XILINX®

An Introduction to Xilinx Products

November 10, 1997

About this Book

This Data Book provides a "snapshot in time" in its listing of IC devices and development system software available from Xilinx as of late 1997. New devices, speed grades, package types and development system products are continually being added to the Xilinx product portfolio. Users are encouraged to contact their local Xilinx sales representative and consult the WebLINX World Wide Web site and the quarterly XCELL newsletter for the latest information regarding new product availability.

This book covers the current XC4000E/EX/XL, XC4000XV, XC4000XLT, Spartan, XC5200, XC3000A/L, XC3100A/L, XC9500, XC1700D/L and XC1701L.

The product specifications for several older Xilinx FPGA families are not included in this Data Book. This does not imply that these products are no longer available. However, for new designs, users are encouraged to use the newer products described in this book, which offer better performance at lower cost than the older technologies. Product specifications for the older products are available at WebLINX, the Xilinx site on the World Wide Web, or through your local Xilinx sales representative.

Data Sheet Categories

In order to provide the most up-to-date information, some component products included in this book may not have been fully characterized at the time of publication. In these cases, the AC and DC characteristics included in the data sheets will be marked as *Advance* or *Preliminary* information. (Not withstanding the definitions of such terms, all specifications are subject to change without notice.) These designations have the following meaning:

- **Advance** — Initial estimates based on simulation and/or extrapolation from other speed grades, devices, or device families. Use as estimates, but not for final production.
- **Preliminary** — Based on preliminary characterization. Changes are possible, but not expected.
- **Final (unmarked)** — Specifications not identified as either Advance or Preliminary are to be considered final.

Data Book Contents

Chapter 1 is a general overview of the Xilinx product line, and is recommended reading for designers who are new to the field of high-density programmable logic.

Chapter 2 contains a discussion of the overall design methodology when using Xilinx programmable logic and descriptions of Xilinx development system products. This chapter is placed at the beginning of the book since these development tools are needed to design with any of the Xilinx programmable logic devices.

Chapter 3 contains the product descriptions for the Xilinx Complex Programmable Logic Device (CPLD) products, including the XC9000 series.

Chapter 4 includes the product descriptions for the Xilinx static-memory-based Field Programmable Gate Array (FPGA) products, including the XC3000, XC4000, XC5000, and Spartan series.

Chapter 5 holds the product descriptions for the XC1701L and XC1700D families of Serial PROM devices. These Serial PROMs provide a convenient, low-cost means of storing configuration programs for the SRAM-based FPGAs described in Chapter 4.

Chapter 6 is an overview of Xilinx components appropriate for 3.3 V and mixed-voltage systems. This chapter will refer you back to the appropriate product descriptions in the earlier chapters.

Chapter 7 contains a brief overview of the HardWire product line. Detailed product specifications are available in separate Xilinx data sheets.

Chapter 8 is an overview of Xilinx High-Reliability/Military products. Detailed product specifications are available in separate Xilinx data sheets.

Chapter 9 describes the HW130 device programmer for the XC170X series of Serial PROMs and the XC9500 series of CPLDs.

Chapter 10 contains a description of all the physical packages for the various IC products, including information about the thermal characteristics of those packages.

Chapter 11 discusses the testing, quality, and reliability of Xilinx component products.

Chapter 12 includes a listing of all the technical support facilities provided by Xilinx.

Chapter 13 contains additional information about Xilinx components that is not provided in the product specifications of the earlier chapters. This includes some additional electrical parameters that are not in the product specifications because they are not part of the manufacturing test program for the particular device, but may be of interest to the user. Also included in this chapter is a discussion of the

JTAG boundary test scan logic found in several Xilinx component families.

The final two sections contain an index to the topics included in this Data Book and a listing of Xilinx sales offices, sales representatives, and distributors.

About the Company

Xilinx, Inc., offers the industry's broadest selection of programmable logic devices. With 1997 revenues of over $560 million, Xilinx is the world's largest supplier of programmable logic, and the market leader in Field Programmable Gate Arrays (FPGAs).

Xilinx was founded in 1984, based on the revolutionary idea of combining the logic density and versatility of gate arrays with the time-to-market advantages and convenience of user-programmable standard parts. One year later, Xilinx introduced the world's first Field Programmable Gate Array. Since then, through a combination of architectural and manufacturing process improvements, the company has continually increased device performance, in terms of capacity, speed, and ease-of-use, while lowering costs.

In 1992, Xilinx expanded its product line to include advanced Complex Programmable Logic Devices (CPLDs). For the user, CPLDs are an attractive complement to FPGAs, offering simpler design software and more predictable timing.

As the market leader in one of the fastest growing segments of the semiconductor industry, Xilinx strategy is to focus its resources on creating new ICs and development system software, providing world-class technical support, developing markets, and building a diverse customer base across a broad range of geographic and end-use application segments. The company has avoided the large capital commitment and overhead burden associated with sole ownership and operation of a wafer fabrication facility. Instead, Xilinx has established alliances with several high-volume, state-of-the-art CMOS IC manufacturers. Using standard, high-volume processes assures low manufacturing costs, produces programmable logic devices with well-established reliability, and provides for early access to advances in CMOS processing technology.

Xilinx headquarters are located in San Jose, California. The company markets its products worldwide through a network of direct sales offices, manufacturers' representatives, and distributors (as listed in the back of this book). The company has representatives and distributors in over 38 countries.

Product Line Overview

Field Programmable Gate Arrays (FPGAs) and Complex Programmable Logic Devices (CPLDs) can be used in virtually any digital logic system. Over 50 million Xilinx components have been used in a wide variety of end-equipment applications, ranging from supercomputers to hand-held

instruments, from central office switches to centrifuges, and from missile guidance systems to guitar synthesizers.

Xilinx achieved its leading position through a continuing commitment to provide a complete product solution. This encompasses a focus on all three critical areas of the high-density programmable solution "triangle": components (silicon), software, and service (Figure 2).

Programmable Logic vs. Gate Arrays

Xilinx programmable logic devices provide the benefits of high integration levels without the risks or expenses of semi-custom and custom IC development. Some of the benefits of programmable logic versus mask-programmed gate arrays are briefly discussed below.

Faster Design and Verification

Xilinx FPGAs and CPLDs can be designed and verified quickly while the same process requires several weeks with gate arrays. There are no non-recurring engineering (NRE) costs, no test vectors to generate, and no delay while waiting for prototypes to be manufactured.

Design Changes without Penalty

Because the devices are software-configured and user-programmed, modifications are much less risky and can be made anytime - in a manner of minutes or hours, as opposed to the weeks it would take with a gate array. This results in significant cost savings in design and production.

Shortest Time-to-Market

When designing with Xilinx programmable logic, time-to-market is measured in days or a few weeks, not the months often required when using gate arrays. A study by market research firm McKinsey & Co. concluded that a six-month delay in getting to market can cost a product
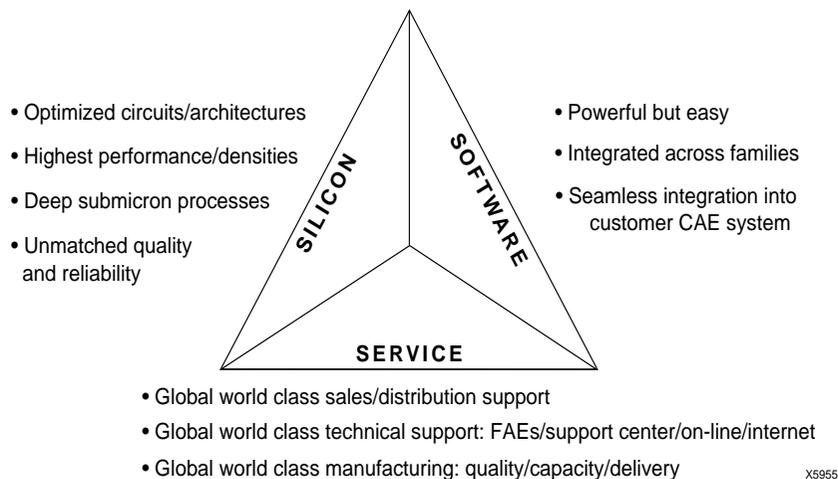
one-third of its lifetime potential profit. With mask-programmed gate arrays, design iterations can easily add that much time, and more, to a product schedule.

Once the decision has been made to use Xilinx programmable logic, a choice must be made from a number of product families, device options, and product types. The information in the product selection matrices that follow can help guide that selection; detailed product specifications are available in subsequent chapters of this book. Since many component products are available in common packages with common footprints, designs often can be migrated to higher or lower density devices, or even across some product families, without any printed circuit board changes. Design ideas, represented in text or schematic format, are converted into a configuration data file for an FPGA or CPLD device using the Xilinx XACT*step* development software running on a PC or workstation.

Component Products

Xilinx offers the broadest line of programmable logic devices available today, with hundreds of products featuring various combinations of architectures, logic densities, package types, and speed grades in commercial, industrial, and military grades. This breadth of product offerings allows the selection of the programmable logic device that is best suited for the target application.

Xilinx programmable logic offerings include several families of reprogrammable FPGAs and FLASH-memory-based CPLDs (Figure 3). HardWire devices are mask-programmed versions of the reprogrammable FPGAs, and provide a transparent, no-risk migration path to lower-cost devices for high-volume, stable designs. Additionally, a family of Serial PROM devices is available to store configuration programs for the reprogrammable FPGA devices. Many devices are available in military temperature range

• Optimized circuits/architectures

• Highest performance/densities

• Deep submicron processes

• Unmatched quality and reliability

SILICON

SOFTWARE

• Powerful but easy

• Integrated across families

• Seamless integration into customer CAE system

SERVICE

• Global world class sales/distribution support

• Global world class technical support: FAEs/support center/on-line/internet

• Global world class manufacturing: quality/capacity/delivery

X5955

Figure 2: The Xilinx Programmable Solution Triangle

and/or MIL-STD-883B versions, for high-reliability and military applications.

Field Programmable Gate Arrays (FPGAs)

FPGA devices feature a gate-array-like architecture, with a matrix of logic cells surrounded by a periphery of I/O cells, as diagrammed in Figure 4. Segments of metal interconnect can be linked in an arbitrary manner by programmable switches to form the desired signal nets between the cells.

FPGAs combine an abundance of logic gates, registers, and I/Os with fast system speed. Xilinx offers several families of reprogrammable, static-memory-based (SRAM-based) FPGAs, including the XC3000, XC4000, XC5000, and XC6000 series.
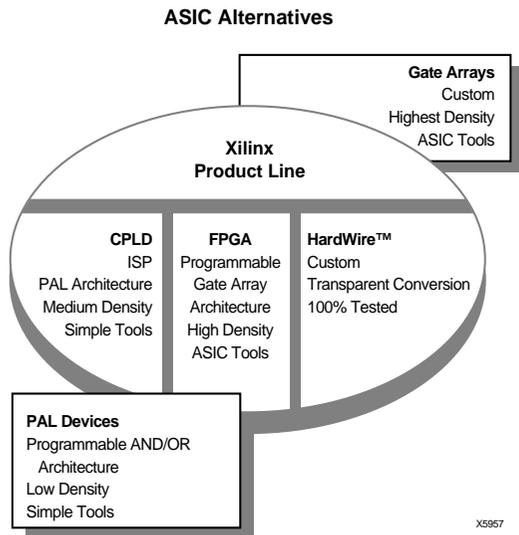
ASIC Alternatives

Figure 3: Application-Specific IC Products

Complex Programmable Logic Devices (CPLDs)

Designers more comfortable with the speed, design simplicity, and predictability of PALs may prefer CPLD devices. Conceptually, CPLDs consist of multiple PAL-like function blocks that can be interconnected through a switch matrix (Figure 5). The XC9000 CPLD series features 5V in-system programmable FLASH technology, and, like most of the FPGA families, includes built-in JTAG boundary scan test logic.

HardWire devices

HardWire devices are masked-programmed versions of the SRAM-based FPGAs. The HardWire products provide an easy, transparent migration path to a cost-reduced device without the engineering burden associated with conventional gate array re-design. The HardWire gate array is architecturally identical to its FPGA counterpart, but the programmable elements in the FPGA are replaced with fixed metal connections. The resulting die is considerably smaller, with a correspondingly lower cost. Using proprietary automatic test vector generation software and patented test logic, Xilinx guarantees over 95% fault coverage, while eliminating the need for user-generated test vectors. The mask and test programs are generated automatically by Xilinx from the user's existing FPGA design file.

Serial PROMs

The XC1700 family features one-time programmable serial PROMs ranging in density from about 18,000 bits to over 260,000 bits. These serial PROMs are an easy-to-use, cost-effective method for storing configuration data for the SRAM-based FPGAs.
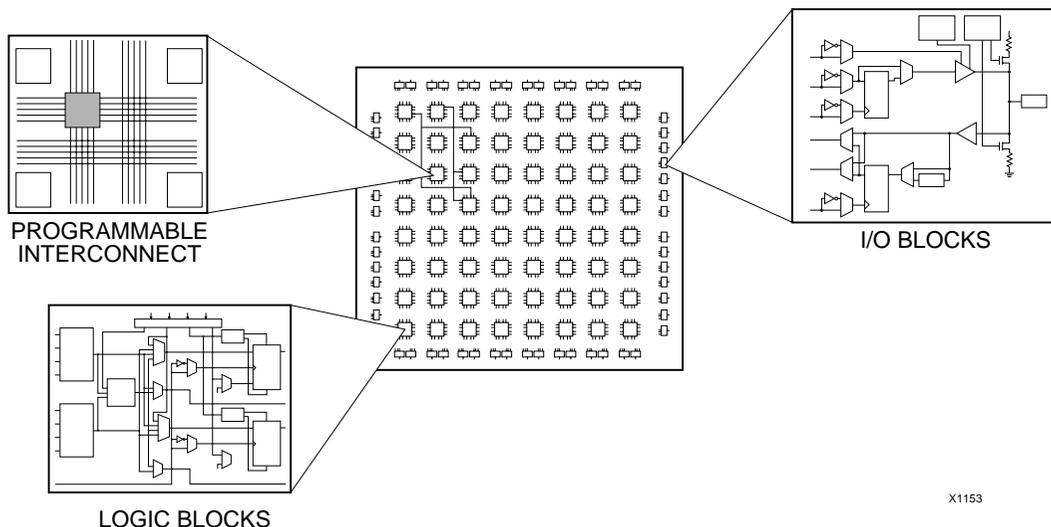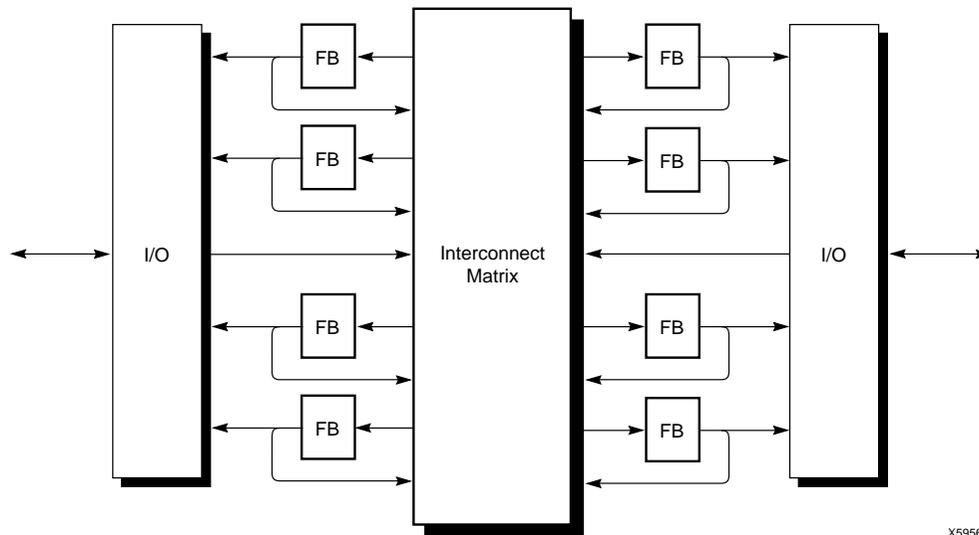

Figure 4: FPGA Architecture

Figure 5:   CPLD Architecture

High-Reliability Devices

Xilinx was the first company to offer high-reliability FPGAs by introducing MIL-STD-883B qualified XC2000 and XC3000 series devices in 1989. MIL-STD-883B members of the XC4000 FPGA series are currently available, and qualified versions of additional Xilinx families are in development. The product line also includes Standard Microcircuit Drawing (SMD) versions of several families. Some Xilinx devices are available in tested die form through arrangements with manufacturing partners.

Development System Products

Xilinx offers a complete software environment for the implementation of logic designs in Xilinx programmable logic devices. This environment combines powerful technology with a flexible, easy-to-use graphical interface to help users achieve the best possible designs, regardless of experience level. The user has a wide range of choices between a fully-automatic implementation and detailed involvement in the layout process. The development system provides all the implementation tools required to design with Xilinx logic devices, including the following:

- libraries and interfaces for popular schematic editors, logic synthesis tools, and simulators
- design manager/flow engine
- module generator
- map, place, and route compilation software
- static timing analyzer
- hardware debugger

Xilinx is committed to an "open system" approach to front-end design creation, synthesis, and verification. Xilinx devices are supported by the broadest number of EDA vendors and synthesis vendors in the industry. Supported plat-forms include the ubiquitous PC and several popular workstations.

Technical Support and Service

Providing global, world-class manufacturing, technical support, and sales/distribution support is an essential foundation of the Xilinx product strategy. Xilinx manufacturing facilities have earned ISO9002 certification, and Xilinx quality and reliability achievements are among the world's best - not just for programmable logic suppliers, but among all semiconductor companies. Comprehensive technical support facilities include training courses, extensive product documentation and application notes, a quarterly technical newsletter, the WebLINX World Wide Web site, technical support hotlines, and a cadre of Field Application Engineers. Sales support is provided by a worldwide network of representatives and distributors.

XC3000 Series Product Selection Matrix

DEVICES	XC3000 Series	XC3020A/L	XC3030A/L	XC3042A/L	XC3064A/L	XC3090A/L	XC3120A	XC3130A	XC3142A	XC3164A	XC3190A	XC3195A	XC3142L	XC3190L
KEY FEATURES				Low Cost/ Low Power					High Performance				Low Voltage (3.3 V) High Performance	
DENSITY	Max Logic Gates (K)	1.5	2	3	4.5	6	1.5	2	3	4.5	6	7.5	3	6
	Max RAM Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Typical Gate Range (K)	1-1.5	1.5-2	2-3	3.5-4.5	5-6	1-1.5	1.5-2	2-3	3.5-4.5	5-6	6.5-7.5	2-3	5-6
	CLBs	64	100	144	224	320	64	100	144	224	320	484	144	320
	Flip-Flops	256	360	480	688	928	256	360	480	688	928	1320	480	928
FEATURES	Output Drive (mA)	4	4	4	4	4	8	8	8	8	8	8	4	4
	JTAG (IEEE 1149.1)	N	N	N	N	N	N	N	N	N	N	N	N	N
	Dedicated Arithmetic	N	N	N	N	N	N	N	N	N	N	N	N	N
	Quiescent Current (mA)	0.5/0.02	0.5/0.02	0.5/0.02	0.5/0.02	0.5/0.02	8	8	8	8	8	8	1.5	1.5
	Fastest Speed Grade	-6/-8	-6/-8	-6/-8	-6/-8	-6/-8	-09	-09	-09	-09	-09	-09	-2	-2

XC4000 Series Product Selection Matrix

DEVICES	XC4000 Series	XC4003E	XC4005E/XL	XC4006E	XC4008E	XC4010E/XL	XC4013E/XL	XC4020E/XL	XC4025E	XC4028EX/XL	XC4036EX/XL	XC4044XL	XC4052XL	XC4062XL	XC4085XL
KEY FEATURES							High Density High Performance Select-RAM™ Memory								
DENSITY	System Gate Range* (Logic and RAM) (K)	2-5	3-9	4-12	6-15	7-20	10-30	13-40	15-45	18-50	22-65	27-80	33-100	40-130	55-180
	Logic Cells	238	466	608	770	950	1368	1862	2432	2432	3078	3800	4598	5472	7448
	Max Logic Gates, (no RAM) (K)	3	5	6	8	10	13	20	25	28	36	44	52	62	85
	Max RAM Bits (no Logic)	3200	6272	8192	10368	12800	18432	25088	32768	32768	41472	51200	61952	73728	100352
	CLBs	100	196	256	324	400	576	784	1024	1024	1296	1600	1936	2304	3136
	Flip-Flops	360	616	768	936	1120	1536	2016	2560	2560	3168	3840	4576	5376	7168
FEATURES	Output Drive (mA)	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	JTAG (IEEE 1149.1)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Dedicated Arithmetic	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Quiescent Current (mA)	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Fastest Speed Grade	-1	-09	-1	-1	-09	-09	-09	-1	-09	-09	-09	-09	-09	-09

*Maximum System gates assume 20% of CLBs used as RAM

Spartan Series Product Selection Matrix

DEVICES	Spartan Series	XCS05 XCS05-XL	XCS10 XCS10-XL	XCS20 XCS20-XL	XCS30 XCS30-XL	XCS40 XCS40-XL
KEY FEATURES		High Density High Performance Select-RAM™ Memory Low Cost				
DENSITY	System Gate Range* (Logic and RAM) (K)	2-5	3-10	7-20	10-30	13-40
	Logic Cells	238	466	950	1368	1862
	Max Logic Gates, (no RAM) (K)	3	5	10	13	20
	Max RAM Bits (no Logic)	3200	6272	12800	18432	25088
	CLBs	100	196	400	576	784
	Flip-Flops	360	616	1120	1536	2016
FEATURES	Output Drive (mA)	12	12	12	12	12
	JTAG (IEEE 1149.1)	Y	Y	Y	Y	Y
	Dedicated Arithmetic	Y	Y	Y	Y	Y
	Quiescent Current (mA)	3	3	3	3	3
	Fastest Speed Grade	-4	-4	-4	-4	-4

*Maximum System gates assume 20% of CLBs used as RAM

XC5200 Series Product Selection Matrix

DEVICES	XC5200 Series	XC5202	XC5204	XC5206	XC5210	XC5215
KEY FEATURES		High Density Low Cost				
DENSITY	Max Logic Gates (K)	3	6	10	16	23
	Max RAM Bits	N/A	N/A	N/A	N/A	N/A
	Typical Gate Range (K)	2-3	4-6	6-10	10-16	15-23
	CLBs/Logic Cells	64	120	196	324	484
	Flip-Flops	256	480	784	1296	1936
FEATURES	Output Drive (mA)	8	8	8	8	8
	JTAG (IEEE 1149.1)	Y	Y	Y	Y	Y
	Dedicated Arithmetic	Y	Y	Y	Y	Y
	Quiescent Current (mA)	15	15	15	15	15
	Fastest Speed Grade	-3	-3	-3	-3	-3

XC9500 Series Product Selection Matrix

DEVICES	CPLD Families	XC9536	XC9572	XC95108	XC95144	XC95216	XC95288
KEY FEATURES		JTAG 5 V ISP 3 V or 5 V I/O					
DENSITY	Gates (K)	0.8	1.6	2.4	3.2	4.8	6.4
	Macrocells	36	72	108	144	216	288
	Flip-Flops	36	72	108	144	216	288
FEATURES	Output Drive (mA)	24	24	24	24	24	24
	JTAG (IEEE 1149.1)	Y	Y	Y	Y	Y	Y
	Dedicated Arithmetic	N	N	N	N	N	N
	Quiescent Current (mA)	–	–	140	–	–	–
	Fastest Speed Grade	-5	-7	-7	-7	-10	-10