XC9536XL High Performance CPLD

September 28, 1998 (Version 1.0)

Preliminary Product Specification

Features

- 4 ns pin-to-pin logic delays
- System frequency up to 200 MHz
- 36 macrocells with 800 usable gates
- Available in small footprint packages
  - 44-pin PLCC (34 user I/O pins)
  - 48-pin CSP (36 user I/O pins)
  - 64-pin VQFP (36 user I/O pins)
- Optimized for high-performance 3.3 V systems
  - Low power operation
  - 5 V tolerant I/O pins accept 5 V, 3.3 V, and 2.5 V signals
  - 3.3 V or 2.5 V output capability
  - Advanced 0.35 micron feature size CMOS FastFLASH™ technology
- Advanced system features
  - In-system programmable
  - Superior pin-locking and routability with FastCONNECT II™ switch matrix
  - Extra wide 54-input Function Blocks
  - Up to 90 product-terms per macrocell with individual product-term allocation
  - Local clock inversion with 3 global and one product-term clocks
  - Individual output enable per output pin
  - Input hysteresis on all user and boundary-scan pin inputs
  - Bus-hold circuitry on all user pin inputs
  - Full IEEE Standard 1149.1 boundary-scan (JTAG)
- Fast concurrent programming
- Slew rate control on individual outputs
- Enhanced data security features
- Excellent quality and reliability
  - Endurance exceeding 10,000 program/erase cycles
  - 20 year data retention
  - ESD protection exceeding 2,000 V
- Pin-compatible with 5 V-core XC9536 device in the 44-pin PLCC package and the 48-pin CSP package

Description

The XC9536XL is a 3.3 V CPLD targeted for high-performance, low-voltage applications in leading-edge communications and computing systems. It is comprised of two 54V18 Function Blocks, providing 800 usable gates with propagation delays of 4 ns. See Figure 2 for architecture overview.

Power Estimation

Power dissipation in CPLDs can vary substantially depending on the system frequency, design application and output loading. To help reduce power dissipation, each macrocell in a XC9500XL device may be configured for low-power mode (from the default high-performance mode). In addition, unused product-terms and macrocells are automatically deactivated by the software to further conserve power.

For a general estimate of I_{CC}, the following equation may be used:

I_{CC} (mA) = $MC_{HP}(0.5) + MC_{LP}(0.3) + MC(0.0045\ mA/MHz)\ f$

Where:

MC_{HP} = Macrocells in high-performance (default) mode

MC_{LP} = Macrocells in low-power mode

MC = Total number of macrocells used

f = Clock frequency (MHz)

This calculation is based on typical operating conditions using a pattern of 16-bit up/down counters in each Function Block with no output loading. The actual I_{CC} value varies with the design application and should be verified during normal system operation.

Figure 1 shows the above estimation in a graphical form.

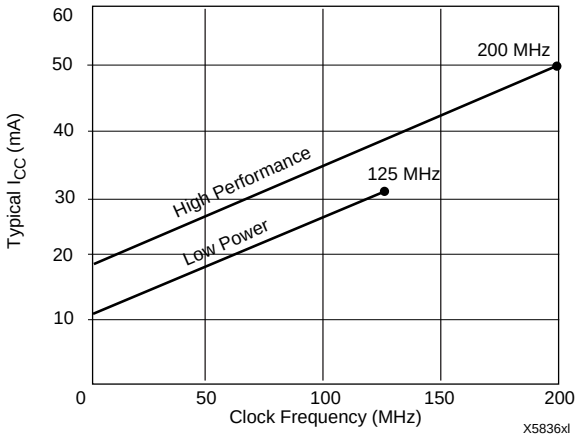


Figure 1: Typical I_{cc} vs. Frequency for XC9536XL

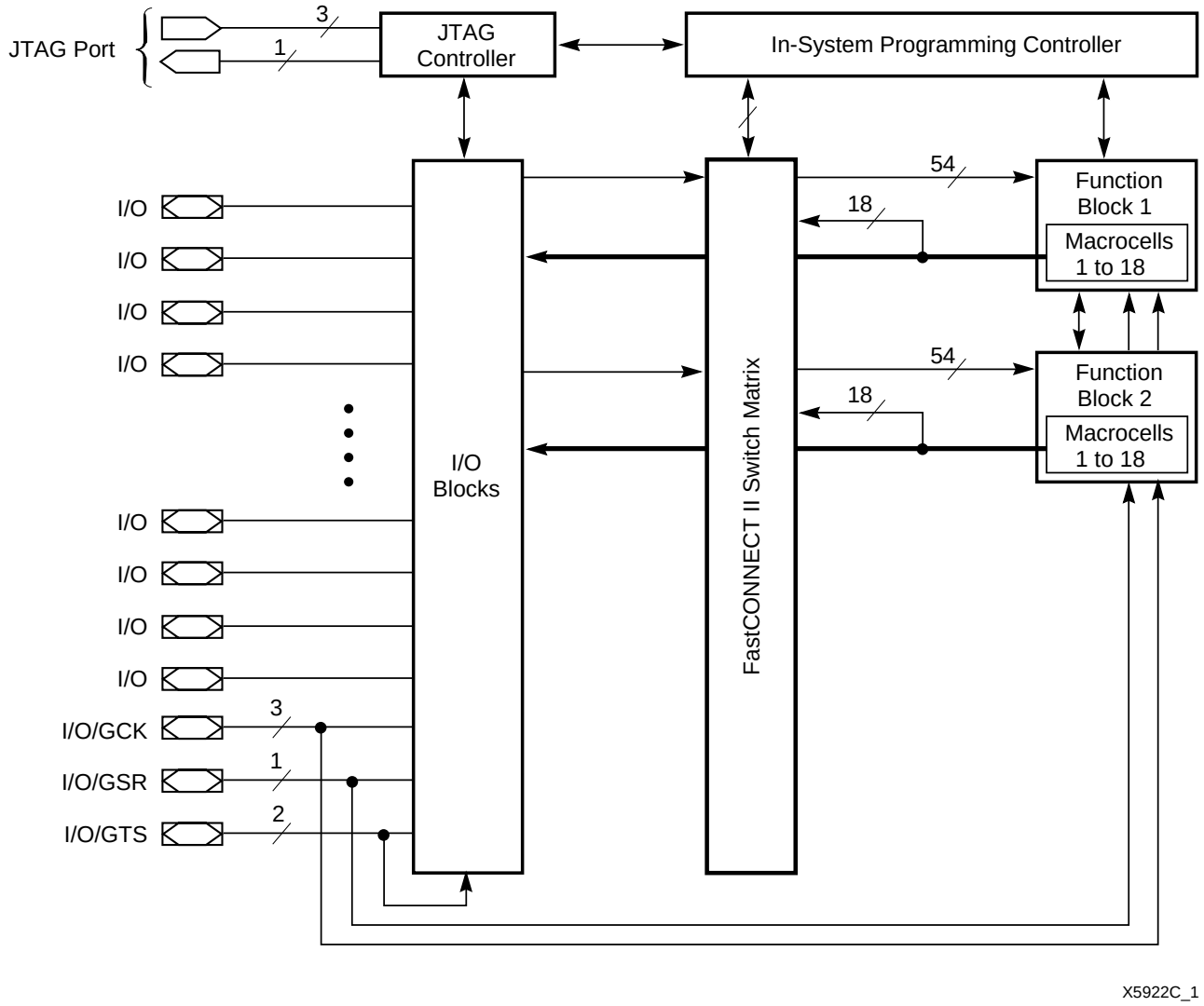


Figure 2: XC9536XL Architecture

Function Block outputs (indicated by the bold line) drive the I/O Blocks directly.

Absolute Maximum Ratings

Symbol	Description	Value	Units
V_{CC}	Supply voltage relative to GND	-0.5 to 4.0	V
V_{IN}	Input voltage relative to GND (Note 1)	-0.5 to 5.5	V
V_{TS}	Voltage applied to 3-state output (Note 1)	-0.5 to 5.5	V
T_{STG}	Storage temperature (ambient)	-65 to +150	^{o}C
T_{SOL}	Maximum soldering temperature (10s @ 1/16 in. = 1.5 mm)	+260	^{o}C
T_J	Junction temperature	+150	^{o}C

Note 1: Maximum DC undershoot below GND must be limited to either 0.5 V or 10 mA, whichever is easier to achieve. During transitions, the device pins may undershoot to -2.0 V or overshoot to +7.0 V, provided this over- or undershoot lasts less than 10 ns and with the forcing current being limited to 200 mA.

Note 2: Stresses beyond those listed under Absolute Maximum Ratings may 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 may affect device reliability.

Recommended Operation Conditions

Symbol	Parameter		Min	Max	Units
V_{CCINT}	Supply voltage for internal logic and input buffers	Commercial T_A = 0^{o}C to 70^{o}C	3.0	3.6	V
		Industrial T_A = -40^{o}C to +85^{o}C	3.0	3.6	V
V_{CCIO}	Supply voltage for output drivers for 3.3 V operation		3.0	3.6	V
	Supply voltage for output drivers for 2.5 V operation		2.3	2.7	V
V_{IL}	Low-level input voltage		0	0.80	V
V_{IH}	High-level input voltage		2.0	5.5	V
V_O	Output voltage		0	V_{CCIO}	V

Quality and Reliability Characteristics

Symbol	Parameter	Min	Max	Units
t_{DR}	Data Retention	20	-	Years
N_{PE}	Program/Erase Cycles (Endurance)	10,000	-	Cycles
V_{ESD}	Electrostatic Discharge (ESD)	2,000	-	Volts

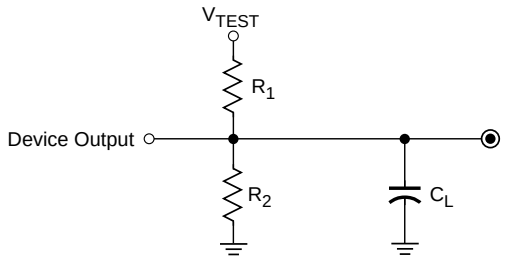
DC Characteristic Over Recommended Operating Conditions

Symbol	Parameter	Test Conditions	Min	Max	Units
V_{OH}	Output high voltage for 3.3 V outputs	I_{OH} = -4.0 mA	2.4		V
	Output high voltage for 2.5 V outputs	I_{OH} = -500 µA	90% V_{CCIO}		V
V_{OL}	Output low voltage for 3.3 V outputs	I_{OL} = 8.0 mA		0.4	V
	Output low voltage for 2.5 V outputs	I_{OL} = 500 µA		0.4	V
I_{IL}	Input leakage current	V_{CC} = Max V_{IN} = GND or V_{cc}		± 10.0	µA
I_{IH}	I/O high-Z leakage current	V_{CC} = Max V_{IN} = GND or V_{CC}		± 10.0	µA
C_{IN}	I/O capacitance	V_{IN} = GND f = 1.0 MHz		10.0	pF
I_{CC}	Operating Supply Current (low power mode, active)	V_I = GND, No load f = 1.0 MHz	10(Typ)		mA

AC Characteristics

Symbol	Parameter	XC9536XL-4		XC9536XL-5		XC9536XL-7		XC9536XL-10		Units
		Min[1]	Max[1]	Min	Max	Min	Max	Min	Max	
t_{PD}	I/O to output valid		4.0		5.0		7.5		10.0	ns
t_{SU}	I/O setup time before GCK	3.0		3.7		4.8		6.5		ns
t_{H}	I/O hold time after GCK	0.0		0.0		0.0		0.0		ns
t_{CO}	GCK to output valid		3.0		3.5		4.5		5.8	ns
f_{SYSTEM}	Multiple FB internal operating frequency		200.0		178.6		125.0		100.0	MHz
t_{PSU}	I/O setup time before p-term clock input	1.2		1.7		1.6		2.1		ns
t_{PH}	I/O hold time after p-term clock input	1.8		2.0		3.2		4.4		ns
t_{PCO}	P-term clock output valid		4.8		5.5		7.7		10.2	ns
t_{OE}	GTS to output valid		3.5		4.0		5.0		7.0	ns
t_{OD}	GTS to output disable				4.0		5.0		7.0	ns
t_{POE}	Product term OE to output enabled		6.5		7.0		9.5		11.0	ns
t_{POD}	Product term OE to output disabled				7.0		9.5		11.0	ns
t_{AO}	GSR to output valid		7.6		10.0		12.0		14.5	ns
t_{PAO}	P-term S/R to output valid		8.4		10.5		12.6		15.3	ns
t_{WLH}	GCK pulse width (High or Low)	2.5		2.8		4.0		4.5		ns
t_{PLH}	P-term clock pulse width (High or Low)	5.0		5.0		6.5		7.0		ns
		Advance		**Preliminary**						

Note 1:Please contact Xilinx for up-to-date information on advance specifications.



Output Type	V_{CCIO}	V_{TEST}	R_1	R_2	C_L
	3.3 V	3.3 V	320 Ω	360 Ω	35 pF
	2.5 V	2.5 V	250 Ω	660 Ω	35 pF

X5906A

Figure 3: AC Load Circuit

Internal Timing Parameters

Symbol	Parameter	XC9536XL-4		XC9536XL-5		XC9536XL-7		XC9536XL-10		Units
		Min[1]	Max[1]	Min	Max	Min	Max	Min	Max	
Buffer Delays										
t_{IN}	Input buffer delay		1.2		1.5		2.3		3.5	ns
t_{GCK}	GCK buffer delay		1.0		1.1		1.5		1.8	ns
t_{GSR}	GSR buffer delay		1.2		2.0		3.1		4.5	ns
t_{GTS}	GTS buffer delay		3.5		4.0		5.0		7.0	ns
t_{OUT}	Output buffer delay		1.6		2.0		2.5		3.0	ns
t_{EN}	Output buffer enable/disable delay		0.0		0.0		0.0		0.0	ns
Product Term Control Delays										
t_{PTCK}	Product term clock delay		1.6		1.6		2.4		2.7	ns
t_{PTSR}	Product term set/reset delay		0.8		1.0		1.4		1.8	ns
t_{PTTS}	Product term 3-state delay		5.3		5.5		7.2		7.5	ns
Internal Register and Combinatorial Delays										
t_{PDI}	Combinatorial logic propagation delay		0.4		0.5		1.3		1.7	ns
t_{SUI}	Register setup time	2.0		2.3		2.6		3.0		ns
t_{HI}	Register hold time	1.0		1.4		2.2		3.5		ns
t_{ECSU}	Register clock enable setup time	2.0		2.3		2.6		3.0		ns
t_{ECHO}	Register clock enable hold time	1.0		1.4		2.2		3.5		ns
t_{COI}	Register clock to output valid time		0.4		0.4		0.5		1.0	ns
t_{AOI}	Register async. S/R to output delay		4.8		6.0		6.4		7.0	ns
t_{RAI}	Register async. S/R recover before clock			5.0		7.5		10.0		ns
t_{LOGI}	Internal logic delay		0.8		1.0		1.4		1.8	ns
t_{LOGILP}	Internal low power logic delay		3.8		5.0		6.4		7.3	ns
Feedback Delays										
t_F	FastCONNECT II™ feedback delay		1.8		1.9		3.5		4.2	ns
Time Adders										
t_{PTA}	Incremental product term allocator delay		0.6		0.7		0.8		1.0	ns
t_{SLEW}	Slew-rate limited delay		2.5		3.0		4.0		4.5	ns
		Advance		**Preliminary**						

Note 1: Please contact Xilinx for up-to-date information on advance specifications.

XC9536XL I/O Pins

Function Block	Macrocell	PC44	CS48	VQ64	BScan Order	Notes
1	1	2	D6	9	105	
1	2	3	C7	10	102	
1	3	5	B7	15	99	[1]
1	4	4	C6	11	96	
1	5	6	B6	16	93	[1]
1	6	8	A6	19	90	
1	7	7	A7	17	87	[1]
1	8	9	C5	20	84	
1	9	11	B5	22	81	
1	10	12	A4	24	78	
1	11	13	B4	25	75	
1	12	14	A3	27	72	
1	13	18	B2	33	69	
1	14	19	B1	35	66	
1	15	20	C2	36	63	
1	16	22	C3	38	60	
1	17	24	D2	42	57	
1	18	-	D3	39	54	

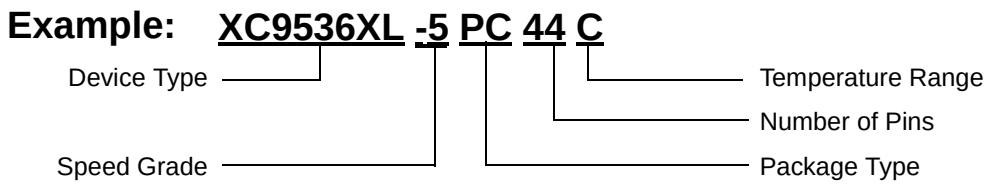
Function Block	Macrocell	PC44	CS48	VQ64	BScan Order	Notes
2	1	1	D7	8	51	
2	2	44	E5	7	48	
2	3	42	E6	5	45	[1]
2	4	43	E7	6	42	
2	5	40	F6	2	39	[1]
2	6	39	G7	64	36	[1]
2	7	38	G6	63	33	
2	8	37	F5	62	30	
2	9	36	G5	61	27	
2	10	35	F4	60	24	
2	11	34	G4	57	21	
2	12	33	E3	56	18	
2	13	29	F2	50	15	
2	14	28	G1	48	12	
2	15	27	F1	45	9	
2	16	26	E2	44	6	
2	17	25	E1	43	3	
2	18	-	E4	49	0	

Note 1: Global control pin.

XC9536XL Global, JTAG and Power Pins

Pin Type	PC44	CS48	VQ64
I/O/GCK1	5	B7	15
I/O/GCK2	6	B6	16
I/O/GCK3	7	A7	17
I/O/GTS1	42	E6	5
I/O/GTS2	40	F6	2
I/O/GSR	39	G7	64
TCK	17	A1	30
TDI	15	B3	28
TDO	30	G2	53
TMS	16	A2	29
V_{CCINT} 3.3 V	21, 41	C1, F7	3, 37
V_{CCIO} 2.5 V/3.3 V	32	G3	55
GND	10, 23, 31	A5, D1, F3	21, 41, 54
No Connects	–	–	1, 4, 12, 13, 14, 18, 23, 26, 31, 32, 34, 40, 46, 47, 51, 52, 58, 59

Ordering Information



Speed Options

-10 10 ns pin-to-pin delay
-7 7.5 ns pin-to-pin delay
-5 5 ns pin-to-pin delay
-4 4 ns pin-to-pin delay

Packaging Options

PC44 44-Pin Plastic Lead Chip Carrier (PLCC)

CS48 48-Pin Chip Scale Package

VQ64 64-Pin Quad Flat Pack (VQFP)

Temperature Options

C = Commercial T_A = 0°C to +70°C
I = Industrial T_A = -40°C to +85°C

Component Availability

Pins		44	48	64
Type		Plastic PLCC	Plastic CSP	Plastic VQFP
Code		PC44	CS48	VQ64
XC9536XL	-10	C, I	-	C, I
	-7	C	C	C
	-5	C	C	C
	-4	(C)	-	(C)

C = Commercial (T_A = 0°C to +70°C) I = Industrial (T_A = -40°C to +85°C)
( ) Parenthesis indicate future planed products. Please contact Xilinx for up-to-date information.