CLEAR LOGIC

CL81188A

Laser-Configured ASIC Family

Key Features

- Laser-Configured ASIC (LASIC®) technology offers the ultimate combination of performance, flexibility, and low cost
- Functionally, architecturally, and electrically compatible with industry-standard FLEX® 8000 series FPGAs
- High Density
  - 12,000 Usable gates
  - 1,188 Flip-flops
  - 184 Maximum user I/O pins
- Laser fuse technology provides very fast, dense interconnect routing
- Optional Instant-On configuration eliminates the need for an external configuration EPROM
- Fabricated using 0.5 micron CMOS process
- Very low current consumption (active and standby)
- Supports 3.3 volt or 5.0 volt I/O operation
- Alpha particle immune

CL8000 Product Family Overview

Parameter	CL8282A	CL8452A	CL8636A	CL8820A	CL81188A
Available Gates	5,000	8,000	12,000	16,000	24,000
Useable Gates	2,500	4,000	6,000	8,000	12,000
Flip-flops	282	452	636	820	1,188
Logic Elements	208	336	504	672	1,008
Max user I/O pins	78	120	136	152	184
Packages	84 pin PLCC 100 pin TQFP	84 pin PLCC 100 pin TQFP 160 pin PQFP	84 pin PLCC 160 pin PQFP 208 pin PQFP	144 pin TQFP 160 pin PQFP 208 pin PQFP	208 pin PQFP 240 pin PQFP

8K tbl 01

Description

The Clear Logic CL8000 Laser-Configured ASIC (LASIC®) family offers the ultimate combination of performance, flexibility, and cost. This family is a system level second source to Altera FLEX® 8000 products. For designs not requiring in-system reprogrammability, design verification can be performed using the programmable Altera devices, and Clear Logic LASICs can be used for low cost, high volume production.

Clear Logic's innovative laser ASIC technology eliminates NRE costs, test vector development, ordering minimums and long lead times. No re-simulation or re-layout is required, as the device is engineered using a cell-based, PLD-like architecture. Clear Logic's TestCell technology ensures complete test coverage through the use of specialized testing modes which are transparent to the user.

The Clear Logic CL8000 Laser-Configured ASIC family is based upon a large array of logic elements. Each logic element contains a configurable look up table for combinatorial functions and a register for sequential operations. A group of eight logic elements forms a block. Laser-configured metal fuses implement logical functions and control signal routing

Laser configuration provides reduced cost and enhanced performance. These inherent performance benefits include extremely consistent propagation delays, reduced power consumption, and improved immunity to noise and upset events.

Configuration

Clear Logic's CL8000 LASIC® family is compatible with all six configuration modes defined for the FLEX® 8000 product family. These configuration modes include the following:

- Active Serial
- Active Parallel Up
- Active Parallel Down
- Passive Parallel Synchronous
- Passive Parallel Asynchronous
- Passive Serial

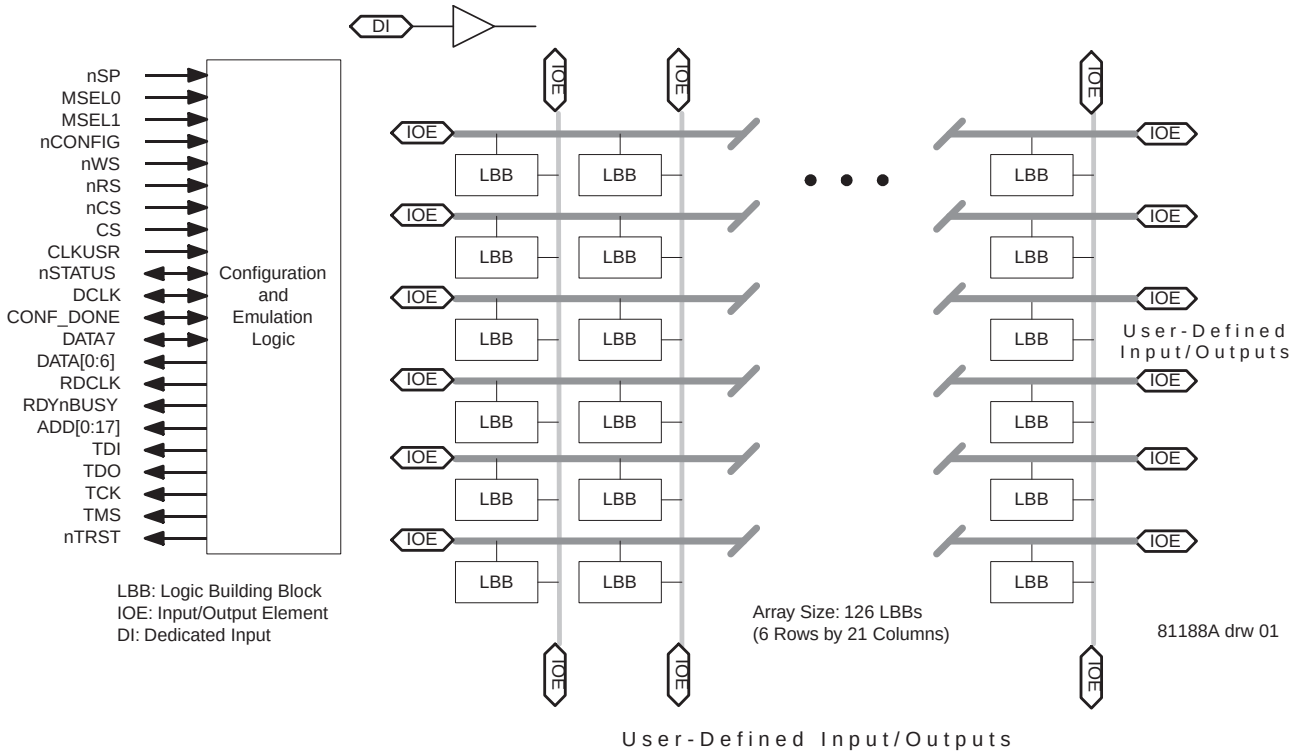
The CL8000 is already configured when it is shipped, and can be configured to bypass the FLEX® 8000 configuration modes. This "Instant-On" configuration mode eliminates the need for external EPROMs or microcode. In the Instant-On mode, the CL8000 device begins Initialization immediately upon a low-to-high transition on the nCONFIG pin.

Additional Information

For further information on designing with the CL8000 LASIC family, please refer to the following documents:

- AN-01: Requesting a First Article. This document provides instructions on how to submit a bitstream file for generation of first articles.
- AN-02: Clear Logic Packaging Guide. This document provides specifications and drawings for packages used by the CL10K family and other Clear Logic devices.
- AN-03: CL8000 and System Configuration. This document contains a detailed discussion of all aspects of configuring CL8000-based systems.
- AN-04: CL8000 Technology White Paper. This document outlines the technologies employed by the CL8000 LASIC family.
- AN-05: Calculating CL8000 Power Consumption. This document provides guidelines for calculating power consumption based on CL8000 design characteristics.
- AN-06: Eliminating the Serial EPROM from FLEX 8000 Designs. This document outlines how additional savings can be achieve by removing the EPROM from the CL8000 LASIC family.
- AN-07: CL8000 Test Methodology. This document describes how Clear Logic provides 100% stuck-at fault coverage.
- AN-08: CL8000 LASIC Timing and Function Compatibility. This document shows how a seamless conversion from FPGA to ASIC can be achieve with no additional engineering can be achieved with Clear Logic.

Block Diagram



CLEARLOGIC

Pin Configuration

Pin Name	208 pin PQFP	240 pin PQFP
nSP	5	237
MSEL0	21	21
MSEL1	33	40
nSTATUS	124	141
nCONFIG	107	117
DCLK	154	184
CONF_DONE	138	160
nWS	118	133
nRS	121	137
RDCLK	137	158
nCS	142	166
CS	144	169
RDYnBUSY	128	146
CLKUSR	134	155
ADD17	46	58
ADD16	45	56
ADD15	44	54
ADD14	39	47
ADD13	37	45
ADD12	36	43
ADD11	31	36
ADD10	30	34
ADD9	29	32
ADD8	26	29
ADD7	25	27
ADD6	24	25
ADD5	18	18
ADD4	17	16

81188A tbl 01A

Pin Configuration

Pin Name	208 pin PQFP	240 pin PQFP
ADD3	16	14
ADD2	10	7
ADD1	9	5
ADD0	8	3
DATA7	177	205
DATA6	175	203
DATA5	172	200
DATA4	170	198
DATA3	168	196
DATA2	166	194
DATA1	163	191
DATA0	161	189
TDI	-	-
TDO	-	-
TCLK	-	-
TMS	-	-
nTRST	-	-
Dedicated Inputs	13, 41, 116, 146	10, 51, 130, 171
VCCINT	4, 20, 35, 48, 50, 102, 114, 131, 147	20, 42, 64, 66, 114, 128, 150, 172, 236
VCCIO	3, 19, 34, 49, 69, 87, 106, 123, 140, 156, 174, 192	19, 41, 65, 81, 99, 116, 140, 162, 186, 202, 220, 235
GND	11, 12, 27, 28, 42, 43, 60, 78, 96, 105, 115, 122, 132, 139, 148, 155, 159, 165, 183, 201	8, 9, 30, 31, 52, 53, 72, 90, 108, 115, 129, 139, 151, 161, 173, 185, 187, 193, 211, 229
NC (No Connect)	1, 2, 51, 52, 53, 54, 103, 104, 157, 158, 207, 208	-
Total user I/O pins	144	18

81188A tbl 01B

DC Electrical Specifications

Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply voltage		-2.0	7.0	V
V_I	DC input voltage[1]		-2.0	7.0	V
I_{OUT}	DC output current, per pin		-25	25	mA
T_{STG}	Storage temperature	No bias	-65	150	°C
T_{AMB}	Ambient temperature	Under bias	-65	135	°C
T_J	Junction temperature	Under bias		135	°C

8K tbl 02

Recommended Operating Conditions [2]

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CCINT}	Supply voltage, internal logic and input buffers				
	Commercial Grade Devices		4.75	5.25	V
	Industrial Grade Devices		4.50	5.50	V
V_{CCIO}	DC input voltage				
	5.0 volt commercial		4.75	5.25	V
	5.0 volt industrial		4.50	5.50	V
	3.3 volt operation		3.00	3.60	V
V_I	Input voltage		0	VCCINT	V
V_O	Output voltage		0	VCCIO	V
T_A	Operating temperature				
	Commercial temperature range		0	70	°C
	Industrial temperature range		-40	85	°C
t_R	Input signal rise time			40	ns
t_F	Input signal fall time			40	ns
t_{RVCC}	V_{CC} rise time			100	ms

8K tbl 03

DC Electrical Specifications cont.

DC Electrical Characteristics (over the operating range)

Symbol	Parameter	Conditions	Min	Typ[3]	Max	Unit
V_{IH}	Input HIGH Voltage		2.0		V_{CCINT} + 0.3	V
V_{IL}	Input LOW Voltage		-0.3		0.8	V
V_{OH}	Output HIGH Voltage	I_{OH} = -4.0 mA, VCCIO = VCCIO[Min]	2.4			V
V_{OL}	Output LOW Voltage	I_{OL} = 12.0 mA, VCCIO = VCCIO[Min]			0.45	V
I_{IN}	Input Leakage Current	V_I = VCC or GND	-10		10	µA
I_{OZ}	Output Leakage Current	V_O = VCC or GND	-40		40	µA
I_{CC0}	Standby Current	V_I = GND, no load		0.5	10	mA

8K tbl 04

Capacitance

Symbol	Parameter	Conditions	Min	Max	Unit
C_{IN}	Input Capacitance	V_{IN} = 0 V, f = 1.0 MHz		10	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0 V, f = 1.0 MHz		10	pF

8K tbl 05

AC Electrical Specifications

I/O Element Timing Parameters [5]

Symbol	Parameter	Conditions	Speed: -2 Min	Speed: -2 Max	Speed: -3 Min	Speed: -3 Max	Speed: -4 Min	Speed: -4 Max	Unit
t_{IOD}	IOE register data delay			0.7		0.8		0.9	ns
t_{IOC}	IOE register control signal delay			1.7		1.8		1.9	ns
t_{IOE}	Output enable delay			1.7		1.8		1.9	ns
t_{IOCO}	IOE register clock to output delay			1.0		1.0		1.0	ns
t_{IOCOMB}	IOE combinatorial delay			0.3		0.2		0.1	ns
t_{IOSU}	IOE register setup time before clock		1.4		1.6		1.8		ns
t_{IOH}	IOE register hold time after clock		0.0		0.0		0.0		ns
t_{IOCLR}	IOE register clear delay			1.2		1.2		1.2	ns
t_{IN}	Input pad and buffer delay			1.5		1.6		1.7	ns
t_{OD1}	Output buffer and pad delay	Slow Slew Rate = off, V_{CCIO} = 5.0v, C_L = 35 pF		1.1		1.4		1.7	ns
t_{OD2}	Output buffer and pad delay	Slow Slew Rate = off, V_{CCIO} = 5.0v, C_L = 35 pF		1.6		1.9		2.2	ns
t_{OD3}	Output buffer and pad delay	Slow Slew Rate = off, V_{CCIO} = 5.0v, C_L = 35 pF		4.6		4.9		5.2	ns
t_{ZX}	Output buffer disable delay	C_L = 5 pF		1.4		1.6		1.8	ns
t_{ZX1}	Output buffer disable delay	Slow Slew Rate = off, V_{CCIO} = 5.0v, C_L = 35 pF		1.4		1.6		1.8	ns
t_{ZX2}	Output buffer disable delay	Slow Slew Rate = off, V_{CCIO} = 5.0v, C_L = 35 pF		1.6		2.1		2.3	ns
t_{ZX3}	Output buffer disable delay	Slow Slew Rate = off, V_{CCIO} = 5.0v, C_L = 35 pF		4.9		5.1		5.3	ns

8K tbl 06C

External Timing Parameters[4]

Symbol	Parameter	Conditions	Speed: -2 Min	Speed: -2 Max	Speed: -3 Min	Speed: -3 Max	Speed -4 Min	Speed -4 Max	Unit
t_{DRR}	Register to register delay via four LEs, three row interconnects, and four local interconnects			16		20		25	ns
t_{ODH}	Output data hold time after clock		1.0		1.0		1.0		ns

8K tbl 07B

AC Electrical Specifications cont.

Logic Element Timing Parameters[5]

Symbol	Parameter	Conditions	Speed: -2 Min	Speed: -2 Max	Speed: -3 Min	Speed: -3 Max	Speed: -4 Min	Speed: -4 Max	Unit
t_{LUT}	Look up table delay for data-in			2.0		2.5		3.2	ns
t_{CLUT}	Look up table delay for carry-in			0.0		0.0		0.0	ns
t_{RLUT}	Look up table delay for LE register feedback			0.9		1.1		1.5	ns
t_{GATE}	Cascade gate delay			0.0		0.0		0.0	ns
t_{CASC}	Cascade chain routing delay			0.6		0.7		0.9	ns
t_{CICO}	Carry-in to carry-out delay			0.4		0.5		0.6	ns
t_{CGEN}	Data-in to carry-out delay			0.4		0.5		0.7	ns
t_{CGENR}	LE register feedback to carry-out delay			0.9		1.1		1.5	ns
t_{C}	LE register control signal delay			1.6		2.0		2.5	ns
t_{CH}	Clock high time		1.7		1.7		2.7		ns
t_{CL}	Clock low time		1.7		1.7		2.7		ns
t_{CO}	LE register clock-to-output delay			0.4		0.5		0.6	ns
t_{COMB}	Combinatorial delay			0.4		0.5		0.6	ns
t_{SU}	LE register setup time before clock		0.8		1.1		1.2		ns
t_{H}	LE register hold time after clock		0.9		1.1		1.5		ns
t_{PRE}	LE register preset delay			0.6		0.7		0.8	ns
t_{CLR}	LE register clear delay			0.6		0.7		0.8	ns

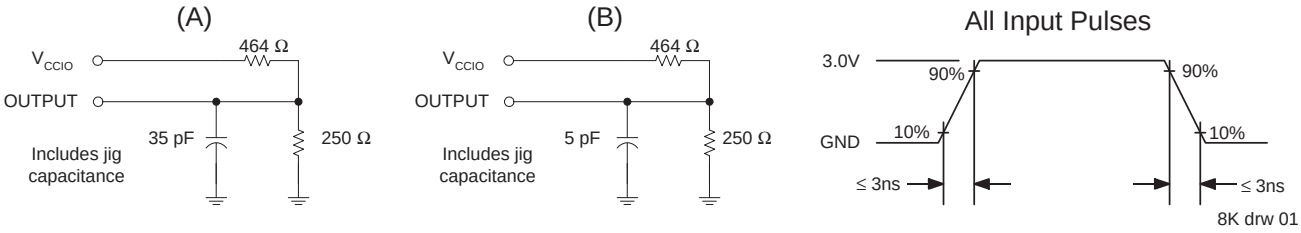
8K tbl 08A

Interconnect Timing Parameters[5]

Symbol	Parameter	Conditions	Speed: -2 Min	Speed: -2 Max	Speed: -3 Min	Speed: -3 Max	Speed: -4 Min	Speed: -4 Max	Unit
$t_{LABCASC}$	Cascade delay between LEs in different LABs			0.3		0.4		0.4	ns
$t_{LABCARRY}$	Carry delay between LEs in different LABs			0.3		0.4		0.4	ns
t_{LOCAL}	LAB local interconnect delay			0.5		0.5		0.7	ns
t_{ROW}	Row interconnect routing delay			5.0		5.0		5.0	ns
t_{COL}	Column interconnect routing delay			3.0		3.0		3.0	ns
t_{DIN_C}	Dedicated input to LE control delay			5.0		5.0		5.5	ns
t_{DIN_D}	Dedicated input to LE data delay			7.0		7.0		7.5	ns
t_{DIN_IO}	Dedicated input to IOE control delay			5.0		5.0		5.5	ns

8K tbl 09B

AC Test Conditions



Notes to Tables

1. During transitions, inputs may undershoot to -2.0V for periods shorter than 20ns. Otherwise, minimum DC input voltage is -0.3V.

2. The following devices do not have V_{CCIO} pins: CL8282A, CL8452A. For these devices, all references to V_{CCIO} should be changed to V_{CCINT}

3. Typical values are at V_{CC} of 5.0 volts and ambient temperature of 25 ºC.

4. Guaranteed but not tested. Characterized initially, and after any design changes which may affect these parameters.

5. Internal timing delays are based on characterization, and cannot be explicitly tested. Internal timing parameters should be used for performance estimation only.

Revision History

16 Jan. 1998:	Created new document
31 Jul. 1999:	Recompiled databook, 8820 package update.
29 Nov. 1999:	Remove reference to the 8282AV device which is not supported.
01 Dec. 2000:	Review and reprint.

Ordering Information

Part Number	Temperature Range	Package Type	Speed	Altera Equivalent
CL81188AQC208-4	Commercial	208-pin Plastic QFP	-4 (slowest)	EPF81188AQC208-4
CL81188AQC208-3			-3	EPF81188AQC208-3
CL81188AQC208-2			-2 (fastest)	EPF81188AQC208-2
CL81188AQC240-4		240-pin Plastic QFP	-4 (slowest)	EPF81188AQC240-4
CL81188AQC240-3			-3	EPF81188AQC240-3
CL81188AQC240-2			-2 (fastest)	EPF81188AQC240-2
CL81188AQI208-4	Industrial	208-pin Plastic QFP	-4 (slowest)	EPF81188AQI208-4
CL81188AQI208-3			-3 (fastest)	EPF81188AQI208-3
CL81188AQI240-4		240-pin Plastic QFP	-4	EPF81188ARI240-4

81188A tbl 02