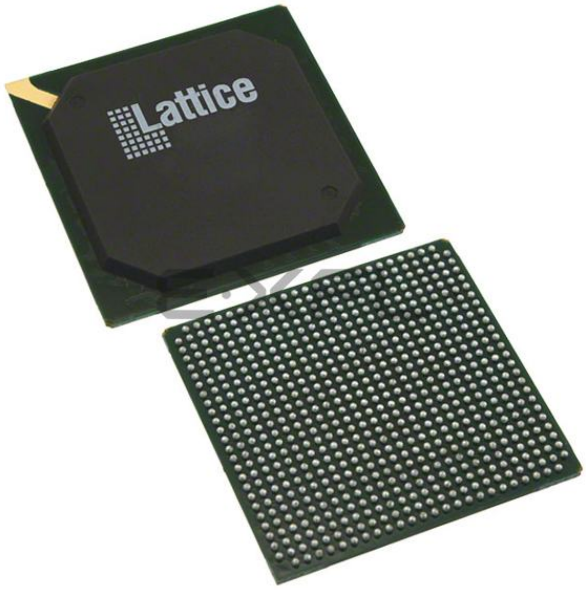

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Understanding Embedded - FPGAs (Field Programmable Gate Array)

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	8375
Number of Logic Elements/Cells	67000
Total RAM Bits	4526080
Number of I/O	380
Number of Gates	-
Voltage - Supply	1.14V ~ 1.26V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 85°C (TJ)
Package / Case	672-BBGA
Supplier Device Package	672-FPBGA (27x27)
Purchase URL	https://www.e-xfl.com/product-detail/lattice-semiconductor/lfe3-70e-7fn672c

Lattice Semiconductor Corporation

LatticeECP3 Family Data Sheet Architecture

March 2010 Preliminary Data Sheet DS1021

Architecture Overview

Each LatticeECP3 device contains an array of logic blocks surrounded by Programmable I/O Cells (PIC). Interspersed between the rows of logic blocks are rows of sysMEM™ Embedded Block RAM (EBR) and rows of sysDSP™ Digital Signal Processing slices, as shown in Figure 2-1. In addition, the LatticeECP3 family contains SERDES Quads on the bottom of the device.

There are two kinds of logic blocks, the Programmable Functional Unit (PFU) and Programmable Functional Unit without RAM (PFF). The PFU contains the building blocks for logic, arithmetic, RAM and ROM functions. The PFF block contains building blocks for logic, arithmetic and ROM functions. Both PFU and PFF blocks are optimized for flexibility, allowing complex designs to be implemented quickly and efficiently. Logic Blocks are arranged in a two-dimensional array. Only one type of block is used per row.

The LatticeECP3 devices contain one or more rows of sysMEM EBR blocks. sysMEM EBRs are large, dedicated 18Kbit fast memory blocks. Each sysMEM block can be configured in a variety of depths and widths as RAM or ROM. In addition, LatticeECP3 devices contain up to two rows of DSP slices. Each DSP slice has multipliers and adder/accumulators, which are the building blocks for complex signal processing capabilities.

The LatticeECP3 devices feature up to 16 embedded 3.2Gbps SERDES (Serializer / Deserializer) channels. Each SERDES channel contains independent 8b/10b encoding / decoding, polarity adjust and elastic buffer logic. Each group of four SERDES channels, along with its Physical Coding Sub-layer (PCS) block, creates a quad. The functionality of the SERDES/PCS quads can be controlled by memory cells set during device configuration or by registers that are addressable during device operation. The registers in every quad can be programmed via the SERDES Client Interface (SCI). These quads (up to four) are located at the bottom of the devices.

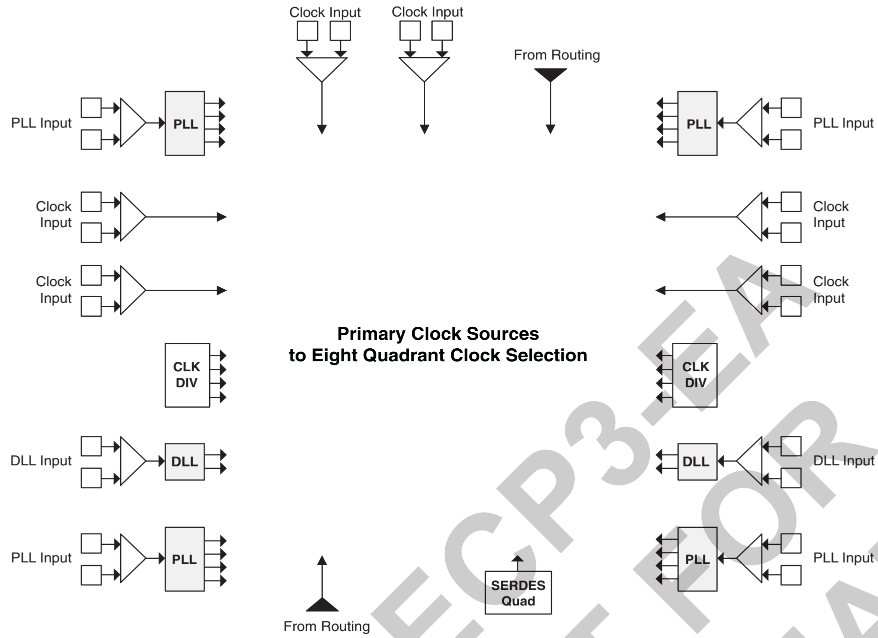
Each PIC block encompasses two PIOs (PIO pairs) with their respective sysI/O buffers. The sysI/O buffers of the LatticeECP3 devices are arranged in seven banks, allowing the implementation of a wide variety of I/O standards. In addition, a separate I/O bank is provided for the programming interfaces. 50% of the PIO pairs on the left and right edges of the device can be configured as LVDS transmit/receive pairs. The PIC logic also includes pre-engineered support to aid in the implementation of high speed source synchronous standards such as XGMII, 7:1 LVDS, along with memory interfaces including DDR3.

Other blocks provided include PLLs, DLLs and configuration functions. The LatticeECP3 architecture provides two Delay Locked Loops (DLLs) and up to ten Phase Locked Loops (PLLs). In addition, each LatticeECP3 family member provides two DLLs per device. The PLL and DLL blocks are located at the end of the EBR/DSP rows.

The configuration block that supports features such as configuration bit-stream decryption, transparent updates and dual-boot support is located toward the center of this EBR row. Every device in the LatticeECP3 family supports a sysCONFIG™ port located in the corner between banks one and two, which allows for serial or parallel device configuration.

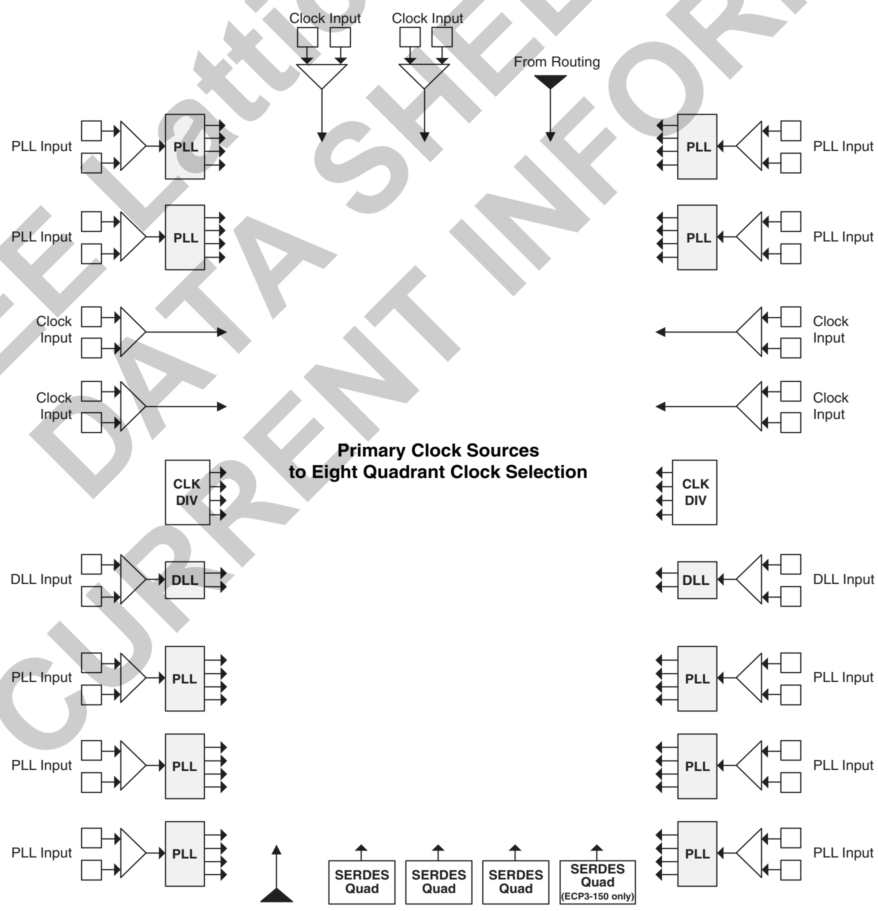
In addition, every device in the family has a JTAG port. This family also provides an on-chip oscillator and soft error detect capability. The LatticeECP3 devices use 1.2V as their core voltage.

Figure 2-10. Primary Clock Sources for LatticeECP3-35



Note: Clock inputs can be configured in differential or single-ended mode.

Figure 2-11. Primary Clock Sources for LatticeECP3-70, -95, -150



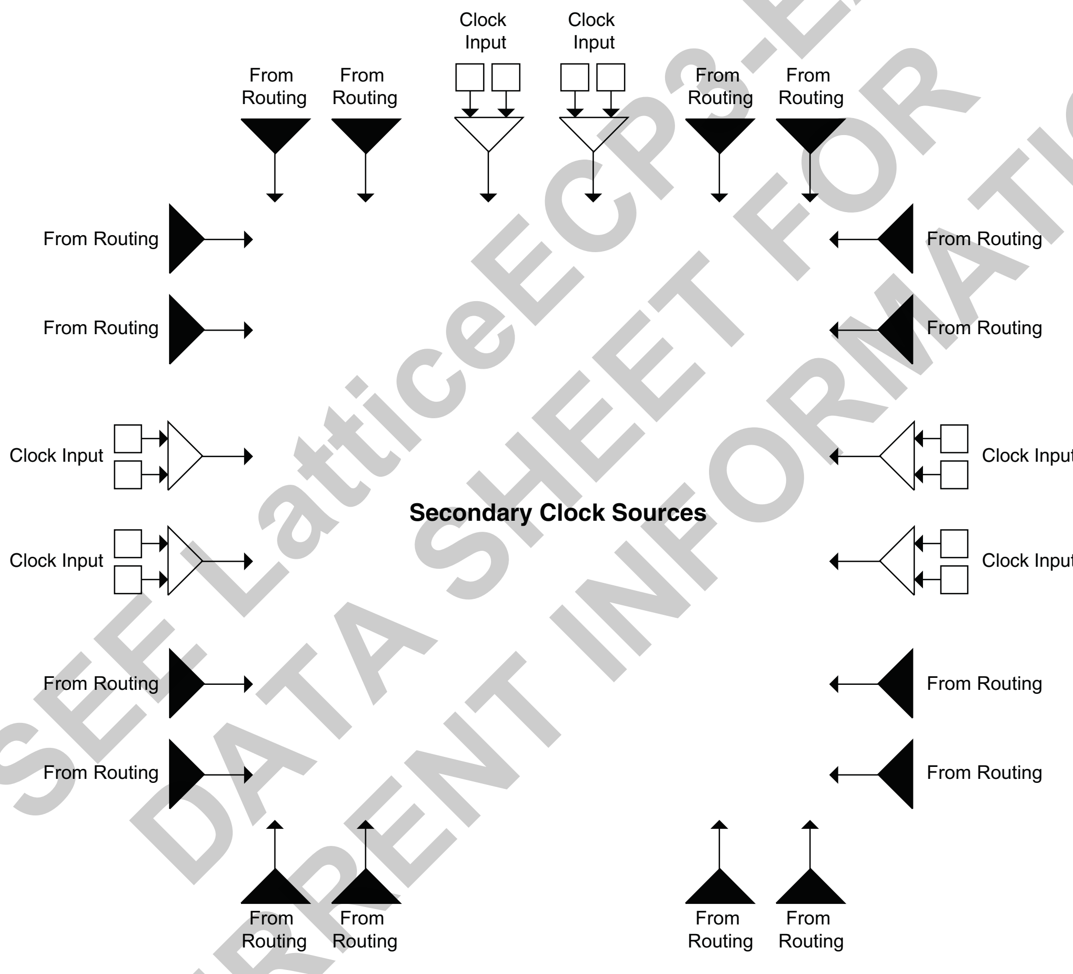
Note: Clock inputs can be configured in differential or single-ended mode.

Secondary Clock/Control Sources

LatticeECP3 devices derive eight secondary clock sources (SC0 through SC7) from six dedicated clock input pads and the rest from routing. Figure 2-14 shows the secondary clock sources. All eight secondary clock sources are defined as inputs to a per-region mux SC0-SC7. SC0-SC3 are primary for control signals (CE and/or LSR), and SC4-SC7 are for clock and high fanout data.

In an actual implementation, there is some overlap to maximize routability. In addition to SC0-SC3, SC7 is also an input to the control signals (LSR or CE). SC0-SC2 are also inputs to clocks along with SC4-SC7. High fanout logic signals (LUT inputs) will utilize the X2 and X0 switches where SC0-SC7 are inputs to X2 switches, and SC4-SC7 are inputs to X0 switches. Note that through X0 switches, SC4-SC7 can also access control signals CE/LSR.

Figure 2-14. Secondary Clock Sources



Note: Clock inputs can be configured in differential or single-ended mode.

Secondary Clock/Control Routing

Global secondary clock is a secondary clock that is distributed to all regions. The purpose of the secondary clock routing is to distribute the secondary clock sources to the secondary clock regions. Secondary clocks in the LatticeECP3 devices are region-based resources. Certain EBR rows and special vertical routing channels bind the secondary clock regions. This special vertical routing channel aligns with either the left edge of the center DSP slice in the DSP row or the center of the DSP row. Figure 2-15 shows this special vertical routing channel and the 20 secondary clock regions for the LatticeECP3 family of devices. All devices in the LatticeECP3 family have eight

as, overflow, underflow and convergent rounding, etc.
– Flexible cascading across slices to get larger functions

- RTL Synthesis friendly synchronous reset on all registers, while still supporting asynchronous reset for legacy users
- Dynamic MUX selection to allow Time Division Multiplexing (TDM) of resources for applications that require processor-like flexibility that enables different functions for each clock cycle

For most cases, as shown in Figure 2-24, the LatticeECP3 DSP slice is backwards-compatible with the LatticeECP2™ sysDSP block, such that, legacy applications can be targeted to the LatticeECP3 sysDSP slice. The functionality of one LatticeECP2 sysDSP Block can be mapped into two adjacent LatticeECP3 sysDSP slices, as shown in Figure 2-25.

Figure 2-24. Simplified sysDSP Slice Block Diagram

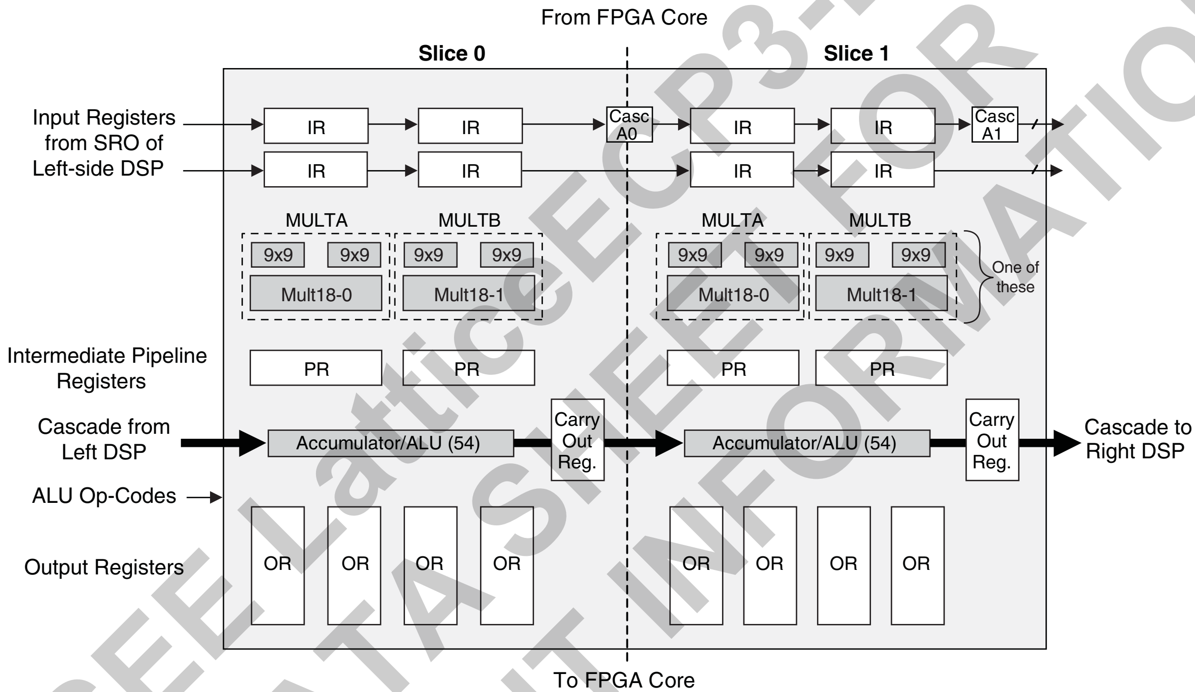
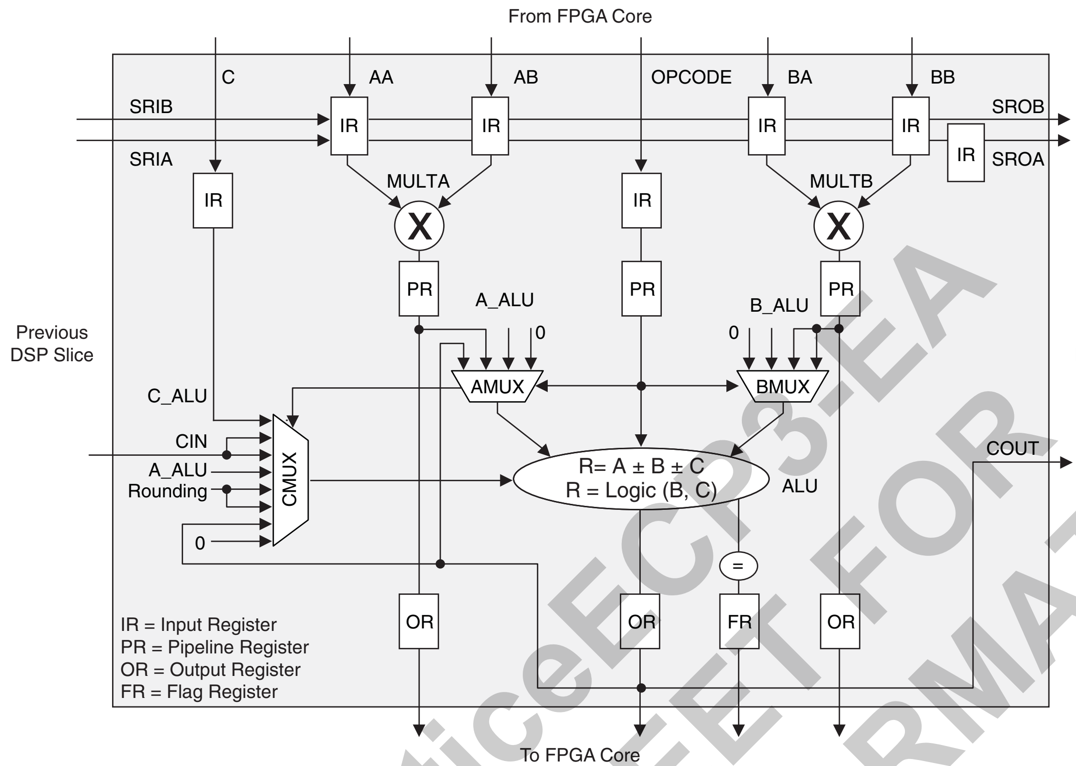


Figure 2-25. Detailed sysDSP Slice Diagram



Note: A_ALU, B_ALU and C_ALU are internal signals generated by combining bits from AA, AB, BA BB and C inputs. See TN1182, LatticeECP3 sysDSP Usage Guide, for further information.

The LatticeECP2 sysDSP block supports the following basic elements.

- MULT (Multiply)
- MAC (Multiply, Accumulate)
- MULTADDSUB (Multiply, Addition/Subtraction)
- MULTADDSUBSUM (Multiply, Addition/Subtraction, Summation)

Table 2-8 shows the capabilities of each of the LatticeECP3 slices versus the above functions.

Table 2-8. Maximum Number of Elements in a Slice

Width of Multiply	x9	x18	x36
MULT	4	2	1/2
MAC	1	1	—
MULTADDSUB	2	1	—
MULTADDSUBSUM	1[1]	1/2	—

1. One slice can implement 1/2 9x9 m9x9addsubsum and two m9x9addsubsum with two slices.

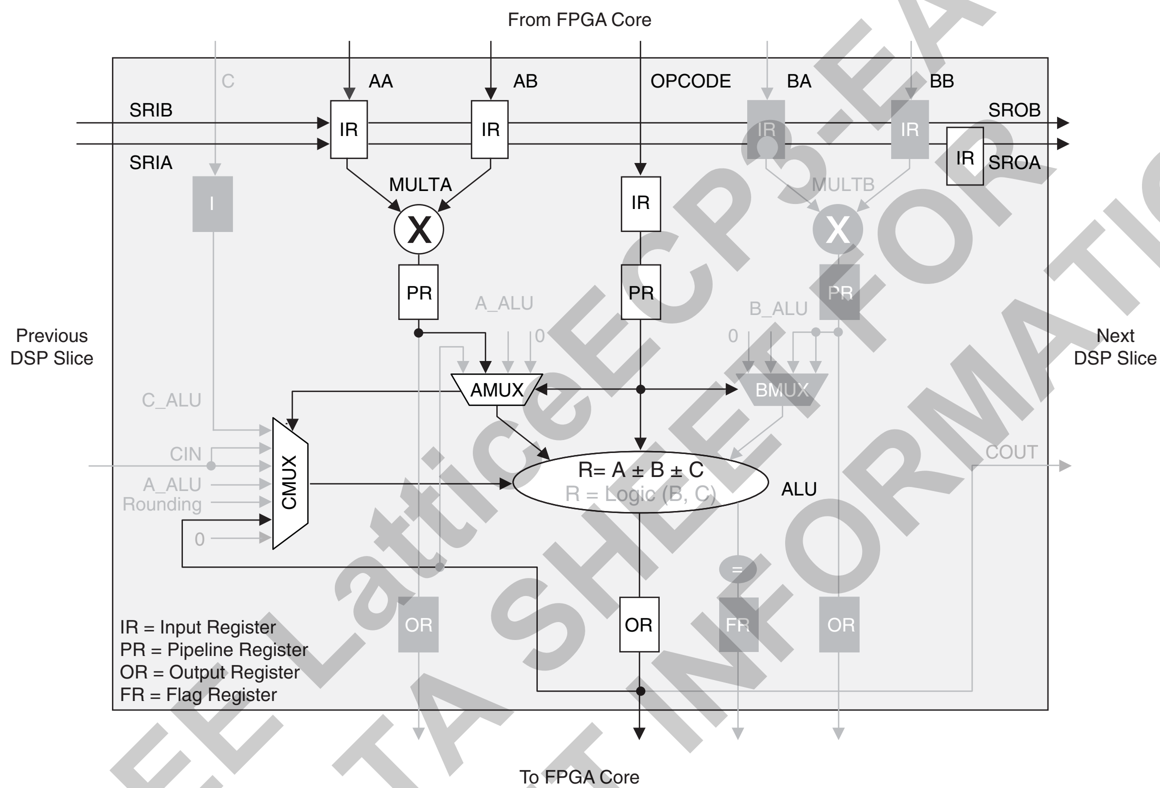
Some options are available in the four elements. The input register in all the elements can be directly loaded or can be loaded as a shift register from previous operand registers. By selecting “dynamic operation” the following operations are possible:

- In the Add/Sub option the Accumulator can be switched between addition and subtraction on every cycle.
- The loading of operands can switch between parallel and serial operations.

MAC DSP Element

In this case, the two operands, AA and AB, are multiplied and the result is added with the previous accumulated value. This accumulated value is available at the output. The user can enable the input and pipeline registers, but the output register is always enabled. The output register is used to store the accumulated value. The ALU is configured as the accumulator in the sysDSP slice in the LatticeECP3 family can be initialized dynamically. A registered overflow signal is also available. The overflow conditions are provided later in this document. Figure 2-27 shows the MAC sysDSP element.

Figure 2-27. MAC DSP Element



MMAC DSP Element

The LatticeECP3 supports a MAC with two multipliers. This is called Multiply Multiply Accumulate or MMAC. In this case, the two operands, AA and AB, are multiplied and the result is added with the previous accumulated value and with the result of the multiplier operation of operands BA and BB. This accumulated value is available at the output. The user can enable the input and pipeline registers, but the output register is always enabled. The output register is used to store the accumulated value. The ALU is configured as the accumulator in the sysDSP slice. A registered overflow signal is also available. The overflow conditions are provided later in this document. Figure 2-28 shows the MMAC sysDSP element.

Figure 2-28. MMAC sysDSP Element

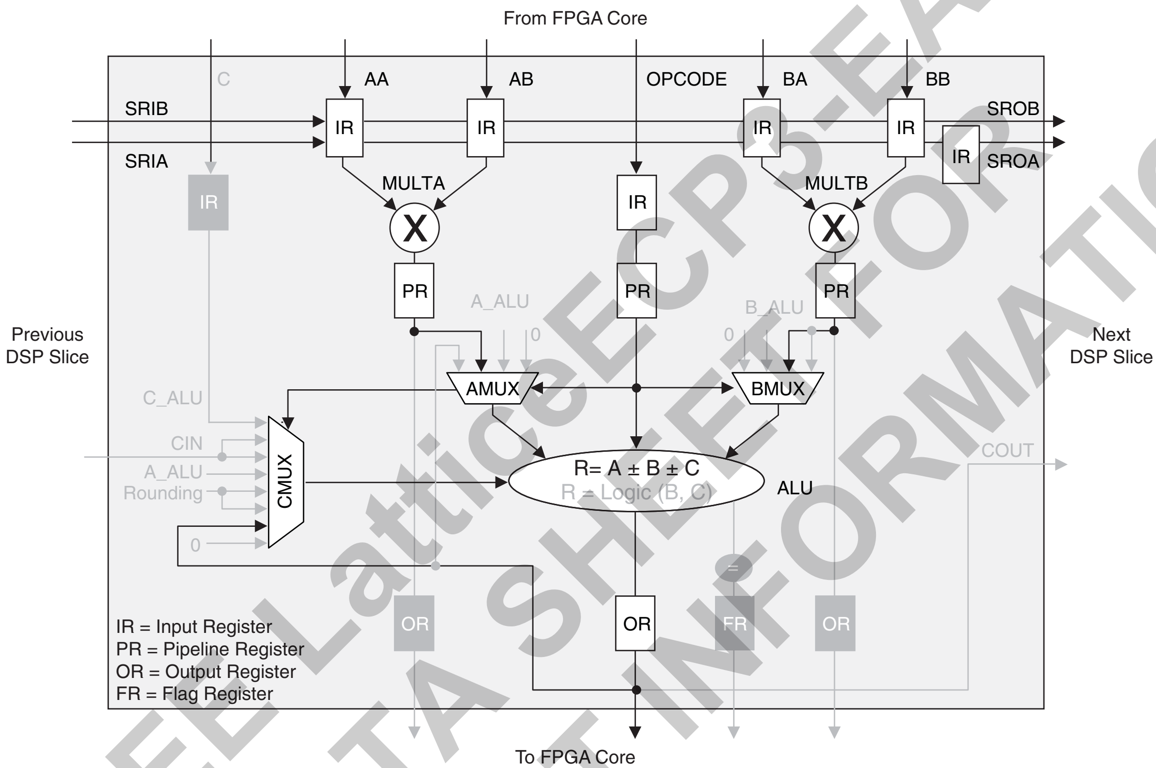
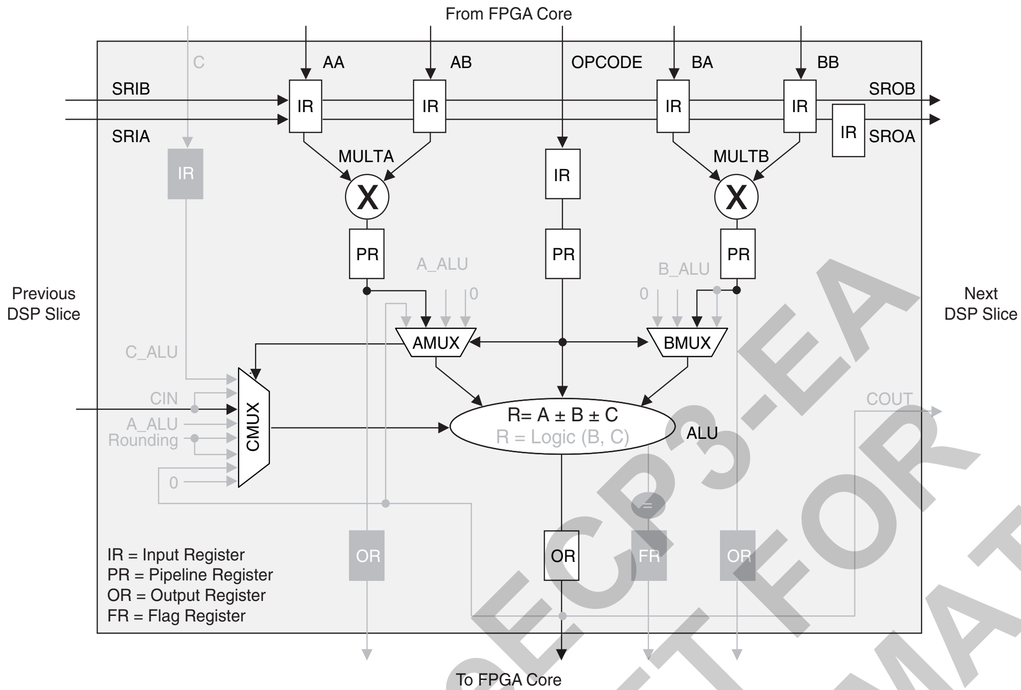


Figure 2-31. MULTADDSUBSUM Slice 1



Advanced sysDSP Slice Features

Cascading

The LatticeECP3 sysDSP slice has been enhanced to allow cascading. Adder trees are implemented fully in sysDSP slices, improving the performance. Cascading of slices uses the signals CIN, COUT and C Mux of the slice.

Addition

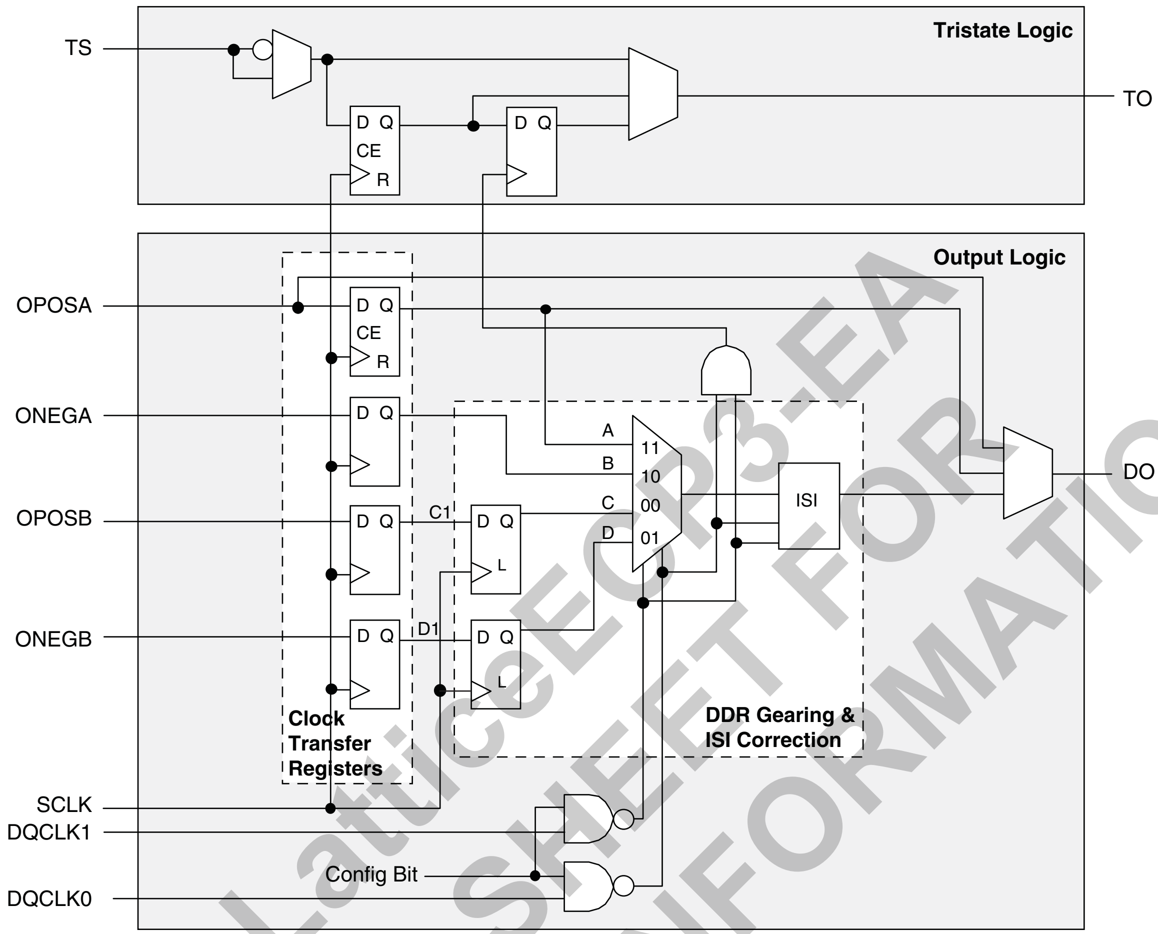
The LatticeECP3 sysDSP slice allows for the bypassing of multipliers and cascading of adder logic. High performance adder functions are implemented without the use of LUTs. The maximum width adders that can be implemented are 54-bit.

Rounding

The rounding operation is implemented in the ALU and is done by adding a constant followed by a truncation operation. The rounding methods supported are:

- Rounding to zero (RTZ)
- Rounding to infinity (RTI)
- Dynamic rounding
- Random rounding
- Convergent rounding

Figure 2-34. ECP3-70/95 (E or EA) Output and Tristate Block for Left and Right Edges



Tristate Register Block

The tristate register block registers tri-state control signals from the core of the device before they are passed to the sysI/O buffers. The block contains a register for SDR operation and an additional register for DDR operation.

In SDR and non-gearing DDR modes, TS input feeds one of the flip-flops that then feeds the output. In DDRX2 mode, the register TS input is fed into another register that is clocked using the DQCLK0 and DQCLK1 signals. The output of this register is used as a tristate control.

ISI Calibration

The setting for Inter-Symbol Interference (ISI) cancellation occurs in the output register block. ISI correction is only available in the DDRX2 modes. ISI calibration settings exist once per output register block, so each I/O in a DQS-12 group may have a different ISI calibration setting.

The ISI block extends output signals at certain times, as a function of recent signal history. So, if the output pattern consists of a long strings of 0's to long strings of 1's, there are no delays on output signals. However, if there are quick, successive transitions from 010, the block will stretch out the binary 1. This is because the long trail of 0's will cause these symbols to interfere with the logic 1. Likewise, if there are quick, successive transitions from 101, the block will stretch out the binary 0. This block is controlled by a 3-bit delay control that can be set in the DQS control logic block.

For more information about this topic, please see the list of technical documentation at the end of this data sheet.

Typical Building Block Function Performance

Pin-to-Pin Performance (LVCMOS25 12mA Drive)[1, 2]

Function	-8 Timing	Units
Basic Functions		
16-bit Decoder	4.7	ns
32-bit Decoder	4.7	ns
64-bit Decoder	5.7	ns
4:1 MUX	4.1	ns
8:1 MUX	4.3	ns
16:1 MUX	4.7	ns
32:1 MUX	4.8	ns

1. These functions were generated using the ispLEVER design tool. Exact performance may vary with device and tool version. The tool uses internal parameters that have been characterized but are not tested on every device.
2. Commercial timing numbers are shown. Industrial numbers are typically slower and can be extracted from the ispLEVER software.

Register-to-Register Performance[1, 2]

Function	-8 Timing	Units
Basic Functions		
16-bit Decoder	500	MHz
32-bit Decoder	500	MHz
64-bit Decoder	475	MHz
4:1 MUX	500	MHz
8:1 MUX	500	MHz
16:1 MUX	500	MHz
32:1 MUX	445	MHz
8-bit adder	500	MHz
16-bit adder	500	MHz
64-bit adder	305	MHz
16-bit counter	500	MHz
32-bit counter	460	MHz
64-bit counter	320	MHz
64-bit accumulator	315	MHz
Embedded Memory Functions		
512x36 Single Port RAM, EBR Output Registers	340	MHz
1024x18 True-Dual Port RAM (Write Through or Normal, EBR Output Registers)	340	MHz
1024x18 True-Dual Port RAM (Read-Before-Write, EBR Output Registers; EA devices only)	130	MHz
1024x18 True-Dual Port RAM (Write Through or Normal, PLC Output Registers)	245	MHz
Distributed Memory Functions		
16x4 Pseudo-Dual Port RAM (One PFU)	500	MHz
32x4 Pseudo-Dual Port RAM	500	MHz
64x8 Pseudo-Dual Port RAM	380	MHz
DSP Function		
18x18 Multiplier (All Registers)	400	MHz
9x9 Multiplier (All Registers)	400	MHz
36x36 Multiply (All Registers)	245	MHz

LatticeECP3 External Switching Characteristics (Continued)[1, 2]

Over Recommended Commercial Operating Conditions

Parameter	Description	Device	-8		-7		-6		Units
			Min.	Max.	Min.	Max.	Min.	Max.	
$t_{DVECLKGDDR}$	Data Hold After CLK	ECP3-70E/95E	0.765	—	0.765	—	0.765	—	UI
f_{MAX_GDDR}	DDR/DDRX2 Clock Frequency[8]	ECP3-70E/95E	—	500	—	420	—	375	MHz
Generic DDRX2 Inputs with Clock and Data (<10 Bits Wide) Centered at Pin (GDDRX2_RX.DQS.Centered) using DQS Pin for Clock Input									
Left and Right Sides									
t_{SUGDDR}	Data Setup Before CLK	ECP3-150EA		—		—		—	ns
t_{HGDDR}	Data Hold After CLK	ECP3-150EA		—		—		—	ns
f_{MAX_GDDR}	DDRX2 Clock Frequency	ECP3-150EA	—		—		—		ns
Generic DDRX2 Inputs with Clock and Data (<10 Bits Side) Aligned at Pin (GDDRX2_RX.DQS.Aligned) Using DQS Pin for Clock Input									
Left and Right Sides									
$t_{DVACLKGDDR}$	Data Setup Before CLK (Left and Right Side)	ECP3-150EA	—		—		—		
$t_{DVECLKGDDR}$	Data Hold After CLK (Left and Right Side)	ECP3-150EA		—		—		—	
f_{MAX_GDDR}	DDRX2 Clock Frequency (Left and Right Side)	ECP3-150EA	—		—		—		
Generic DDRX1 Output with Clock and Data (>10 Bits Wide) Centered at Pin (GDDRX1_TX.SCLK.Centered)									
Left, Right and Top Sides									
$t_{DVBGDDR}$	Data Valid Before CLK	ECP3-150EA		—		—		—	
$t_{DVAGDDR}$	Data Valid After CLK	ECP3-150EA		—		—		—	
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-150EA	—		—		—		
Generic DDRX1 Outputs with clock in the center of data window, with PLL 90-degree shifted clock ouput (GDDRX1_TX.ECLK.Centered)									
$t_{DIBGDDR}$	Data Invalid Before CLK	ECP3-70E/95E	670	—	670	—	670	—	ps
$t_{DIAGDDR}$	Data Invalid After CLK	ECP3-70E/95E	670	—	670	—	670	—	ps
fMAX_GDDR	DDRX1 Clock Frequency	ECP3-70E/95E	—	250	—	250	—	250	MHz
Generic DDRX1 Output with Clock and Data (> 10 Bits Wide) Aligned at Pin (GDDRX1_TX.SCLK.Aligned)									
Left, Right and Top Sides									
$t_{DIBGDDR}$	Data Hold After CLK	ECP3-150EA	—		—		—		
$t_{DIAGDDR}$	Data Setup Before CLK	ECP3-150EA	—		—		—		
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-150EA	—		—		—		
Generic DDRX1 Outputs with clock and data edge aligned, without PLL									
$t_{DIBGDDR}$	Data Invalid Before CLK	ECP3-70E/95E	—	330	—	330	—	330	ps
$t_{DIAGDDR}$	Data Invalid After CLK	ECP3-70E/95E	—	330	—	330	—	330	ps
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-70E/95E	—	250	—	250	—	250	MHz
Generic DDRX1 Output with Clock and Data (<10 Bits Wide) Centered at Pin (GDDRX1_TX.DQS.Centered)									
Left, Right and Top Sides									
$t_{DVBGDDR}$	Data Valid Before CLK	ECP3-150EA	—		—		—		
$t_{DVAGDDR}$	Data Valid After CLK	ECP3-150EA	—		—		—		
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-150EA	—		—		—		

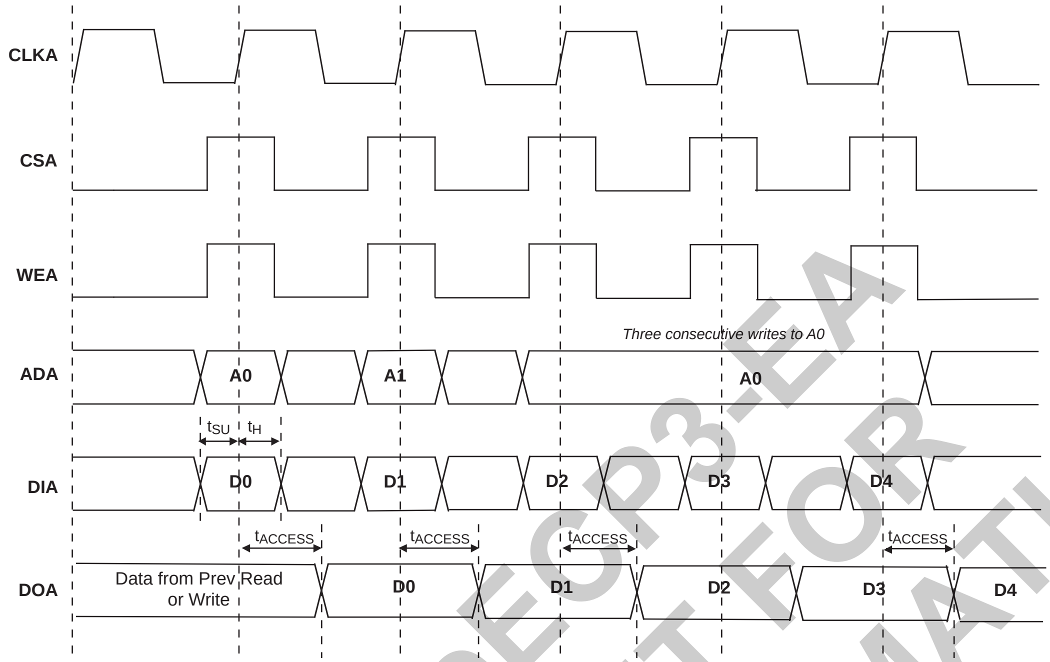
LatticeECP3 External Switching Characteristics (Continued)[1, 2]

Over Recommended Commercial Operating Conditions

Parameter	Description	Device	-8		-7		-6		Units
			Min.	Max.	Min.	Max.	Min.	Max.	
Generic DDRX2 Output with Clock and Data (> 10 Bits Wide) Aligned at Pin (GDDRX2_TX.ECLK.Aligned)									
Left and Right Sides									
$t_{DIBGDDR}$	Data Setup Before CLK	ECP3-150EA	—		—		—		ps
$t_{DIAGDDR}$	Data Hold After CLK	ECP3-150EA	—		—		—		ps
f_{MAX_GDDR}	DDRX2 Clock Frequency	ECP3-150EA	—		—		—		MHz
Generic DDRX2 Outputs with Clock and Data Edges Aligned, Without PLL 90-degree shifted clock output[5] (GDDRX2_TX.Aligned)									
$t_{DIBGDDR}$	Data Invalid Before Clock	ECP3-70E/95E	—	200	—	225	—	250	ps
$t_{DIAGDDR}$	Data Invalid After Clock	ECP3-70E/95E	—	200	—	225	—	250	ps
f_{MAX_GDDR}	DDR/DDRX2 Clock Frequency[8]	ECP3-70E/95E	—	500	—	420	—	375	MHz
Generic DDRX2 Output with Clock and Data (> 10 Bits Wide) Centered at Pin Using DQSDLL (GDDRX2_TX.DQS-DLL.Centered)									
Left and Right Sides									
$t_{DVBGDDR}$	Data Valid Before CLK	ECP3-150EA		—		—		—	ns
$t_{DVAGDDR}$	Data Valid After CLK	ECP3-150EA		—		—		—	ns
f_{MAX_GDDR}	DDRX2 Clock Frequency	ECP3-150EA	—		—		—		ns
Generic DDRX2 Output with Clock and Data (> 10 Bits Wide) Centered at Pin Using PLL (GDDRX2_TX.PLL.Centered)									
Left and Right Sides									
$t_{DVBGDDR}$	Data Valid Before CLK	ECP3-150EA		—		—		—	ns
$t_{DVAGDDR}$	Data Valid After CLK	ECP3-150EA		—		—		—	ns
f_{MAX_GDDR}	DDRX2 Clock Frequency	ECP3-150EA	—		—		—		ns
Generic DDRX2 Outputs with Clock Edge in the Center of Data Window, with PLL 90-degree Shifted Clock Output[6] (GDDRX2_TX.PLL.Centered)									
$t_{DVBGDDR}$	Data Valid Before CLK	ECP3-70E/95E	300	—	370	—	417	—	ps
$t_{DVAGDDR}$	Data Valid After CLK	ECP3-70E/95E	300	—	370	—	417	—	ps
f_{MAX_GDDR}	DDR/DDRX2 Clock Frequency[8]	ECP3-70E/95E	—	500	—	420	—	375	MHz

Parameter	Description	Device	-8		-7		-6		Units
			Min.	Max.	Min.	Max.	Min.	Max.	
Memory Interface									
DDR/DDR2 SDRAM I/O Pin Parameters (Input Data are Strobe Edge Aligned, Output Strobe Edge is Data Centered)[4]									
t_{DVADQ}	Data Valid After DQS (DDR Read)	ECP3-150EA	—	0.225	—	0.225	—	0.225	UI
t_{DVEDQ}	Data Hold After DQS (DDR Read)	ECP3-150EA	0.64	—	0.64	—	0.64	—	UI
t_{DQVBS}	Data Valid Before DQS	ECP3-150EA	0.25	—	0.25	—	0.25	—	UI
t_{DQVAS}	Data Valid After DQS	ECP3-150EA	0.25	—	0.25	—	0.25	—	UI
f_{MAX_DDR}	DDR Clock Frequency	ECP3-150EA	95	200	95	200	95	166	MHz
f_{MAX_DDR2}	DDR2 clock frequency	ECP3-150EA	133	266	133	200	133	166	MHz
t_{DVADQ}	Data Valid After DQS (DDR Read)	ECP3-70E/95E	—	0.225	—	0.225	—	0.225	UI
t_{DVEDQ}	Data Hold After DQS (DDR Read)	ECP3-70E/95E	0.64	—	0.64	—	0.64	—	UI
t_{DQVBS}	Data Valid Before DQS	ECP3-70E/95E	0.25	—	0.25	—	0.25	—	UI
t_{DQVAS}	Data Valid After DQS	ECP3-70E/95E	0.25	—	0.25	—	0.25	—	UI
f_{MAX_DDR}	DDR Clock Frequency	ECP3-70E/95E	95	200	95	200	95	133	MHz

Figure 3-11. Write Through (SP Read/Write on Port A, Input Registers Only)



Note: Input data and address are registered at the positive edge of the clock and output data appears after the positive edge of the clock.

DLL Timing

Over Recommended Operating Conditions

Parameter	Description	Condition	Min.	Typ.	Max.	Units
f_{REF}	Input reference clock frequency (on-chip or off-chip)		133	—	500	MHz
f_{FB}	Feedback clock frequency (on-chip or off-chip)		133	—	500	MHz
f_{CLKOP}[1]	Output clock frequency, CLKOP		133	—	500	MHz
f_{CLKOS}[2]	Output clock frequency, CLKOS		33.3	—	500	MHz
t_{PJIT}	Output clock period jitter (clean input)			—	200	ps p-p
t_{DUTY}	Output clock duty cycle (at 50% levels, 50% duty cycle input clock, 50% duty cycle circuit turned off, time reference delay mode)	Edge Clock	40		60	%
		Primary Clock	30		70	%
$t_{DUTYTRD}$	Output clock duty cycle (at 50% levels, arbitrary duty cycle input clock, 50% duty cycle circuit enabled, time reference delay mode)	Primary Clock < 250MHz	45		55	%
		Primary Clock ≥ 250MHz	30		70	%
		Edge Clock	45		55	%
$t_{DUTYCIR}$	Output clock duty cycle (at 50% levels, arbitrary duty cycle input clock, 50% duty cycle circuit enabled, clock injection removal mode) with DLL cascading	Primary Clock < 250MHz	40		60	%
		Primary Clock ≥ 250MHz	30		70	%
		Edge Clock	45		55	%
t_{SKEW}[3]	Output clock to clock skew between two outputs with the same phase setting		—	—	100	ps
t_{PHASE}	Phase error measured at device pads between off-chip reference clock and feedback clocks		—	—	+/-400	ps
t_{PWH}	Input clock minimum pulse width high (at 80% level)		550	—	—	ps
t_{PWL}	Input clock minimum pulse width low (at 20% level)		550	—	—	ps
t_{INSTB}	Input clock period jitter		—	—	500	p-p
t_{LOCK}	DLL lock time		8	—	8200	cycles
t_{RSWD}	Digital reset minimum pulse width (at 80% level)		3	—	—	ns
t_{DEL}	Delay step size		27	45	70	ps
t_{RANGE1}	Max. delay setting for single delay block (64 taps)		1.9	3.1	4.4	ns
t_{RANGE4}	Max. delay setting for four chained delay blocks		7.6	12.4	17.6	ns

1. CLKOP runs at the same frequency as the input clock.
2. CLKOS minimum frequency is obtained with divide by 4.
3. This is intended to be a “path-matching” design guideline and is not a measurable specification.

Gigabit Ethernet/Serial Rapid I/O Type 1/SGMII Electrical and Timing Characteristics

AC and DC Characteristics

Table 3-17. Transmit

Symbol	Description	Test Conditions	Min.	Typ.	Max.	Units
T_{RF}	Differential rise/fall time	20%-80%	—	80	—	ps
$Z_{TX\_DIFF\_DC}$	Differential impedance		80	100	120	Ohms
J_{TX_DDJ} [3, 4, 5]	Output data deterministic jitter		—	—	0.10	UI
J_{TX_TJ} [2, 3, 4, 5]	Total output data jitter		—	—	0.24	UI

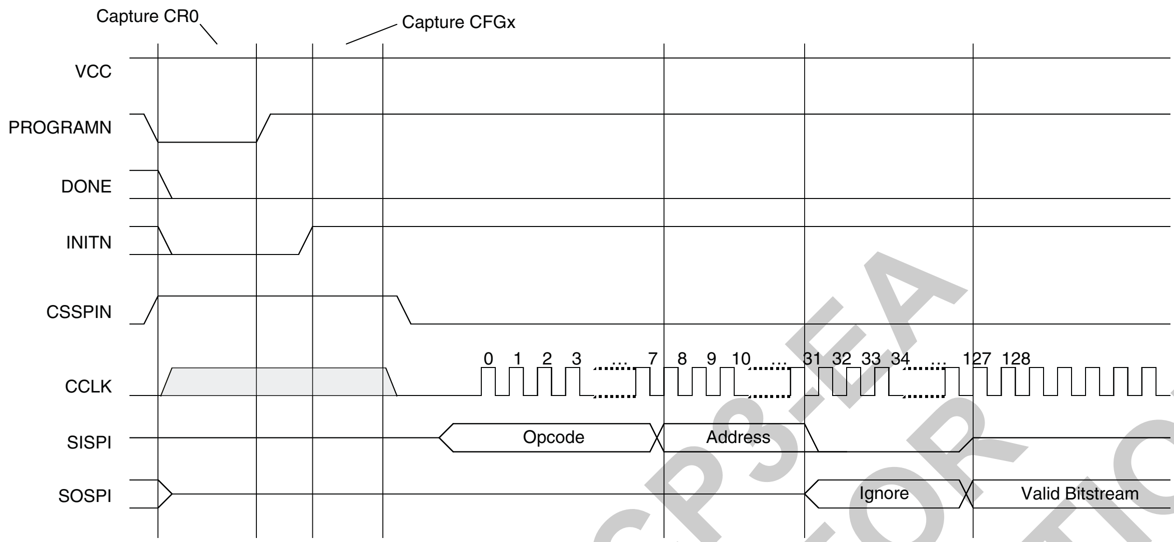
1. Rise and fall times measured with board trace, connector and approximately 2.5pf load.
2. Total jitter includes both deterministic jitter and random jitter. The random jitter is the total jitter minus the actual deterministic jitter.
3. Jitter values are measured with each CML output AC coupled into a 50-ohm impedance (100-ohm differential impedance).
4. Jitter and skew are specified between differential crossings of the 50% threshold of the reference signal.
5. Values are measured at 1.25 Gbps.

Table 3-18. Receive and Jitter Tolerance

Symbol	Description	Test Conditions	Min.	Typ.	Max.	Units
RL_{RX_DIFF}	Differential return loss	From 100 MHz to 1.25 GHz	10	—	—	dB
RL_{RX_CM}	Common mode return loss	From 100 MHz to 1.25 GHz	6	—	—	dB
Z_{RX_DIFF}	Differential termination resistance		80	100	120	Ohms
J_{RX_DJ} [1, 2, 3, 4, 5]	Deterministic jitter tolerance (peak-to-peak)		—	—	0.34	UI
J_{RX_RJ} [1, 2, 3, 4, 5]	Random jitter tolerance (peak-to-peak)		—	—	0.26	UI
J_{RX_SJ} [1, 2, 3, 4, 5]	Sinusoidal jitter tolerance (peak-to-peak)		—	—	0.11	UI
J_{RX_TJ} [1, 2, 3, 4, 5]	Total jitter tolerance (peak-to-peak)		—	—	0.71	UI
T_{RX_EYE}	Receiver eye opening		0.29	—	—	UI

1. Total jitter includes deterministic jitter, random jitter and sinusoidal jitter. The sinusoidal jitter tolerance mask is shown in Figure 3-14.
2. Jitter values are measured with each high-speed input AC coupled into a 50-ohm impedance.
3. Jitter and skew are specified between differential crossings of the 50% threshold of the reference signal.
4. Jitter tolerance, Differential Input Sensitivity and Receiver Eye Opening parameters are characterized when Full Rx Equalization is enabled.
5. Values are measured at 1.25 Gbps.

Figure 3-24. Master SPI Configuration Waveforms



Point-to-Point LVDS (PPLVDS)

Over Recommended Operating Conditions

Description	Min.	Typ.	Max.	Units
Output driver supply (+/- 5%)	3.14	3.3	3.47	V
	2.25	2.5	2.75	V
Input differential voltage	100		400	mV
Input common mode voltage	0.2		2.3	V
Output differential voltage	130		400	mV
Output common mode voltage	0.5	0.8	1.4	V

RSDS

Over Recommended Operating Conditions

Parameter Symbol	Description	Min.	Typ.	Max.	Units
V_{OD}	Output voltage, differential, R_T = 100 ohms	100	200	600	mV
V_{OS}	Output voltage, common mode	0.5	1.2	1.5	V
I_{RSDS}	Differential driver output current	1	2	6	mA
V_{THD}	Input voltage differential	100	—	—	mV
V_{CM}	Input common mode voltage	0.3	—	1.5	V
T_R, T_F	Output rise and fall times, 20% to 80%	—	500	—	ps
T_{ODUTY}	Output clock duty cycle	35	50	65	%

Note: Data is for 2mA drive. Other differential driver current options are available.

Lattice Semiconductor Corporation

LatticeECP3 Family Data Sheet
Ordering Information

March 2010 **Preliminary Data Sheet DS1021**

LatticeECP3 Part Number Description

LFE3 – XXX XX – X XXXXXX X

Device Family
ECP3 (LatticeECP3 FPGA + SERDES)

Logic Capacity
17 = 17K LUTs
35 = 33K LUTs
70 = 67K LUTs
95 = 92K LUTs
150 = 149K LUTs

Supply Voltage
E or EA = 1.2V

Speed
6 = Slowest
7
8 = Fastest

Grade
C = Commercial
I = Industrial

Package
FTN256 = 256-ball Lead-Free ftBGA
FN484 = 484-ball Lead-Free fpBGA
FN672 = 672-ball Lead-Free fpBGA
FN1156 = 1156-ball Lead-Free fpBGA

Ordering Information

LatticeECP3 devices have top-side markings, for commercial and industrial grades, as shown below:

Commercial	Industrial
Lattice ECP3	Lattice ECP3
LFE3-95E	LFE3-95E
7FN672C	7FN672I
Datecode	Datecode

Industrial

The following devices may have associated errata. Specific devices with associated errata will be notated with a footnote.

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-17EA-6FTN256I	1.2V	-6	Lead-Free ftBGA	256	IND	17
LFE3-17EA-7FTN256I	1.2V	-7	Lead-Free ftBGA	256	IND	17
LFE3-17EA-8FTN256I	1.2V	-8	Lead-Free ftBGA	256	IND	17
LFE3-17EA-6FN484I	1.2V	-6	Lead-Free fpBGA	484	IND	17
LFE3-17EA-7FN484I	1.2V	-7	Lead-Free fpBGA	484	IND	17
LFE3-17EA-8FN484I	1.2V	-8	Lead-Free fpBGA	484	IND	17

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-35EA-6FTN256I	1.2V	-6	Lead-Free ftBGA	256	IND	33
LFE3-35EA-7FTN256I	1.2V	-7	Lead-Free ftBGA	256	IND	33
LFE3-35EA-8FTN256I	1.2V	-8	Lead-Free ftBGA	256	IND	33
LFE3-35EA-6FN484I	1.2V	-6	Lead-Free fpBGA	484	IND	33
LFE3-35EA-7FN484I	1.2V	-7	Lead-Free fpBGA	484	IND	33
LFE3-35EA-8FN484I	1.2V	-8	Lead-Free fpBGA	484	IND	33
LFE3-35EA-6FN672I	1.2V	-6	Lead-Free fpBGA	672	IND	33
LFE3-35EA-7FN672I	1.2V	-7	Lead-Free fpBGA	672	IND	33
LFE3-35EA-8FN672I	1.2V	-7	Lead-Free fpBGA	672	IND	33

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-70EA-6FN484I	1.2V	-6	Lead-Free fpBGA	484	IND	67
LFE3-70EA-7FN484I	1.2V	-7	Lead-Free fpBGA	484	IND	67
LFE3-70EA-8FN484I	1.2V	-8	Lead-Free fpBGA	484	IND	67
LFE3-70EA-6FN672I	1.2V	-6	Lead-Free fpBGA	672	IND	67
LFE3-70EA-7FN672I	1.2V	-7	Lead-Free fpBGA	672	IND	67
LFE3-70EA-8FN672I	1.2V	-8	Lead-Free fpBGA	672	IND	67
LFE3-70EA-6FN1156I	1.2V	-6	Lead-Free fpBGA	1156	IND	67
LFE3-70EA-7FN1156I	1.2V	-7	Lead-Free fpBGA	1156	IND	67
LFE3-70EA-8FN1156I	1.2V	-8	Lead-Free fpBGA	1156	IND	67

LatticeECP3 Family Data Sheet Supplemental Information

For Further Information

A variety of technical notes for the LatticeECP3 family are available on the Lattice website at www.latticesemi.com.

- TN1169, LatticeECP3 sysCONFIG Usage Guide
- TN1176, LatticeECP3 SERDES/PCS Usage Guide
- TN1177, LatticeECP3 sysIO Usage Guide
- TN1178, LatticeECP3 sysCLOCK PLL/DLL Design and Usage Guide
- TN1179, LatticeECP3 Memory Usage Guide
- TN1180, LatticeECP3 High-Speed I/O Interface
- TN1181, Power Consumption and Management for LatticeECP3 Devices
- TN1182, LatticeECP3 sysDSP Usage Guide
- TN1184, LatticeECP3 Soft Error Detection (SED) Usage Guide
- TN1189, LatticeECP3 Hardware Checklist

For further information on interface standards refer to the following websites:

- JEDEC Standards (LVTTL, LVCMOS, SSTL, HSTL): www.jedec.org
- PCI: www.pcisig.com