated local clocking resources.
- Configurable Logic Blocks (CLBs), the basic logic elements for Xilinx FPGAs, provide combinatorial and synchronous logic as well as distributed memory and SRL16 shift register capability.
- Block RAM modules provide flexible 18Kbit true dual-port RAM, that are cascadable to form larger memory blocks. In addition, Virtex-4 block RAMs contain optional programmable FIFO logic for increased device utilization.
- Cascadable embedded XtremeDSP slices with 18-bit x 18-bit dedicated multipliers, integrated Adder, and 48-bit accumulator.
- Digital Clock Manager (DCM) blocks provide self-calibrating, fully digital solutions for clock distribution delay compensation, clock multiplication/division, and coarse-/fine-grained clock phase shifting.

Additionally, FX devices support the following embedded system functionality:

- Integrated high-speed serial transceivers enable data rates up to 11.1 Gb/s per channel.
- Embedded IBM PowerPC 405 RISC CPU (up to 450 MHz) with the auxiliary processor unit interface
- 10/100/1000 Ethernet media-access control (EMAC) cores.

The general routing matrix (GRM) provides an array of routing switches between each component. Each programmable element is tied to a switch matrix, allowing multiple connections to the general routing matrix. The overall programmable interconnection is hierarchical and designed to support high-speed designs.

All programmable elements, including the routing resources, are controlled by values stored in static memory cells. These values are loaded in the memory cells during configuration and can be reloaded to change the functions of the programmable elements.

## Virtex-4 Features

This section briefly describes the features of the Virtex-4 family of FPGAs.

### Input/Output Blocks (SelectIO)

IOBs are programmable and can be categorized as follows:

- Programmable single-ended or differential (LVDS) operation
- Input block with an optional single data rate (SDR) or double data rate (DDR) register
- Output block with an optional SDR or DDR register
- Bidirectional block
- Per-bit deskew circuitry
- Dedicated I/O and regional clocking resources
- Built in data serializer/deserializer

The IOB registers are either edge-triggered D-type flip-flops or level-sensitive latches.

IOBs support the following single-ended standards:

- LVTTTL
- LVCMOS (3.3V, 2.5V, 1.8V, and 1.5V)
- PCI (33 and 66 MHz)
- PCI-X
- GTL and GTLP
- HSTL 1.5V and 1.8V (Class I, II, III, and IV)
- SSTL 1.8V and 2.5V (Class I and II)

The DCI I/O feature can be configured to provide on-chip termination for each single-ended I/O standard and some differential I/O standards.

The IOB elements also support the following differential signaling I/O standards:

- LVDS and Extended LVDS (2.5V only)
- BLVDS (Bus LVDS)
- ULVDS
- Hypertransport™
- Differential HSTL 1.5V and 1.8V (Class II)
- Differential SSTL 1.8V and 2.5V (Class II)

Two adjacent pads are used for each differential pair. Two or four IOB blocks connect to one switch matrix to access the routing resources.

Per-bit deskew circuitry allows for programmable signal delay internal to the FPGA. Per-bit deskew flexibly provides fine-grained increments of delay to carefully produce a range of signal delays. This is especially useful for synchronizing signal edges in source synchronous interfaces.

General purpose I/O in select locations (four per bank) are designed to be "regional clock capable" I/O by adding special hardware connections for I/O in the same locality. These regional clock inputs are distributed within a limited region to minimize clock skew between IOBs. Regional I/O clocking supplements the global clocking resources.

Data serializer/deserializer capability is added to every I/O to support source synchronous interfaces. A serial-to-parallel converter with associated clock divider is included in the input path, and a parallel-to-serial converter in the output path.

An in-depth guide to the Virtex-4 IOB is discussed in the [Virtex-4 User Guide](#).

### Configurable Logic Blocks (CLBs)

A CLB resource is made up of four slices. Each slice is equivalent and contains:

- Two function generators (F & G)
- Two storage elements
- Arithmetic logic gates
- Large multiplexers
- Fast carry look-ahead chain
- Horizontal cascade chain

The function generators F & G are configurable as 4-input look-up tables (LUTs). Two slices in a CLB can have their LUTs configured as 16-bit shift registers, or as 16-bit distributed RAM. In addition, the two storage elements are either edge-triggered D-type flip-flops or level sensitive latches. Each CLB has internal fast interconnect and connects to a switch matrix to access general routing resources.

The Virtex-4 CLBs are further discussed in the [Virtex-4 User Guide](#).

### Block RAM

The block RAM resources are 18 Kb true dual-port RAM blocks, programmable from 16K x 1 to 512 x 36, in various depth and width configurations. Each port is totally synchronous and independent, offering three "read-during-write" modes. Block RAM is cascadable to implement large embedded storage blocks. Additionally, back-end pipeline registers, clock control circuitry, built-in FIFO support, and byte write enable are new features supported in the Virtex-4 FPGA.

The block RAM feature in Virtex-4 devices is further discussed in the [Virtex-4 User Guide](#).

## XtremeDSP Slices

The XtremeDSP slices contain a dedicated 18 x 18-bit 2's complement signed multiplier, adder logic, and a 48-bit accumulator. Each multiplier or accumulator can be used independently. These blocks are designed to implement extremely efficient and high-speed DSP applications.

The block DSP feature in Virtex-4 devices are further discussed in *XtremeDSP Design Considerations*.

## Global Clocking

The DCM and global-clock multiplexer buffers provide a complete solution for designing high-speed clock networks.

Up to twenty DCM blocks are available. To generate deskewed internal or external clocks, each DCM can be used to eliminate clock distribution delay. The DCM also provides 90°, 180°, and 270° phase-shifted versions of the output clocks. Fine-grained phase shifting offers higher resolution phase adjustment with fraction of the clock period increments. Flexible frequency synthesis provides a clock output frequency equal to a fractional or integer multiple of the input clock frequency.

Virtex-4 devices have 32 global-clock MUX buffers. The clock tree is designed to be differential. Differential clocking helps reduce jitter and duty cycle distortion.

## Routing Resources

All components in Virtex-4 devices use the same interconnect scheme and the same access to the global routing matrix. Timing models are shared, greatly improving the predictability of the performance for high-speed designs.

## Boundary Scan

Boundary-scan instructions and associated data registers support a standard methodology for accessing and configuring Virtex-4 devices, complying with IEEE standards 1149.1 and 1532.

## Configuration

Virtex-4 devices are configured by loading the bitstream into internal configuration memory using one of the following modes:

- Slave-serial mode
- Master-serial mode
- Slave SelectMAP mode
- Master SelectMAP mode
- Boundary-scan mode (IEEE-1532)

Optional 256-bit AES decryption is supported on-chip (with software bitstream encryption) providing Intellectual Property security.

## Virtex-4 FX Family

This section briefly describes blocks available only in FX devices.

### RocketIO Multi-Gigabit Transceiver

8 - 24 Channels RocketIO Multi-Gigabit Serial Transceivers (MGTs) capable of running 622 Mb/s - 11.1 Gb/s

- Full Clock and Data Recovery
- 32-bit or 40-bit datapath support
- Optional 8b/10b, 64b/66b, or FPGA-based encode/decode
- Integrated FIFO/Elastic Buffer
- Support for Channel Bonding
- Embedded 32-bit CRC generation/checking
- Integrated Comma-detect or programmable A1/A2, A1A1/A2A2 detection
- Programmable pre-emphasis (AKA transmitter equalization)
- Programmable receiver equalization
- Embedded support for:
  - Out of Band (OOB) Signalling: Serial ATA
  - Beaconing and Electrical Idle: PCI-Express™
- On-chip bypassable AC coupling for receiver

### One or Two PowerPC 405 Processor Cores

- 32-bit Harvard Architecture
- 5-Stage Execution Pipeline
- Integrated 16KB Level 1 Instruction Cache and 16KB Level 1 Data Cache
  - Integrated Level 1 Cache Parity Generation and Checking
- CoreConnect™ Bus Architecture
- Efficient, high-performance on-chip memory (OCM) interface to block RAM
- PLB Synchronization Logic (Enables Non-Integer CPU-to-PLB Clock Ratios)
- Auxiliary Processor Unit (APU) Interface and Integrated APU Controller
  - Optimized FPGA-based Coprocessor connection
    - Automatic decode of PowerPC floating-point instructions
  - Allows custom instructions (Decode for up to eight instructions)
  - Extremely efficient microcontroller-style interfacing

## Two or Four Tri-Mode (10/100/1000 Mb/s) Ethernet Media Access Control (MAC) Cores

- IEEE 802.3-2000 Compliant
- MII/GMII Interface or SGMII (when used with RocketIO Transceivers)
- Can Operate Independent of PowerPC processor
- Half or Full Duplex
- Supports Jumbo Frames
- 1000 Base-X PCS/PMA: When used with RocketIO MGT can provide complete 1000 Base-X implementation on-chip

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## Intellectual Property Cores

Xilinx offers IP cores for commonly used complex functions including DSP, bus interfaces, processors, and processor peripherals. Using Xilinx LogiCORE™ products and cores from third party AllianceCORE participants, customers can shorten development time, reduce design risk, and obtain superior performance for their designs. Additionally, our CORE Generator™ system allows customers to implement IP cores into Virtex-4 FPGAs with predictable and repeatable performance. It offers a simple user interface to generate parameter-based cores optimized for our FPGAs.

The System Generator for DSP tool allows system architects to quickly model and implement DSP functions using handcrafted IP, and features an interface to third-party system level DSP design tools. System Generator for DSP implements many of the high-performance DSP cores supporting Virtex-4 FPGAs including the Xilinx Forward Error Correction Solution with Interleaver/De-interleaver, Reed-Solomon encoder/decoders, and Viterbi decoders. These are ideal for creating highly-flexible, concatenated codecs to support the communications market.

Industry leading connectivity and networking IP cores include the electronics industry's first Advanced Switching

product, leading-edge PCI Express, Serial RapidIO, Fibre Channel, and 10Gb Ethernet cores that include Virtex-4 RocketIO multi-gigabit serial interfaces. The Xilinx SPI-4.2 IP core utilizes the Virtex-4 embedded ChipSync technology to implement dynamic phase alignment for high-performance source-synchronous operation.

MicroBlaze™ 32-bit core provides the industry's fastest soft processing solution for building complex systems for the networking, telecommunication, data communication, embedded and consumer markets. The MicroBlaze processor features a RISC architecture with Harvard-style separate 32-bit instruction and data busses running at full speed to execute programs and access data from both on-chip and external memory. A standard set of peripherals are also CoreConnect™ enabled to offer MicroBlaze designers compatibility and reuse.

All IP cores for Virtex-4 FPGAs are found on the Xilinx IP Center Internet portal presenting the latest intellectual property cores and reference designs via Smart Search for faster access.

## Application Notes and Reference Designs

Application notes and reference designs written specifically for the Virtex-4 family are available on the Xilinx web site at:

<http://www.xilinx.com/virtex4>

## Virtex-4 Device and Package Combinations and Maximum I/Os

Table 2: Virtex-4 Device and Package Combinations and Maximum Available I/Os

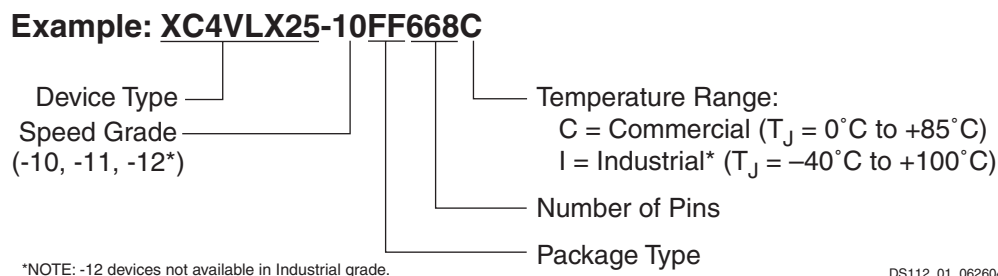
Package	SF363		FF672		FF668		FF1148		FF1152		FF1513		FF1517		FF1760	
Size	17 x 17		27 x 27		27 x 27		35 x 35		35 x 35		40 x 40		40 x 40		42.5 x 42.5	
Device	MGTs	I/O	MGTs	I/O	MGTs	I/O	MGTs	I/O	MGTs	I/O	MGTs	I/O	MGTs	I/O	MGTs	I/O
XC4VLX15	N/A	240			N/A	320										
XC4VLX25	N/A	240			N/A	448										
XC4VLX40					N/A	448	N/A	640								
XC4VLX60					N/A	448	N/A	640								
XC4VLX80							N/A	768								
XC4VLX100							N/A	768			N/A	960				
XC4VLX160							N/A	768			N/A	960				
XC4VLX200											N/A	960				
XC4VSX25					N/A	320										
XC4VSX35					N/A	448										
XC4VSX55							N/A	640								
XC4VFX12 <sup>(1)</sup>	N/A	240			N/A	320										
XC4VFX20 <sup>(1)</sup>			8	320												
XC4VFX40 <sup>(1)</sup>			12	352					12	448						
XC4VFX60 <sup>(1)</sup>			12	352					16	576						
XC4VFX100 <sup>(1)</sup>									20	576			20	768		
XC4VFX140 <sup>(1)</sup>													24	768	24	896

**Notes:**

1. These package/part combinations and the quantity of MGTs and I/Os are not final numbers.

## Virtex-4 Ordering Information

Virtex-4 ordering information is shown in Figure 1.



DS112\_01\_062604

Figure 1: Virtex-4 Ordering Information



## Revision History

The following table shows the revision history for this document.

Date	Version	Revision
08/02/04	1.0	Initial Xilinx release. Printed Handbook version.
09/10/04	1.1	Typographical edits.
12/08/04	1.2	Removed System Monitor and ADC references. Edited Ethernet MAC section.

## Virtex-4 Documentation

Complete and up-to-date documentation of the Virtex-4 family of FPGAs is available on the Xilinx web site. In addition to the most recent Virtex-4 Family Overview, the following files are also available for download:

### *Virtex-4 Data Sheet: DC and Switching Characteristics*

This data sheet contains the DC and Switching Characteristic specifications for the Virtex-4 family.

### *Virtex-4 User Guide*

This guide includes chapters on:

- Clocking Resources
- Digital Clock Manager (DCM)
- Phase-Matched Clock Dividers (PMCD)
- Block RAM and FIFO memory
- Configurable Logic Blocks (CLBs)
- SelectIO Resources
- SelectIO Logic Resources
- Advanced SelectIO Logic Resources

### *XtremeDSP Design Considerations*

This guide describes the DSP48 slice and includes reference designs for using DSP48 math functions and various FIR filters.

### *Virtex-4 Configuration Guide*

This all-encompassing configuration guide includes chapters on configuration interfaces (serial and SelectMAP), bit-stream encryption, boundary-scan and JTAG configuration, and reconfiguration techniques.

### *Virtex-4 Packaging and Pinout Specification*

This specification includes the tables for device/package combinations and maximum I/Os, pin definitions, pinout tables, pinout diagrams, mechanical drawings, and thermal specifications.

### *Virtex-4 PCB Designer's Guide*

This guide describes PCB guidelines for the Virtex-4 family. It covers SelectIO signaling, RocketIO signaling, power distribution systems, PCB breakout, and parts placement.

### *Virtex-4 RocketIO Multi-Gigabit Transceiver User Guide*

This guide describes the RocketIO Multi-Gigabit Transceivers available in the Virtex-4 FX family.

### *Virtex-4 Tri-mode Ethernet Media Access Controller*

This guide describes the Embedded Tri-mode Ethernet Media Access Controller available in the Virtex-4 FX family.

### *PowerPC 405 Processor Block Reference Guide*

This guide is updated to include the PowerPC 405 processor block available in the Virtex-4 FX family.

