Lattice Semiconductor Corporation - LFE3-95E-7FN484I Datasheet

Welcome to E-XFL.COM

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	11500
Number of Logic Elements/Cells	92000
Total RAM Bits	4526080
Number of I/O	295
Number of Gates	-
Voltage - Supply	1.14V ~ 1.26V
Mounting Type	Surface Mount
Operating Temperature	-40°C ~ 100°C (TJ)
Package / Case	484-BBGA
Supplier Device Package	484-FPBGA (23x23)
Purchase URL	https://www.e-xfl.com/product-detail/lattice-semiconductor/lfe3-95e-7fn484i

LatticeECP3 Family Data Sheet Introduction

November 2009 Preliminary Data Sheet DS1021

Features

- **Higher Logic Density for Increased System Integration**
  - 17K to 149K LUTs
  - 133 to 586 I/Os
- **Embedded SERDES**
  - 150 Mbps to 3.2 Gbps for Generic 8b10b, 10-bit SERDES, and 8-bit SERDES modes
  - Data Rates 230 Mbps to 3.2 Gbps per channel for all other protocols
  - Up to 16 channels per device: PCI Express, SONET/SDH, Ethernet (1GbE, SGMII, XAUI), CPRI, SMPTE 3G and Serial RapidIO
- **sysDSP™**
  - Fully cascadable slice architecture
  - 12 to 160 slices for high performance multiply and accumulate
  - Powerful 54-bit ALU operations
  - Time Division Multiplexing MAC Sharing
  - Rounding and truncation
  - Each slice supports
    - Half 36x36, two 18x18 or four 9x9 multipliers
    - Advanced 18x36 MAC and 18x18 Multiply-Multiply-Accumulate (MMAC) operations
- **Flexible Memory Resources**
  - Up to 6.85Mbits sysMEM™ Embedded Block RAM (EBR)
  - 36K to 303K bits distributed RAM
- **sysCLOCK Analog PLLs and DLLs**
  - Two DLLs and up to ten PLLs per device
- **Pre-Engineered Source Synchronous I/O**
  - DDR registers in I/O cells
  - Dedicated read/write levelling functionality
  - Dedicated gearing logic
  - Source synchronous standards support
    - ADC/DAC, 7:1 LVDS, XGMII
    - High Speed ADC/DAC devices
  - Dedicated DDR/DDR2/DDR3 memory with DQS support
  - Optional Inter-Symbol Interference (ISI) correction on outputs
- **Programmable sysI/O™ Buffer Supports Wide Range of Interfaces**
  - On-chip termination
  - Optional equalization filter on inputs
  - LVTTL and LVCMOS 33/25/18/15/12
  - SSTL 33/25/18/15 I, II
  - HSTL15 I and HSTL18 I, II
  - PCI and Differential HSTL, SSTL
  - LVDS, Bus-LVDS, LVPECL, RSDS, MLVDS
- **Flexible Device Configuration**
  - Dedicated bank for configuration I/Os
  - SPI boot flash interface
  - Dual-boot images supported
  - Slave SPI
  - TransFR™ I/O for simple field updates
  - Soft Error Detect embedded macro
- **System Level Support**
  - IEEE 1149.1 and IEEE 1532 compliant
  - Reveal Logic Analyzer
  - ORCAstra FPGA configuration utility
  - On-chip oscillator for initialization & general use
  - 1.2V core power supply

Table 1-1. LatticeECP3™ Family Selection Guide

Device	ECP3-17	ECP3-35	ECP3-70	ECP3-95	ECP3-150
LUTs (K)	17	33	67	92	149
sysMEM Blocks (18Kbits)	38	72	240	240	372
Embedded Memory (Kbits)	700	1327	4420	4420	6850
Distributed RAM Bits (Kbits)	36	68	145	188	303
18X18 Multipliers	24	64	128	128	320
SERDES (Quad)	1	1	3	3	4
PLLs/DLLs	2 / 2	4 / 2	10 / 2	10 / 2	10 / 2
Packages and SERDES Channels/ I/O Combinations					
256 ftBGA (17x17 mm)	4 / 133	4 / 133			
484 fpBGA (23x23 mm)	4 / 222	4 / 295	4 / 295	4 / 295	
672 fpBGA (27x27 mm)		4 / 310	8 / 380	8 / 380	8 / 380
1156 fpBGA (35x35 mm)			12 / 490	12 / 490	16 / 586

Introduction

The LatticeECP3™ (EConomy Plus Third generation) family of FPGA devices is optimized to deliver high performance features such as an enhanced DSP architecture, high speed SERDES and high speed source synchronous interfaces in an economical FPGA fabric. This combination is achieved through advances in device architecture and the use of 65nm technology making the devices suitable for high-volume, high-speed, low-cost applications.

The LatticeECP3 device family expands look-up-table (LUT) capacity to 149K logic elements and supports up to 486 user I/Os. The LatticeECP3 device family also offers up to 320 18x18 multipliers and a wide range of parallel I/O standards.

The LatticeECP3 FPGA fabric is optimized with high performance and low cost in mind. The LatticeECP3 devices utilize reconfigurable SRAM logic technology and provide popular building blocks such as LUT-based logic, distributed and embedded memory, Phase Locked Loops (PLLs), Delay Locked Loops (DLLs), pre-engineered source synchronous I/O support, enhanced sysDSP slices and advanced configuration support, including encryption and dual-boot capabilities.

The pre-engineered source synchronous logic implemented in the LatticeECP3 device family supports a broad range of interface standards, including DDR3, XGMII and 7:1 LVDS.

The LatticeECP3 device family also features high speed SERDES with dedicated PCS functions. High jitter tolerance and low transmit jitter allow the SERDES plus PCS blocks to be configured to support an array of popular data protocols including PCI Express, SMPTE, Ethernet (XAUI, GbE, and SGMII) and CPRI. Transmit Pre-emphasis and Receive Equalization settings make the SERDES suitable for transmission and reception over various forms of media.

The LatticeECP3 devices also provide flexible, reliable and secure configuration options, such as dual-boot capability, bit-stream encryption, and TransFR field upgrade features.

The ispLEVER® design tool suite from Lattice allows large complex designs to be efficiently implemented using the LatticeECP3 FPGA family. Synthesis library support for LatticeECP3 is available for popular logic synthesis tools. The ispLEVER tool uses the synthesis tool output along with the constraints from its floor planning tools to place and route the design in the LatticeECP3 device. The ispLEVER tool extracts the timing from the routing and back-annotates it into the design for timing verification.

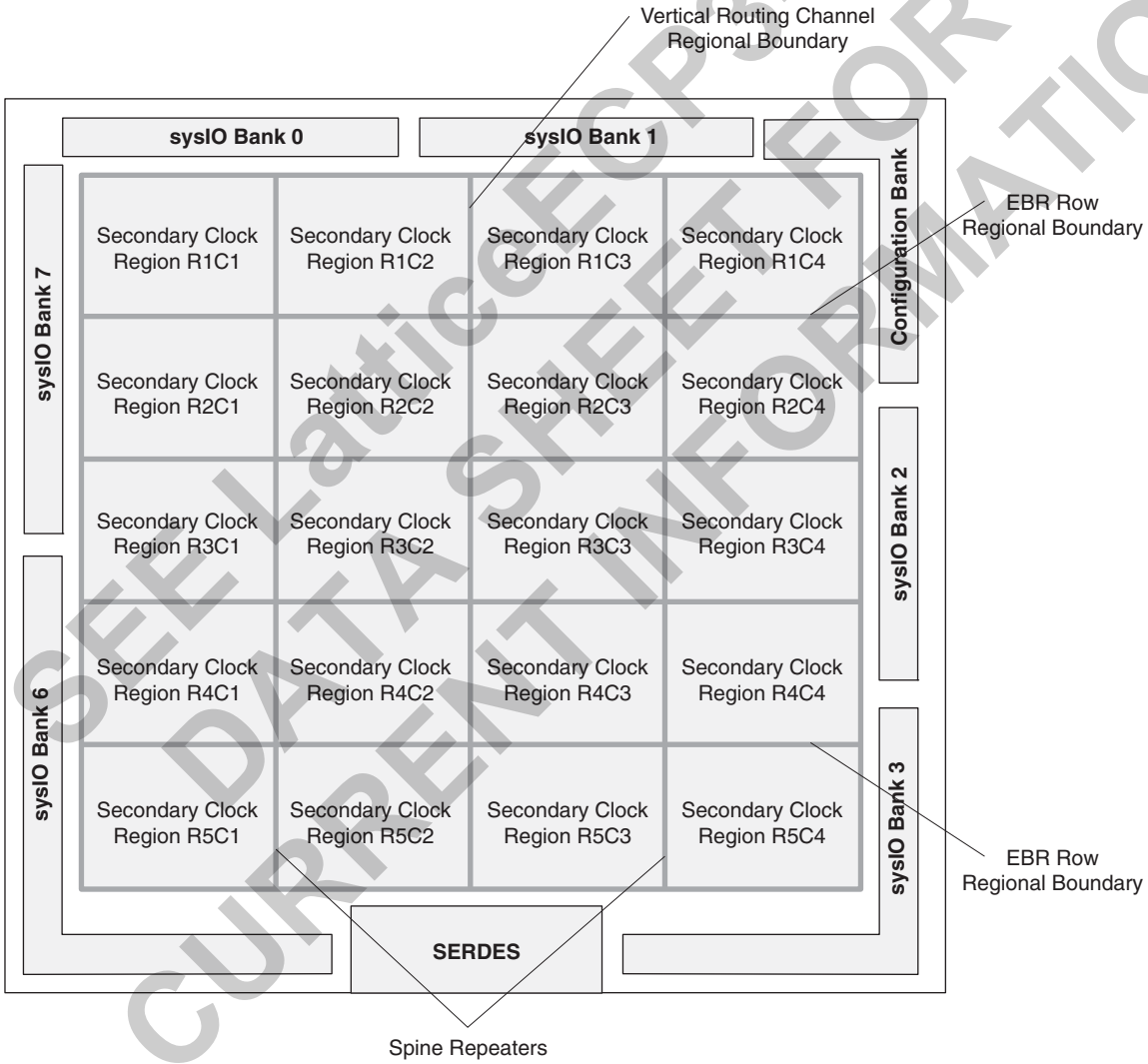
Lattice provides many pre-engineered IP (Intellectual Property) ispLeverCORE™ modules for the LatticeECP3 family. By using these configurable soft core IPs as standardized blocks, designers are free to concentrate on the unique aspects of their design, increasing their productivity.

secondary clock resources per region (SC0 to SC7). The same secondary clock routing can be used for control signals.

Table 2-6. Secondary Clock Regions

Device	Number of Secondary Clock Regions
ECP3-17	16
ECP3-35	16
ECP3-70	20
ECP3-95	20
ECP3-150	36

Figure 2-15. LatticeECP3-70 and LatticeECP3-95 Secondary Clock Regions



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

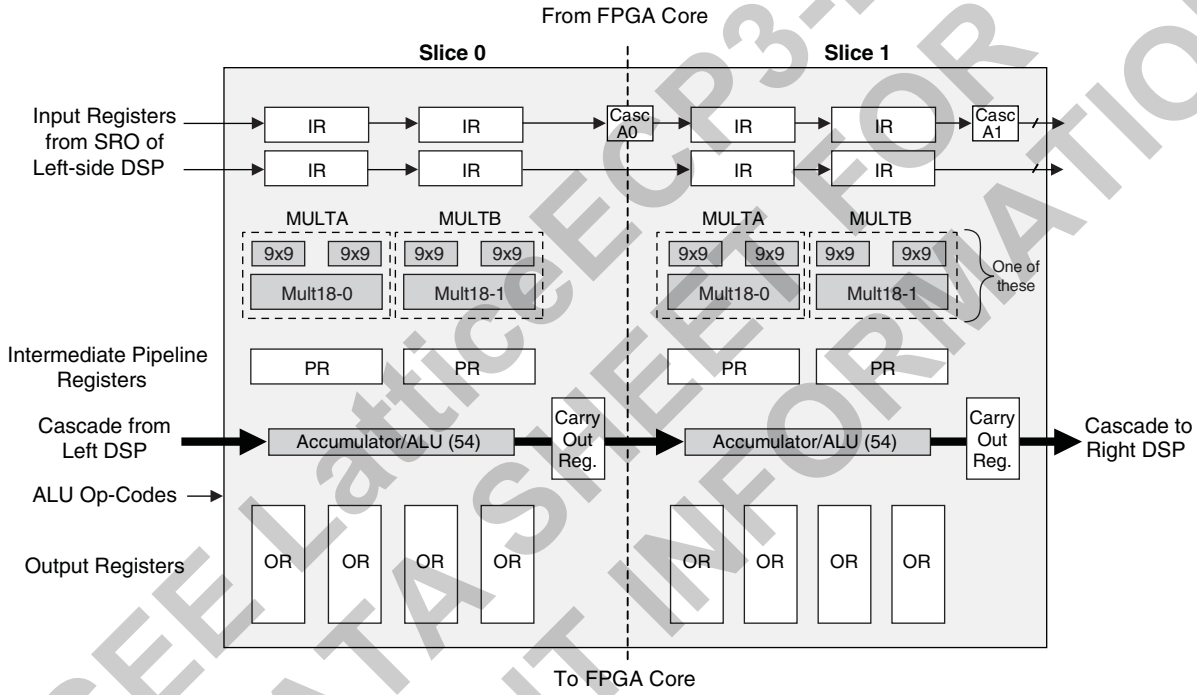
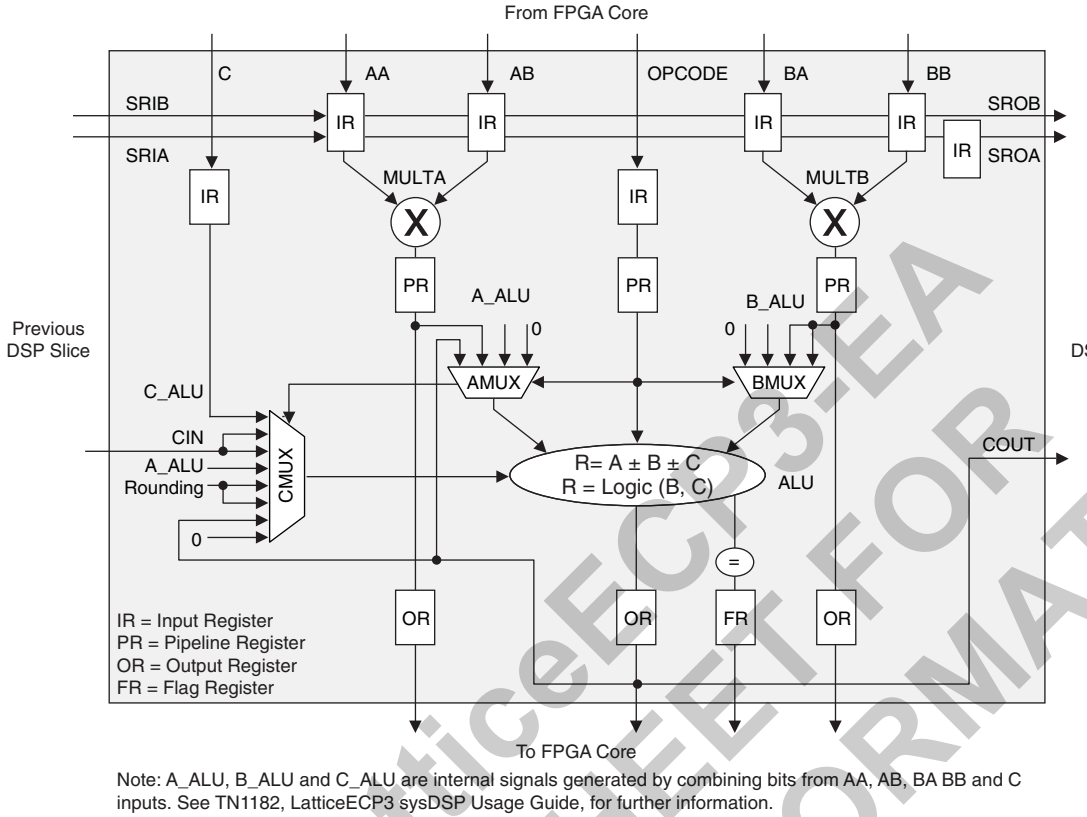


Figure 2-25. Detailed sysDSP Slice Diagram



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:

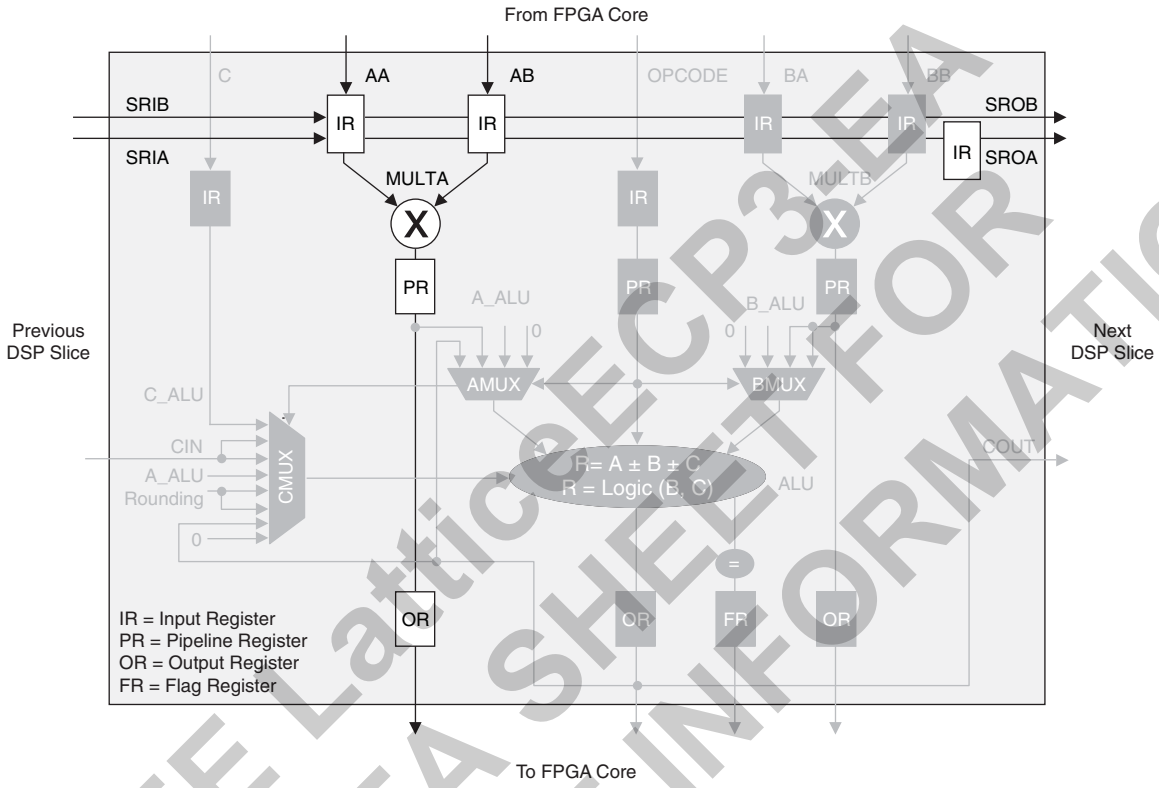
- In the Add/Sub option the Accumulator can be switched between addition and subtraction on every cycle.
- The loading of operands can switch between parallel and serial operations.

For further information, please refer to TN1182, LatticeECP3 sysDSP Usage Guide.

MULT DSP Element

This multiplier element implements a multiply with no addition or accumulator nodes. The two operands, AA and AB, are multiplied and the result is available at the output. The user can enable the input/output and pipeline registers. Figure 2-26 shows the MULT sysDSP element.

Figure 2-26. MULT sysDSP Element



(referred to as DQS) is not free-running so this approach cannot be used. The DQS Delay block provides the required clock alignment for DDR memory interfaces.

The delay required for the DQS signal is generated by two dedicated DLLs (DDR DLL) on opposite side of the device. Each DLL creates DQS delays in its half of the device as shown in Figure 2-36. The DDR DLL on the left side will generate delays for all the DQS Strobe pins on Banks 0, 7 and 6 and DDR DLL on the right will generate delays for all the DQS pins on Banks 1, 2 and 3. The DDR DLL loop compensates for temperature, voltage and process variations by using the system clock and DLL feedback loop. DDR DLL communicates the required delay to the DQS delay block using a 7-bit calibration bus (DCNTL[6:0])

The DQS signal (selected PIOs only, as shown in Figure 2-35) feeds from the PAD through a DQS control logic block to a dedicated DQS routing resource. The DQS control logic block consists of DQS Read Control logic block that generates control signals for the read side and DQS Write Control logic that generates the control signals required for the write side. A more detailed DQS control diagram is shown in Figure 2-37, which shows how the DQS control blocks interact with the data paths.

The DQS Read control logic receives the delay generated by the DDR DLL on its side and delays the incoming DQS signal by 90 degrees. This delayed ECLKDQSR is routed to 10 or 11 DQ pads covered by that DQS signal. This block also contains a polarity control logic that generates a DDRCLKPOL signal, which controls the polarity of the clock to the sync registers in the input register blocks. The DQS Read control logic also generates a DDRLAT signal that is in the input register block to transfer data from the first set of DDR register to the second set of DDR registers when using the DDRX2 gearbox mode for DDR3 memory interface.

The DQS Write control logic block generates the DQCLK0 and DQCLK1 clocks used to control the output gearing in the Output register block which generates the DDR data output and the DQS output. They are also used to control the generation of the DQS output through the DQS output register block. In addition to the DCNTL [6:0] input from the DDR DLL, the DQS Write control block also uses a Dynamic Delay DYN DEL [7:0] attribute which is used to further delay the DQS to accomplish the write leveling found in DDR3 memory. Write leveling is controlled by the DDR memory controller implementation. The DYN DELAY can set 128 possible delay step settings. In addition, the most significant bit will invert the clock for a 180-degree shift of the incoming clock. This will generate the DQSW signal used to generate the DQS output in the DQS output register block.

Figure 2-36 and Figure 2-37 show how the DQS transition signals that are routed to the PIOs.

Please see TN1180, LatticeECP3 High-Speed I/O Interface for more information on this topic.

Figure 2-36. Edge Clock, DLL Calibration and DQS Local Bus Distribution

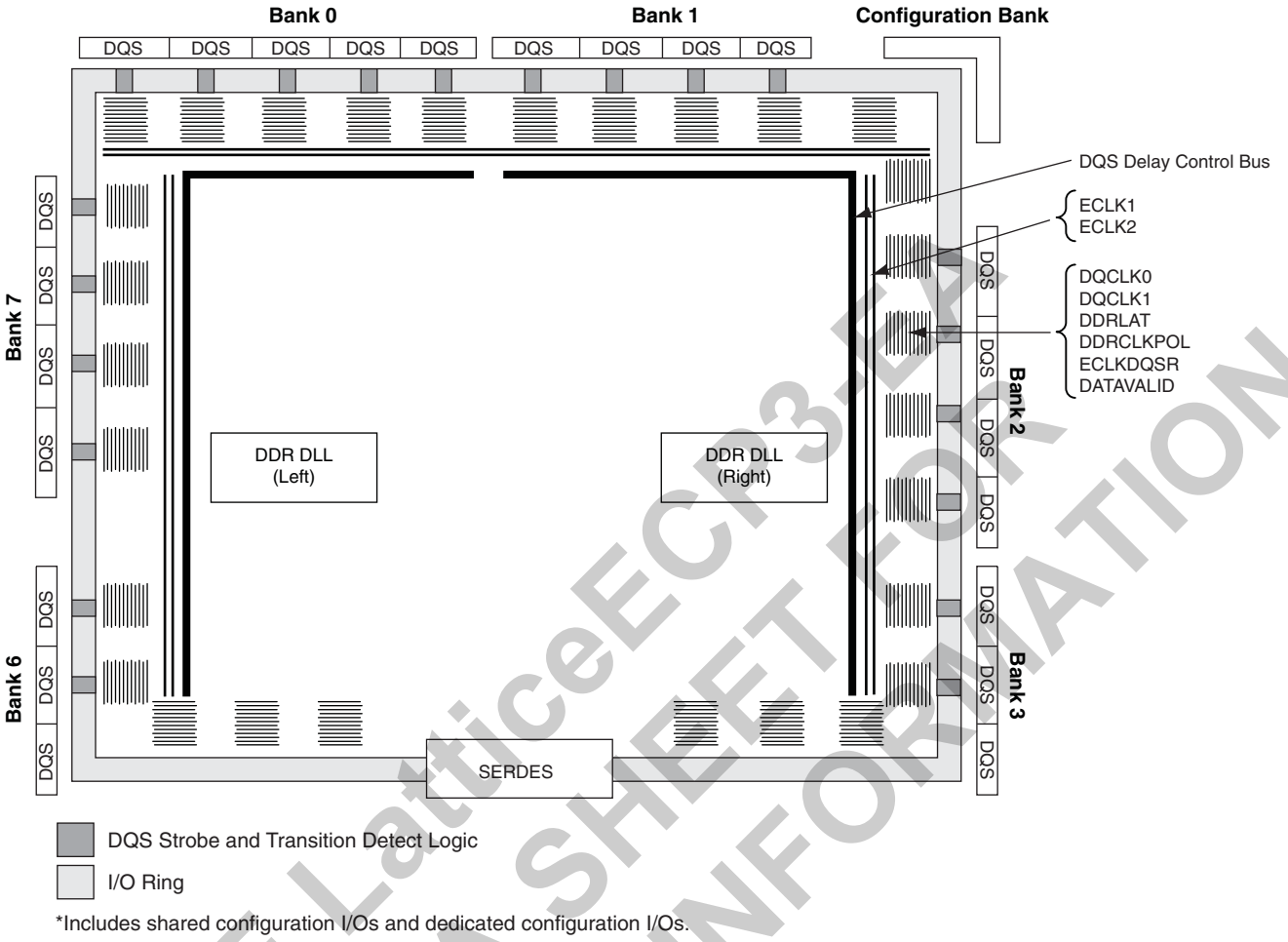
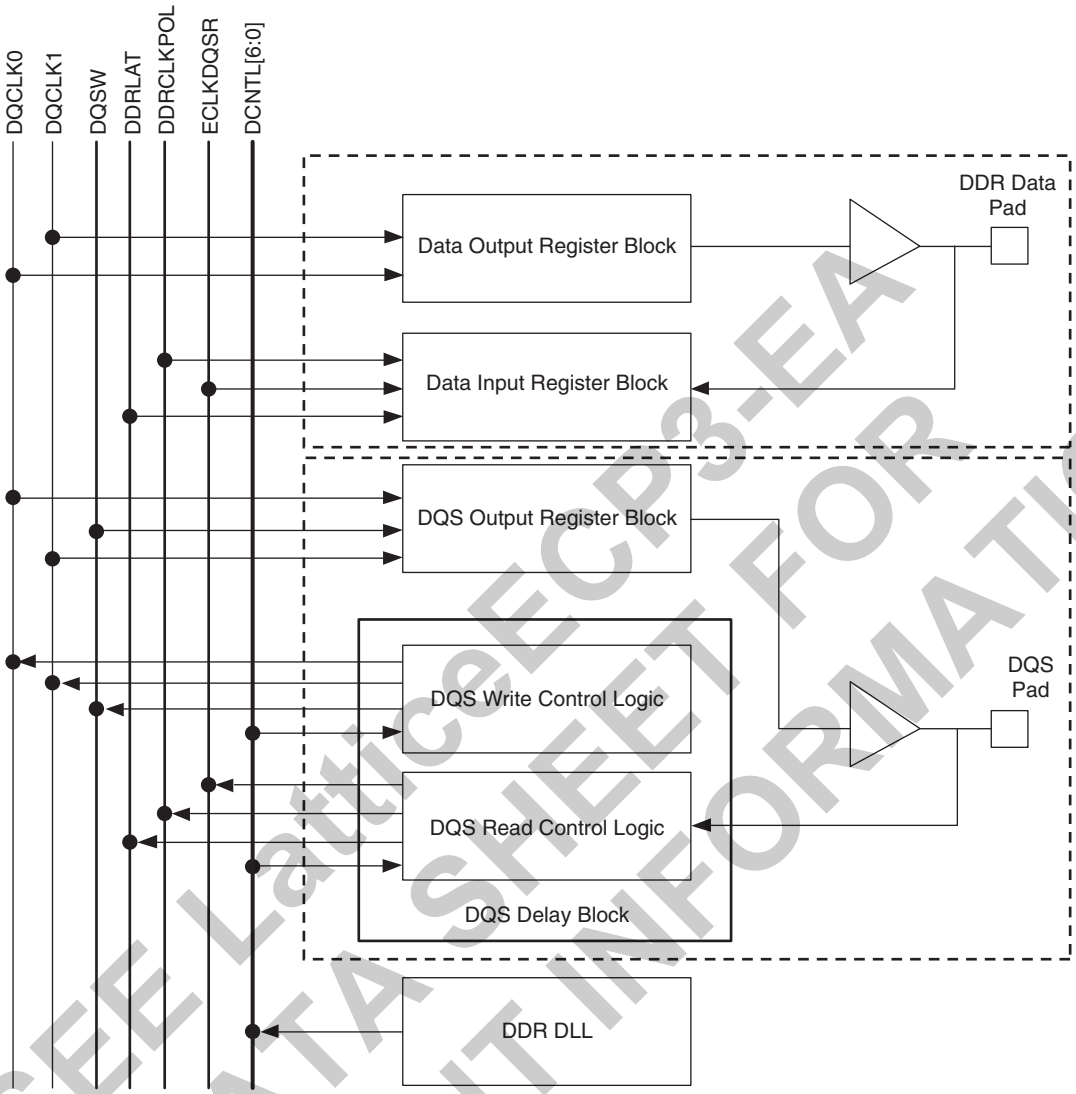


Figure 2-37. DQS Local Bus



Polarity Control Logic

In a typical DDR Memory interface design, the phase relationship between the incoming delayed DQS strobe and the internal system clock (during the READ cycle) is unknown. The LatticeECP3 family contains dedicated circuits to transfer data between these domains. A clock polarity selector is used to prevent set-up and hold violations at the domain transfer between DQS (delayed) and the system clock. This changes the edge on which the data is registered in the synchronizing registers in the input register block. This requires evaluation at the start of each READ cycle for the correct clock polarity.

Prior to the READ operation in DDR memories, DQS is in tristate (pulled by termination). The DDR memory device drives DQS low at the start of the preamble state. A dedicated circuit detects the first DQS rising edge after the preamble state. This signal is used to control the polarity of the clock to the synchronizing registers.

DDR3 Memory Support

LatticeECP3 supports the read and write leveling required for DDR3 memory interfaces.

Read leveling is supported by the use of the DDRCLKPOL and the DDRLAT signals generated in the DQS Read Control logic block. These signals dynamically control the capture of the data with respect to the DQS at the input register block.

can also be programmed to utilize a Soft Error Detect (SED) mode that checks for soft errors in configuration SRAM. The SED operation can be run in the background during user mode. If a soft error occurs, during user mode (normal operation) the device can be programmed to generate an error signal.

For further information on SED support, please see TN1184, LatticeECP3 Soft Error Detection (SED) Usage Guide.

External Resistor

LatticeECP3 devices require a single external, 10K ohm ±1% value between the XRES pin and ground. Device configuration will not be completed if this resistor is missing. There is no boundary scan register on the external resistor pad.

On-Chip Oscillator

Every LatticeECP3 device has an internal CMOS oscillator which is used to derive a Master Clock (MCLK) for configuration. The oscillator and the MCLK run continuously and are available to user logic after configuration is completed. The software default value of the MCLK is nominally 2.5MHz. Table 2-16 lists all the available MCLK frequencies. When a different Master Clock is selected during the design process, the following sequence takes place:

1. Device powers up with a nominal Master Clock frequency of 3.1MHz.
2. During configuration, users select a different master clock frequency.
3. The Master Clock frequency changes to the selected frequency once the clock configuration bits are received.
4. If the user does not select a master clock frequency, then the configuration bitstream defaults to the MCLK frequency of 2.5MHz.

This internal CMOS oscillator is available to the user by routing it as an input clock to the clock tree. For further information on the use of this oscillator for configuration or user mode, please see TN1169, LatticeECP3 sysCONFIG Usage Guide.

Table 2-16. Selectable Master Clock (MCLK) Frequencies During Configuration (Nominal)

MCLK (MHz)	MCLK (MHz)	MCLK (MHz)
2.5[1]	10	41
3.1	13	45
4.3	15	51
5.4	20	55
6.9	26	60
8.1	30	130
9.2	34	—

1. Software default MCLK frequency. Hardware default is 3.1MHz.

Density Shifting

The LatticeECP3 family is designed to ensure that different density devices in the same family and in the same package have the same pinout. Furthermore, the architecture ensures a high success rate when performing design migration from lower density devices to higher density devices. In many cases, it is also possible to shift a lower utilization design targeted for a high-density device to a lower density device. However, the exact details of the final resource utilization will impact the likelihood of success in each case. An example is that some user I/Os may become No Connects in smaller devices in the same packge.

DC Electrical Characteristics

Over Recommended Operating Conditions

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
I_{IL}, I_{IH}[1, 4]	Input or I/O Low Leakage	$0 \le V_{IN} \le (V_{CCIO} - 0.2V)$	—	—	10	µA
I_{IH}[1, 3]	Input or I/O High Leakage	$(V_{CCIO} - 0.2V) < V_{IN} \le 3.6V$	—	—	150	µA
I_{PU}	I/O Active Pull-up Current	$0 \le V_{IN} \le 0.7\ V_{CCIO}$	-30	—	-210	µA
I_{PD}	I/O Active Pull-down Current	V_{IL} (MAX) $\le V_{IN} \le V_{CCIO}$	30	—	210	µA
I_{BHLS}	Bus Hold Low Sustaining Current	$V_{IN} = V_{IL}$ (MAX)	30	—	—	µA
I_{BHHS}	Bus Hold High Sustaining Current	$V_{IN} = 0.7\ V_{CCIO}$	-30	—	—	µA
I_{BHLO}	Bus Hold Low Overdrive Current	$0 \le V_{IN} \le V_{CCIO}$	—	—	210	µA
I_{BHHO}	Bus Hold High Overdrive Current	$0 \le V_{IN} \le V_{CCIO}$	—	—	-210	µA
V_{BHT}	Bus Hold Trip Points	$0 \le V_{IN} \le V_{IH}$ (MAX)	V_{IL} (MAX)	—	V_{IH} (MIN)	V
C1	I/O Capacitance[2]	V_{CCIO} = 3.3V, 2.5V, 1.8V, 1.5V, 1.2V, V_{CC} = 1.2V, V_{IO} = 0 to V_{IH} (MAX)	—	8	—	pf
C2	Dedicated Input Capacitance[2]	V_{CCIO} = 3.3V, 2.5V, 1.8V, 1.5V, 1.2V, V_{CC} = 1.2V, V_{IO} = 0 to V_{IH} (MAX)	—	6	—	pf

1. Input or I/O leakage current is measured with the pin configured as an input or as an I/O with the output driver tri-stated. It is not measured with the output driver active. Bus maintenance circuits are disabled.
2. T_A 25°C, f = 1.0MHz.
3. Applicable to general purpose I/Os in top and bottom banks.
4. When used as V_{REF}, maximum leakage= 25µA.

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.	
f_{MAX_DDR2}	DDR2 Clock Frequency	ECP3-70E/95E	133	266	133	200	133	166	MHz
DDR3 (Using PLL for SCLK) I/O Pin Parameters									
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_DDR3}	DDR3 clock frequency	ECP3-150EA	266	400	266	333	266	300	MHz

1. Commercial timing numbers are shown. Industrial numbers are typically slower and can be extracted from the ispLEVER software.
2. General I/O timing numbers based on LVCMOS 2.5, 12mA, 0pf load.
3. Generic DDR timing numbers based on LVDS I/O.
4. DDR timing numbers based on SSTL25. DDR2 timing numbers based on SSTL18.
5. DDR3 timing numbers based on SSTL15.
6. Uses LVDS I/O standard.
7. The current version of software does not support per bank skew numbers; this will be supported in a future release.
8. Maximum clock frequencies are tested under best case conditions. System performance may vary upon the user environment.

LatticeECP3 Maximum I/O Buffer Speed (Continued)[1, 2, 3, 4, 5, 6]

Over Recommended Operating Conditions

Buffer	Description	Max.	Units
PCI33	PCI, V_{CCIO} = 3.3V	66	MHz

1. These maximum speeds are characterized but not tested on every device.
2. Maximum I/O speed for differential output standards emulated with resistors depends on the layout.
3. LVCMOS timing is measured with the load specified in the Switching Test Conditions table of this document.
4. All speeds are measured at fast slew.
5. Actual system operation may vary depending on user logic implementation.
6. Maximum data rate equals 2 times the clock rate when utilizing DDR.

SERDES External Reference Clock

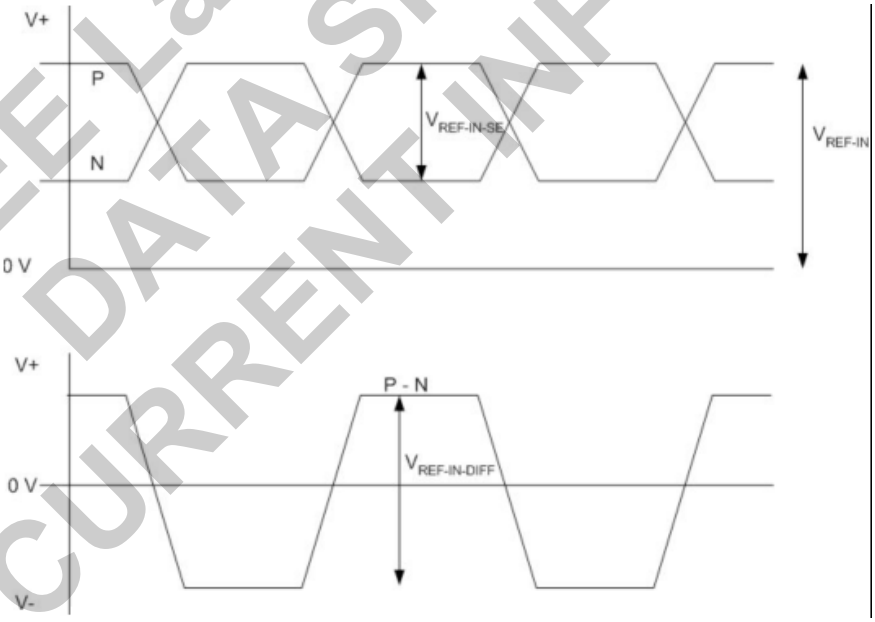
The external reference clock selection and its interface are a critical part of system applications for this product. Table 3-12 specifies reference clock requirements, over the full range of operating conditions.

Table 3-12. External Reference Clock Specification (refclkp/refclkn)

Symbol	Description	Min.	Typ.	Max.	Units
F_{REF}	Frequency range	15	—	320	MHz
$F_{REF-PPM}$	Frequency tolerance[4]	-1000	—	1000	ppm
$V_{REF-IN-SE}$	Input swing, single-ended clock[1]	200	—	V_{CCA}	mV, p-p
$V_{REF-IN-DIFF}$	Input swing, differential clock	200	—	$2*V_{CCA}$	mV, p-p differential
V_{REF-IN}	Input levels	0	—	V_{CCA} + 0.3	V
$V_{REF-CM-AC}$	Input common mode range (AC coupled)[2]	0.125	—	V_{CCA}	V
D_{REF}	Duty cycle[3]	40	—	60	%
T_{REF-R}	Rise time (20% to 80%)	200	500	1000	ps
T_{REF-F}	Fall time (80% to 20%)	200	500	1000	ps
$Z_{REF-IN-TERM-DIFF}$	Differential input termination	-20%	100/2K	+20%	Ohms
$C_{REF-IN-CAP}$	Input capacitance	—	—	7	pF

1. The signal swing for a single-ended input clock must be as large as the p-p differential swing of a differential input clock to get the same gain at the input receiver. Lower swings for the clock may be possible, but will tend to increase jitter.
2. When AC coupled, the input common mode range is determined by:
(Min input level) + (Peak-to-peak input swing)/2 ≤ (Input common mode voltage) ≤ (Max input level) - (Peak-to-peak input swing)/2
3. Measured at 50% amplitude.
4. Depending on the application, the PLL_LOL_SET and CDR_LOL_SET control registers may be adjusted for other tolerance values as described in TN1176, LatticeECP3 SERDES/PCS Usage Guide.

Figure 3-13. SERDES External Reference Clock Waveforms



HDMI (High-Definition Multimedia Interface) Electrical and Timing Characteristics

AC and DC Characteristics

Table 3-22. Transmit and Receive[1, 2]

Symbol	Description	Spec. Compliance		Units
		Min. Spec.	Max. Spec.	
Transmit				
Intra-pair Skew		—	75	ps
Inter-pair Skew		—	800	ps
TMDS Differential Clock Jitter		—	0.25	UI
Receive				
R_T	Termination Resistance	40	60	Ohms
V_{ICM}	Input AC Common Mode Voltage (50-ohm Setting)	—	50	mV
TMDS Clock Jitter	Clock Jitter Tolerance	—	0.25	UI

1. Output buffers must drive a translation device. Max. speed is 2Gbps. If translation device does not modify rise/fall time, the maximum speed is 1.5Gbps.
2. Input buffers must be AC coupled in order to support the 3.3V common mode. Generally, HDMI inputs are terminated by an external cable equalizer before data/clock is forwarded to the LatticeECP3 device.

Logic Signal Connections

Package pinout information can be found under “Data Sheets” on the LatticeECP3 product pages on the Lattice website at www.latticesemi.com/products/fpga/ecp3 and in the Lattice ispLEVER Design Planner software. To create pinout information from within Design Planner, select **View -> Package View**. Then select **Select File -> Export** and choose a type of output file. See Design Planner help for more information.

Thermal Management

Thermal management is recommended as part of any sound FPGA design methodology. To assess the thermal characteristics of a system, Lattice specifies a maximum allowable junction temperature in all device data sheets. Designers must complete a thermal analysis of their specific design to ensure that the device and package do not exceed the junction temperature limits. Refer to the Thermal Management document to find the device/package specific thermal values.

For Further Information

For further information regarding Thermal Management, refer to the following:

- Thermal Management document
- TN1181, Power Consumption and Management for LatticeECP3 Devices
- Power Calculator tool included with the Lattice ispLEVER design tool, or as a standalone download from www.latticesemi.com/software

LatticeECP3 Devices, Lead-Free Packaging

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

Commercial

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-17EA-6FTN256C	1.2V	-6	Lead-Free ftBGA	256	COM	17
LFE3-17EA-7FTN256C	1.2V	-7	Lead-Free ftBGA	256	COM	17
LFE3-17EA-8FTN256C	1.2V	-8	Lead-Free ftBGA	256	COM	17
LFE3-17EA-6FN484C	1.2V	-6	Lead-Free fpBGA	484	COM	17
LFE3-17EA-7FN484C	1.2V	-7	Lead-Free fpBGA	484	COM	17
LFE3-17EA-8FN484C	1.2V	-8	Lead-Free fpBGA	484	COM	17

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-35EA-6FTN256C	1.2V	-6	Lead-Free ftBGA	256	COM	33
LFE3-35EA-7FTN256C	1.2V	-7	Lead-Free ftBGA	256	COM	33
LFE3-35EA-8FTN256C	1.2V	-8	Lead-Free ftBGA	256	COM	33
LFE3-35EA-6FN484C	1.2V	-6	Lead-Free fpBGA	484	COM	33
LFE3-35EA-7FN484C	1.2V	-7	Lead-Free fpBGA	484	COM	33
LFE3-35EA-8FN484C	1.2V	-8	Lead-Free fpBGA	484	COM	33
LFE3-35EA-6FN672C	1.2V	-6	Lead-Free fpBGA	672	COM	33
LFE3-35EA-7FN672C	1.2V	-7	Lead-Free fpBGA	672	COM	33
LFE3-35EA-8FN672C	1.2V	-8	Lead-Free fpBGA	672	COM	33

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-70EA-6FN484C	1.2V	-6	Lead-Free fpBGA	484	COM	67
LFE3-70EA-7FN484C	1.2V	-7	Lead-Free fpBGA	484	COM	67
LFE3-70EA-8FN484C	1.2V	-8	Lead-Free fpBGA	484	COM	67
LFE3-70EA-6FN672C	1.2V	-6	Lead-Free fpBGA	672	COM	67
LFE3-70EA-7FN672C	1.2V	-7	Lead-Free fpBGA	672	COM	67
LFE3-70EA-8FN672C	1.2V	-8	Lead-Free fpBGA	672	COM	67
LFE3-70EA-6FN1156C	1.2V	-6	Lead-Free fpBGA	1156	COM	67
LFE3-70EA-7FN1156C	1.2V	-7	Lead-Free fpBGA	1156	COM	67
LFE3-70EA-8FN1156C	1.2V	-8	Lead-Free fpBGA	1156	COM	67

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-70E-6FN484C[1]	1.2V	-6	Lead-Free fpBGA	484	COM	67
LFE3-70E-7FN484C[1]	1.2V	-7	Lead-Free fpBGA	484	COM	67
LFE3-70E-8FN484C[1]	1.2V	-8	Lead-Free fpBGA	484	COM	67
LFE3-70E-6FN672C[1]	1.2V	-6	Lead-Free fpBGA	672	COM	67
LFE3-70E-7FN672C[1]	1.2V	-7	Lead-Free fpBGA	672	COM	67
LFE3-70E-8FN672C[1]	1.2V	-8	Lead-Free fpBGA	672	COM	67
LFE3-70E-6FN1156C[1]	1.2V	-6	Lead-Free fpBGA	1156	COM	67
LFE3-70E-7FN1156C[1]	1.2V	-7	Lead-Free fpBGA	1156	COM	67
LFE3-70E-8FN1156C[1]	1.2V	-8	Lead-Free fpBGA	1156	COM	67

1.This device has associated errata. View www.latticesemi.com/documents/ds1021.zip for a description of the errata.

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-95EA-6FN484C	1.2V	-6	Lead-Free fpBGA	484	COM	92
LFE3-95EA-7FN484C	1.2V	-7	Lead-Free fpBGA	484	COM	92
LFE3-95EA-8FN484C	1.2V	-8	Lead-Free fpBGA	484	COM	92
LFE3-95EA-6FN672C	1.2V	-6	Lead-Free fpBGA	672	COM	92
LFE3-95EA-7FN672C	1.2V	-7	Lead-Free fpBGA	672	COM	92
LFE3-95EA-8FN672C	1.2V	-8	Lead-Free fpBGA	672	COM	92
LFE3-95EA-6FN1156C	1.2V	-6	Lead-Free fpBGA	1156	COM	92
LFE3-95EA-7FN1156C	1.2V	-7	Lead-Free fpBGA	1156	COM	92
LFE3-95EA-8FN1156C	1.2V	-8	Lead-Free fpBGA	1156	COM	92

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-95E-6FN484C[1]	1.2V	-6	Lead-Free fpBGA	484	COM	92
LFE3-95E-7FN484C[1]	1.2V	-7	Lead-Free fpBGA	484	COM	92
LFE3-95E-8FN484C[1]	1.2V	-8	Lead-Free fpBGA	484	COM	92
LFE3-95E-6FN672C[1]	1.2V	-6	Lead-Free fpBGA	672	COM	92
LFE3-95E-7FN672C[1]	1.2V	-7	Lead-Free fpBGA	672	COM	92
LFE3-95E-8FN672C[1]	1.2V	-8	Lead-Free fpBGA	672	COM	92
LFE3-95E-6FN1156C[1]	1.2V	-6	Lead-Free fpBGA	1156	COM	92
LFE3-95E-7FN1156C[1]	1.2V	-7	Lead-Free fpBGA	1156	COM	92
LFE3-95E-8FN1156C[1]	1.2V	-8	Lead-Free fpBGA	1156	COM	92

1.This device has associated errata. View www.latticesemi.com/documents/ds1021.zip for a description of the errata.

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-150EA-6FN672C	1.2V	-6	Lead-Free fpBGA	672	COM	149
LFE3-150EA-7FN672C	1.2V	-7	Lead-Free fpBGA	672	COM	149
LFE3-150EA-8FN672C	1.2V	-8	Lead-Free fpBGA	672	COM	149
LFE3-150EA-6FN1156C	1.2V	-6	Lead-Free fpBGA	1156	COM	149
LFE3-150EA-7FN1156C	1.2V	-7	Lead-Free fpBGA	1156	COM	149
LFE3-150EA-8FN1156C	1.2V	-8	Lead-Free fpBGA	1156	COM	149

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-150EA-6FN672CTW*	1.2V	-6	Lead-Free fpBGA	672	COM	149
LFE3-150EA-7FN672CTW*	1.2V	-7	Lead-Free fpBGA	672	COM	149
LFE3-150EA-8FN672CTW*	1.2V	-8	Lead-Free fpBGA	672	COM	149
LFE3-150EA-6FN1156CTW*	1.2V	-6	Lead-Free fpBGA	1156	COM	149
LFE3-150EA-7FN1156CTW*	1.2V	-7	Lead-Free fpBGA	1156	COM	149
LFE3-150EA-8FN1156CTW*	1.2V	-8	Lead-Free fpBGA	1156	COM	149

*Note: Specifications for the LFE3-150EA-*sp*FN*pkg*CTW and LFE3-150EA-*sp*FN*pkg*ITW devices, (where *sp* is the speed and *pkg* is the package), are the same as the LFE3-150EA-*sp*FN*pkg*C and LFE3-150EA-*sp*FN*pkg*I devices respectively, except as specified below.

- The CTC (Clock Tolerance Circuit) inside the SERDES hard PCS in the TW device is not functional but it can be bypassed and implemented in soft IP.
- The SERDES XRES pin on the TW device passes CDM testing at 250V.

Date	Version	Section	Change Summary
November 2009 (cont.)	01.5 (cont.)	Architecture (cont.)	Updated Table 2-13, SERDES Standard Support to include SONET/ SDH and updated footnote 2.
		DC and Switching Characterisitcs	Added footnote to ESD Performance table.
			Updated SERDES Power Supply Requirements table and footnotes.
			Updated Maximum I/O Buffer Speed table.
			Updated Pin-to-Pin Peformance table.
			Updated sysCLOCK PLL Timing table.
			Updated DLL timing table.
			Updated High-Speed Data Transmitter tables.
			Updated High-Speed Data Receiver table.
			Updated footnote for Receiver Total Jitter Tolerance Specification table.
			Updated Periodic Receiver Jitter Tolerance Specification table.
			Updated SERDES External Reference Clock Specification table.
			Updated PCI Express Electrical and Timing AC and DC Characteristics.
			Deleted Reference Clock table for PCI Express Electrical and Timing AC and DC Characteristics.
			Updated SMPTE AC/DC Characteristics Transmit table.
			Updated Mini LVDS table.
			Updated RSDS table.
			Added Supply Current (Standby) table for EA devices.
			Updated Internal Switching Characteristics table.
			Updated Register-to-Register Performance table.
			Added HDMI Electrical and Timing Characteristics data.
			Updated Family Timing Adders table.
			Updated sysCONFIG Port Timing Specifications table.
			Updated Recommended Operating Conditions table.
			Updated Hot Socket Specifications table.
			Updated Single-Ended DC table.
			Updated TRLVDS table and figure.
			Updated Serial Data Input Specifications table.
			Updated HDMI Transmit and Receive table.
		Ordering Information	Added LFE3-150EA “TW” devices and footnotes to the Commercial and Industrial tables.
March 2010	01.6	Architecture	Added Read-Before-Write information.
		DC and Switching Characteristics	Added footnote #6 to Maximum I/O Buffer Speed table.
			Corrected minimum operating conditions for input and output differential voltages in the Point-to-Point LVDS table.
		Pinout Information	Added pin information for the LatticeECP3-70EA and LatticeECP3-95EA devices.
		Ordering Information	Added ordering part numbers for the LatticeECP3-70EA and LatticeECP3-95EA devices.
			Removed dual mark information.