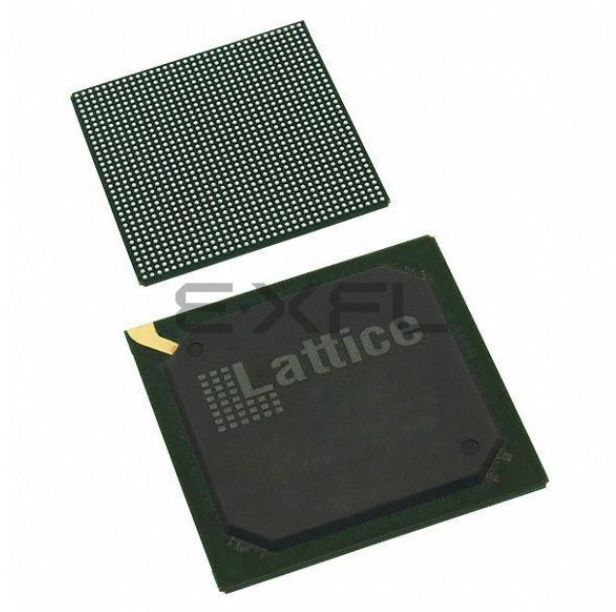
Lattice Semiconductor Corporation - LFE3-70E-6FN1156I Datasheet



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Details	
Product Status	Obsolete
Number of LABs/CLBs	8375
Number of Logic Elements/Cells	67000
Total RAM Bits	4526080
Number of I/O	490
Number of Gates	-
Voltage - Supply	1.14V ~ 1.26V
Mounting Type	Surface Mount
Operating Temperature	-40°C ~ 100°C (TJ)
Package / Case	1156-BBGA
Supplier Device Package	1156-FPBGA (35x35)
Purchase URL	https://www.e-xfl.com/product-detail/lattice-semiconductor/lfe3-70e-6fn1156i

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.

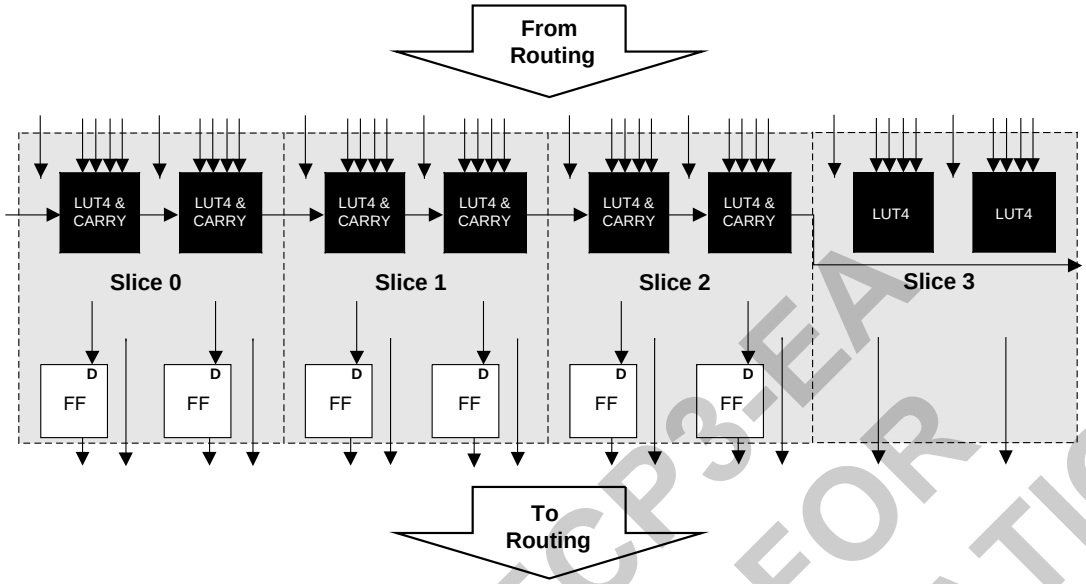
Each PIC block encompasses two PIOs (PIO pairs) with their respective sysI/O buffers. The sysI/O buffers of the LatticeECP3 devices are arranged in seven banks, allowing the implementation of a wide variety of I/O standards. In addition, a separate I/O bank is provided for the programming interfaces. 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 2-2. PFU Diagram



Slice

Slice 0 through Slice 2 contain two LUT4s feeding two registers, whereas Slice 3 contains two LUT4s only. For PFUs, Slice 0 through Slice 2 can be configured as distributed memory, a capability not available in the PFF. Table 2-1 shows the capability of the slices in both PFF and PFU blocks along with the operation modes they enable. In addition, each PFU contains logic that allows the LUTs to be combined to perform functions such as LUT5, LUT6, LUT7 and LUT8. There is control logic to perform set/reset functions (programmable as synchronous/ asynchronous), clock select, chip-select and wider RAM/ROM functions.

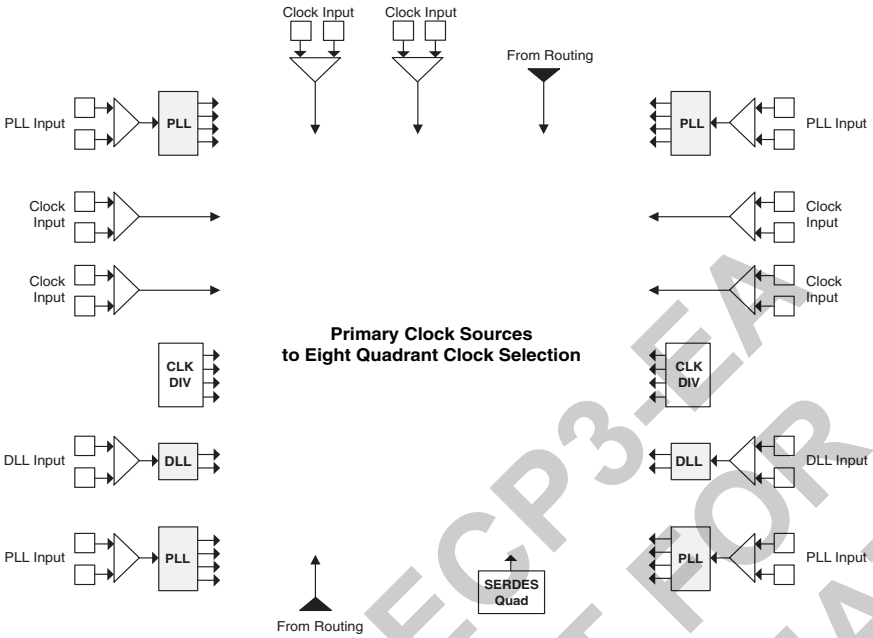
Table 2-1. Resources and Modes Available per Slice

Slice	PFU BLock		PFF Block	
	Resources	Modes	Resources	Modes
Slice 0	2 LUT4s and 2 Registers	Logic, Ripple, RAM, ROM	2 LUT4s and 2 Registers	Logic, Ripple, ROM
Slice 1	2 LUT4s and 2 Registers	Logic, Ripple, RAM, ROM	2 LUT4s and 2 Registers	Logic, Ripple, ROM
Slice 2	2 LUT4s and 2 Registers	Logic, Ripple, RAM, ROM	2 LUT4s and 2 Registers	Logic, Ripple, ROM
Slice 3	2 LUT4s	Logic, ROM	2 LUT4s	Logic, ROM

Figure 2-3 shows an overview of the internal logic of the slice. The registers in the slice can be configured for positive/negative and edge triggered or level sensitive clocks.

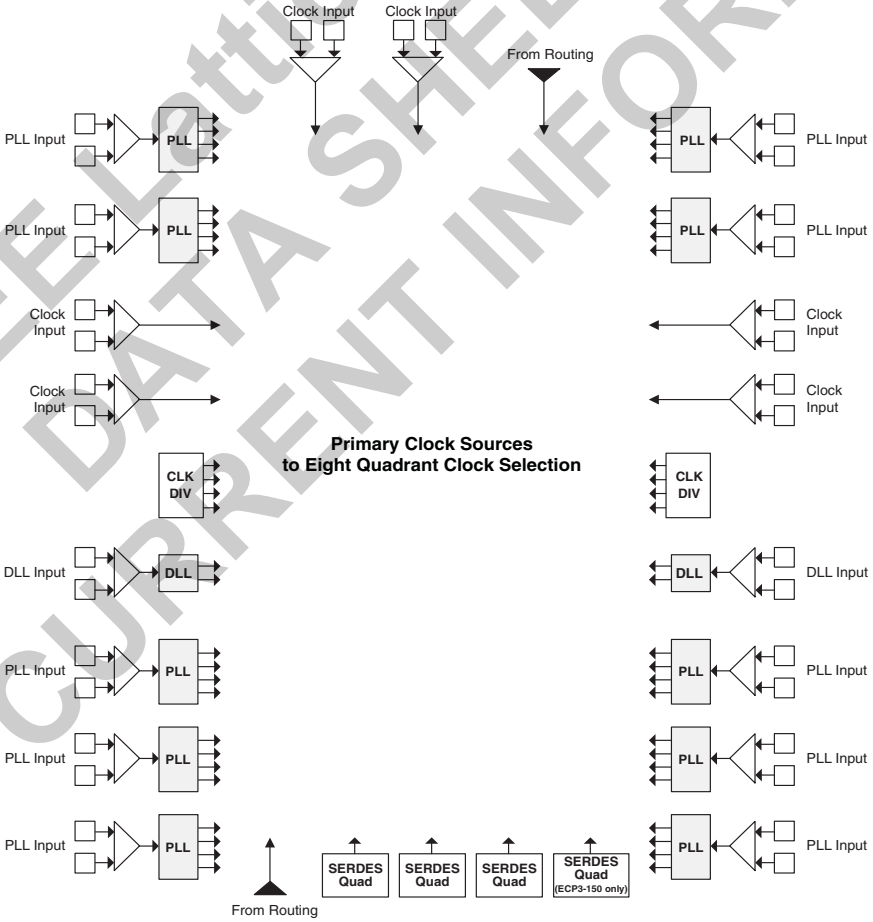
Slices 0, 1 and 2 have 14 input signals: 13 signals from routing and one from the carry-chain (from the adjacent slice or PFU). There are seven outputs: six to routing and one to carry-chain (to the adjacent PFU). Slice 3 has 10 input signals from routing and four signals to routing. Table 2-2 lists the signals associated with Slice 0 to Slice 2.

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



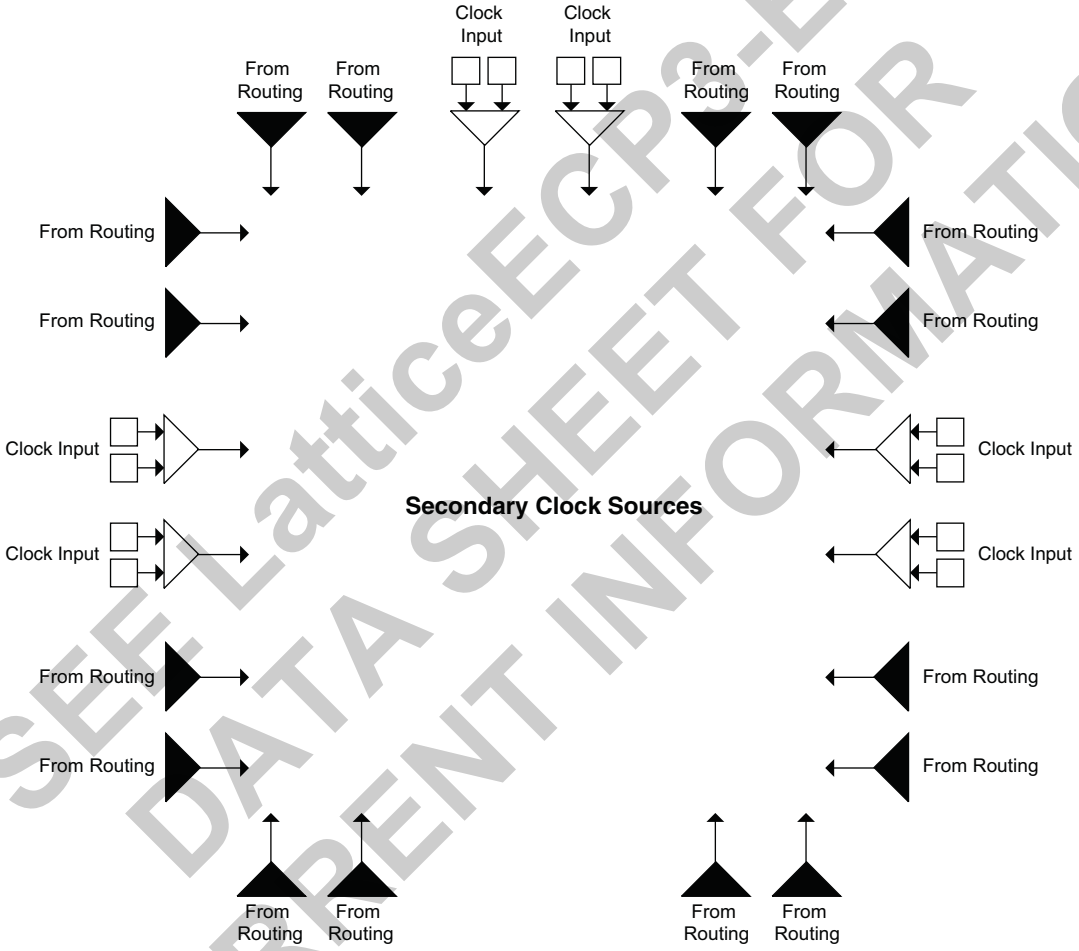
Note: Clock inputs can be configured in differential or single-ended mode.

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.

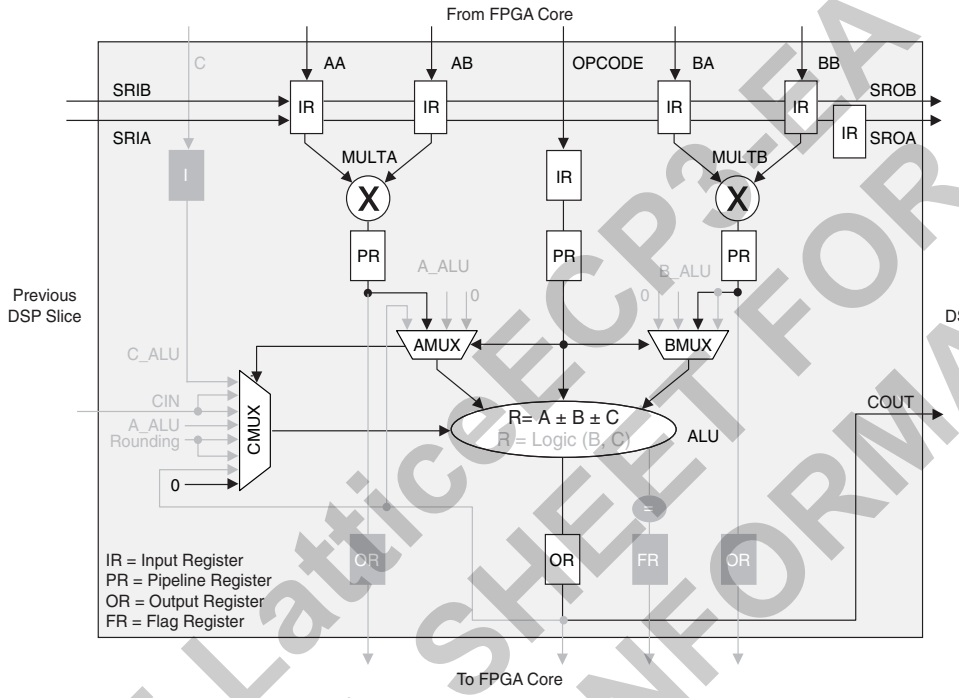
Secondary Clock/Control Routing

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

MULTADDSUBSUM DSP Element

In this case, the operands AA and AB are multiplied and the result is added/subtracted with the result of the multiplier operation of operands BA and BB of Slice 0. Additionally, the operands AA and AB are multiplied and the result is added/subtracted with the result of the multiplier operation of operands BA and BB of Slice 1. The results of both addition/subtractions are added by the second ALU following the slice cascade path. The user can enable the input, output and pipeline registers. Figure 2-30 and Figure 2-31 show the MULTADDSUBSUM sysDSP element.

Figure 2-30. MULTADDSUBSUM Slice 0



Two adjacent PIOs can be joined to provide a differential I/O pair (labeled as "T" and "C") as shown in Figure 2-32. The PAD Labels "T" and "C" distinguish the two PIOs. Approximately 50% of the PIO pairs on the left and right edges of the device can be configured as true LVDS outputs. All I/O pairs can operate as LVDS inputs.

Table 2-11. PIO Signal List

Name	Type	Description
INDD	Input Data	Register bypassed input. This is not the same port as INCK.
IPA, INA, IPB, INB	Input Data	Ports to core for input data
OPOSA, ONEGA[1], OPOSB, ONEGB[1]	Output Data	Output signals from core. An exception is the ONEGB port, used for tristate logic at the DQS pad.
CE	PIO Control	Clock enables for input and output block flip-flops.
SCLK	PIO Control	System Clock (PCLK) for input and output/TS blocks. Connected from clock ISB.
LSR	PIO Control	Local Set/Reset
ECLK1, ECLK2	PIO Control	Edge clock sources. Entire PIO selects one of two sources using mux.
ECLKDQSR[1]	Read Control	From DQS_STROBE, shifted strobe for memory interfaces only.
DDRCLKPOL[1]	Read Control	Ensures transfer from DQS domain to SCLK domain.
DDRLAT[1]	Read Control	Used to guarantee INDDRX2 gearing by selectively enabling a D-Flip-Flop in datapath.
DEL[3:0]	Read Control	Dynamic input delay control bits.
INCK	To Clock Distribution and PLL	PIO treated as clock PIO, path to distribute to primary clocks and PLL.
TS	Tristate Data	Tristate signal from core (SDR)
DQCLK0[1], DQCLK1[1]	Write Control	Two clocks edges, 90 degrees out of phase, used in output gearing.
DQSW[2]	Write Control	Used for output and tristate logic at DQS only.
DYNDEL[7:0]	Write Control	Shifting of write clocks for specific DQS group, using 6:0 each step is approximately 25ps, 128 steps. Bit 7 is an invert (timing depends on input frequency). There is also a static control for this 8-bit setting, enabled with a memory cell.
DCNTL[6:0]	PIO Control	Original delay code from DDR DLL
DATAVALID[1]	Output Data	Status flag from DATAVALID logic, used to indicate when input data is captured in IOLOGIC and valid to core.
READ	For DQS_Strobe	Read signal for DDR memory interface
DQSI	For DQS_Strobe	Unshifted DQS strobe from input pad
PRMBDET	For DQS_Strobe	DQSI biased to go high when DQSI is tristate, goes to input logic block as well as core logic.
GSRN	Control from routing	Global Set/Reset

1. Signals available on left/right/top edges only.
2. Selected PIO.

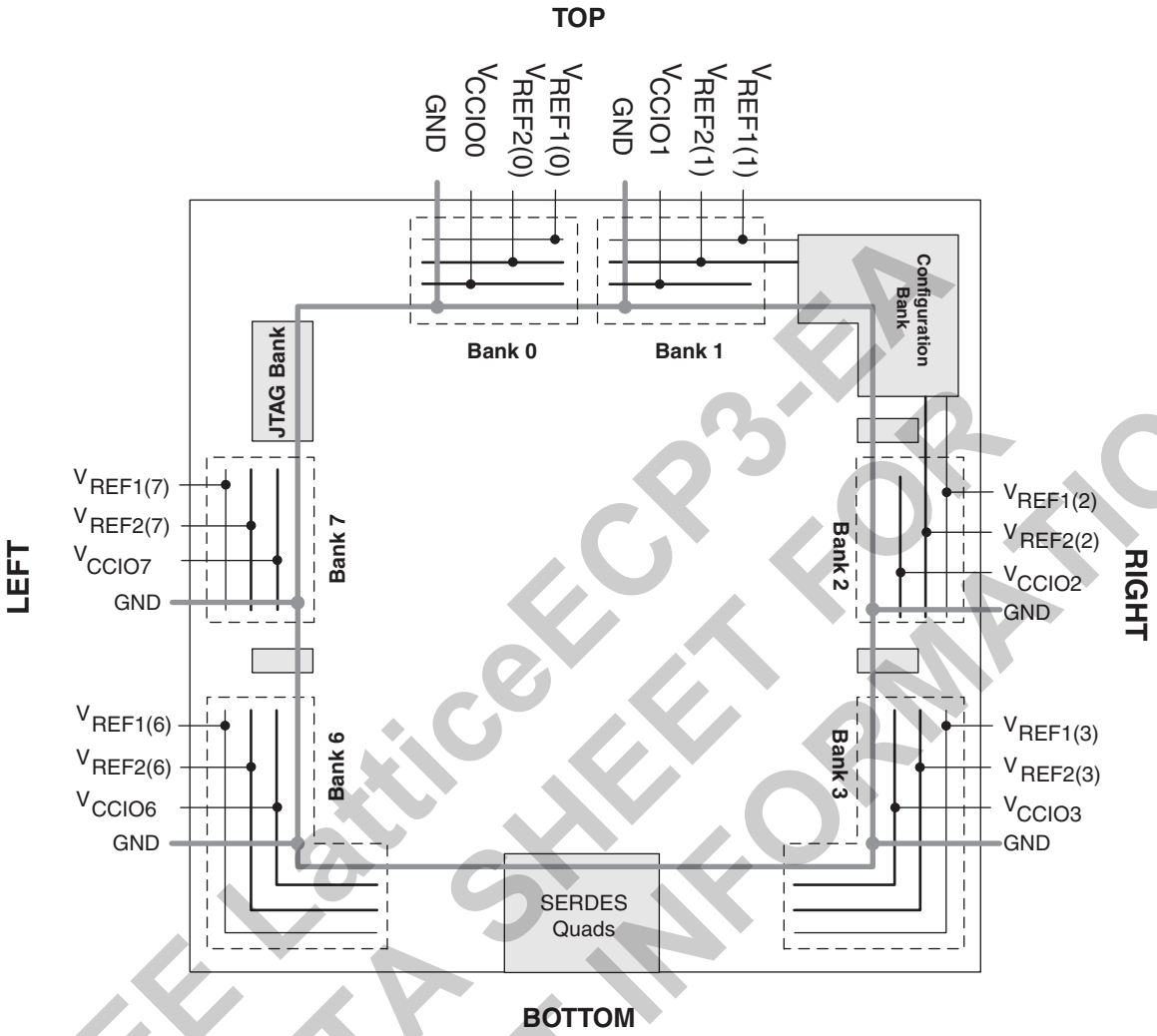
PIO

The PIO contains four blocks: an input register block, output register block, tristate register block and a control logic block. These blocks contain registers for operating in a variety of modes along with the necessary clock and selection logic.

Input Register Block

The input register blocks for the PIOs, in the left, right and top edges, contain delay elements and registers that can be used to condition high-speed interface signals, such as DDR memory interfaces and source synchronous interfaces, before they are passed to the device core. Figure 2-33 shows the input register block for the left, right and top edges. The input register block for the bottom edge contains one element to register the input signal and no DDR registers. The following description applies to the input register block for PIOs in the left, right and top edges only.

Figure 2-38. LatticeECP3 Banks



LatticeECP3 devices contain two types of sysI/O buffer pairs.

1. **Top (Bank 0 and Bank 1) and Bottom sysI/O Buffer Pairs (Single-Ended Outputs Only)**
   The sysI/O buffer pairs in the top banks of the device consist of two single-ended output drivers and two sets of single-ended input buffers (both ratioed and referenced). One of the referenced input buffers can also be configured as a differential input. Only the top edge buffers have a programmable PCI clamp.

   The two pads in the pair are described as “true” and “comp”, where the true pad is associated with the positive side of the differential input buffer and the comp (complementary) pad is associated with the negative side of the differential input buffer.

   On the top and bottom sides, there is no support for programmable on-chip input termination, which is required for DQ and DQS pins for DDR3 interface. This side is ideal for ADDR/CMD signals of DDR3, general purpose I/O, PCI, TR-LVDS (transition reduced LVDS) or LVDS inputs. Only the top I/O banks support hot socketing with I_{DK} specified under the Hot Socketing Specifications. The configuration bank is not hot-socketable.

2. **Left and Right (Banks 2, 3, 6 and 7) sysI/O Buffer Pairs (50% Differential and 100% Single-Ended Outputs)**
   The sysI/O buffer pairs in the left and right banks of the device consist of two single-ended output drivers, two sets of single-ended input buffers (both ratioed and referenced) and one differential output driver. One of the referenced input buffers can also be configured as a differential input. In these banks the two pads in the pair are described as “true” and “comp”, where the true pad is associated with the positive side of the differential I/O, and the comp (complementary) pad is associated with the negative side of the differential I/O.

   In addition, programmable on-chip input termination (parallel or differential, static or dynamic) is supported on these sides, which is required for DDR3 interface. However, there is no support for hot-socketing on these sides as the clamp is always present.

   LVDS, RSDS, PPLVDS and Mini-LVDS differential output drivers are available on 50% of the buffer pairs on the left and right banks.

3. **Configuration Bank sysI/O Buffer Pairs (Single-Ended Outputs, Only on Shared Pins When Not Used by Configuration)**
   The sysI/O buffers in the Configuration Bank consist of single-ended output drivers and single-ended input buffers (both ratioed and referenced). The referenced input buffer can also be configured as a differential input.

   The two pads in the pair are described as “true” and “comp”, where the true pad is associated with the positive side of the differential input buffer and the comp (complementary) pad is associated with the negative side of the differential input buffer.

Programmable PCI clamps are only available on top banks (PCI clamps are used primarily on inputs and bidirectional pads to reduce ringing on the receiving end) can also be used on inputs.

Typical sysI/O I/O Behavior During Power-up

The internal power-on-reset (POR) signal is deactivated when V_{CC}, V_{CCIO8} and V_{CCAUX} have reached satisfactory levels. After the POR signal is deactivated, the FPGA core logic becomes active. It is the user’s responsibility to ensure that all other V_{CCIO} banks are active with valid input logic levels to properly control the output logic states of all the I/O banks that are critical to the application. For more information about controlling the output logic state with valid input logic levels during power-up in LatticeECP3 devices, see the list of technical documentation at the end of this data sheet.

The V_{CC} and V_{CCAUX} supply the power to the FPGA core fabric, whereas the V_{CCIO} supplies power to the I/O buffers. In order to simplify system design while providing consistent and predictable I/O behavior, it is recommended that the I/O buffers be powered-up prior to the FPGA core fabric. V_{CCIO} supplies should be powered-up before or together with the V_{CC} and V_{CCAUX} supplies.

Supported sysI/O Standards

The LatticeECP3 sysI/O buffer supports both single-ended and differential standards. Single-ended standards can be further subdivided into LVCMOS, LVTTL and other standards. The buffers support the LVTTL, LVCMOS 1.2V, 1.5V, 1.8V, 2.5V and 3.3V standards. In the LVCMOS and LVTTL modes, the buffer has individual configuration options for drive strength, slew rates, bus maintenance (weak pull-up, weak pull-down, or a bus-keeper latch) and open drain. Other single-ended standards supported include SSTL and HSTL. Differential standards supported include LVDS, BLVDS, LVPECL, MLVDS, RSDS, Mini-LVDS, PPLVDS (point-to-point LVDS), TRLVDS (Transition Reduced LVDS), differential SSTL and differential HSTL. Tables 2-13 and 2-14 show the I/O standards (together with their supply and reference voltages) supported by LatticeECP3 devices. For further information on utilizing the sysI/O buffer to support a variety of standards please see TN1177, LatticeECP3 sysIO Usage Guide.

Figure 2-40. SERDES/PCS Quads (LatticeECP3-150)

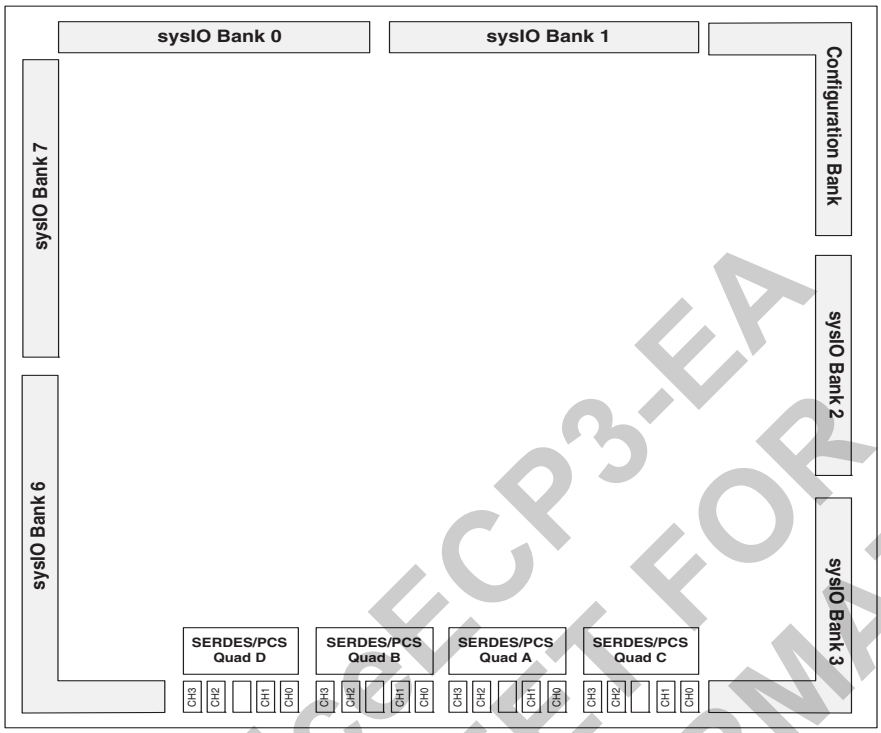


Table 2-13. LatticeECP3 SERDES Standard Support

Standard	Data Rate (Mbps)	Number of General/Link Width	Encoding Style
PCI Express 1.1	2500	x1, x2, x4	8b10b
Gigabit Ethernet	1250, 2500	x1	8b10b
SGMII	1250	x1	8b10b
XAUI	3125	x4	8b10b
Serial RapidIO Type I, Serial RapidIO Type II, Serial RapidIO Type III	1250, 2500, 3125	x1, x4	8b10b
CPRI-1, CPRI-2, CPRI-3, CPRI-4	614.4, 1228.8, 2457.6, 3072.0	x1	8b10b
SD-SDI (259M, 344M)	143[1], 177[1], 270, 360, 540	x1	NRZI/Scrambled
HD-SDI (292M)	1483.5, 1485	x1	NRZI/Scrambled
3G-SDI (424M)	2967, 2970	x1	NRZI/Scrambled
SONET-STS-3[2]	155.52	x1	N/A
SONET-STS-12[2]	622.08	x1	N/A
SONET-STS-48[2]	2488	x1	N/A

1. For slower rates, the SERDES are bypassed and CML signals are directly connected to the FPGA routing.
2. The SONET protocol is supported in 8-bit SERDES mode. See TN1176 Lattice ECP3 SERDES/PCS Usage Guide for more information.

MLVDS25

The LatticeECP3 devices support the differential MLVDS standard. This standard is emulated using complementary LVCMOS outputs in conjunction with a parallel resistor across the driver outputs. The MLVDS input standard is supported by the LVDS differential input buffer. The scheme shown in Figure 3-5 is one possible solution for MLVDS standard implementation. Resistor values in Figure 3-5 are industry standard values for 1% resistors.

Figure 3-5. MLVDS25 (Multipoint Low Voltage Differential Signaling)

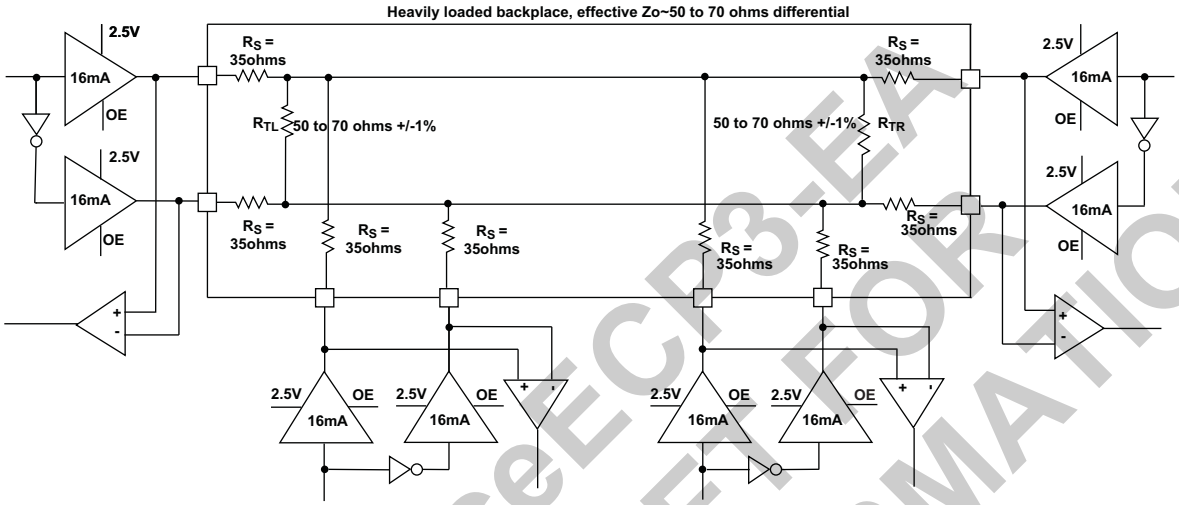


Table 3-5. MLVDS25 DC Conditions[1]

Parameter	Description	Typical		Units
		Zo=50Ω	Zo=70Ω	
V_{CCIO}	Output Driver Supply (+/-5%)	2.50	2.50	V
Z_{OUT}	Driver Impedance	10.00	10.00	Ω
R_S	Driver Series Resistor (+/-1%)	35.00	35.00	Ω
R_{TL}	Driver Parallel Resistor (+/-1%)	50.00	70.00	Ω
R_{TR}	Receiver Termination (+/-1%)	50.00	70.00	Ω
V_{OH}	Output High Voltage	1.52	1.60	V
V_{OL}	Output Low Voltage	0.98	0.90	V
V_{OD}	Output Differential Voltage	0.54	0.70	V
V_{CM}	Output Common Mode Voltage	1.25	1.25	V
I_{DC}	DC Output Current	21.74	20.00	mA

1. For input buffer, see LVDS table.

Figure 3-6. Generic DDR/DDR2 (With Clock and Data Edges Aligned)

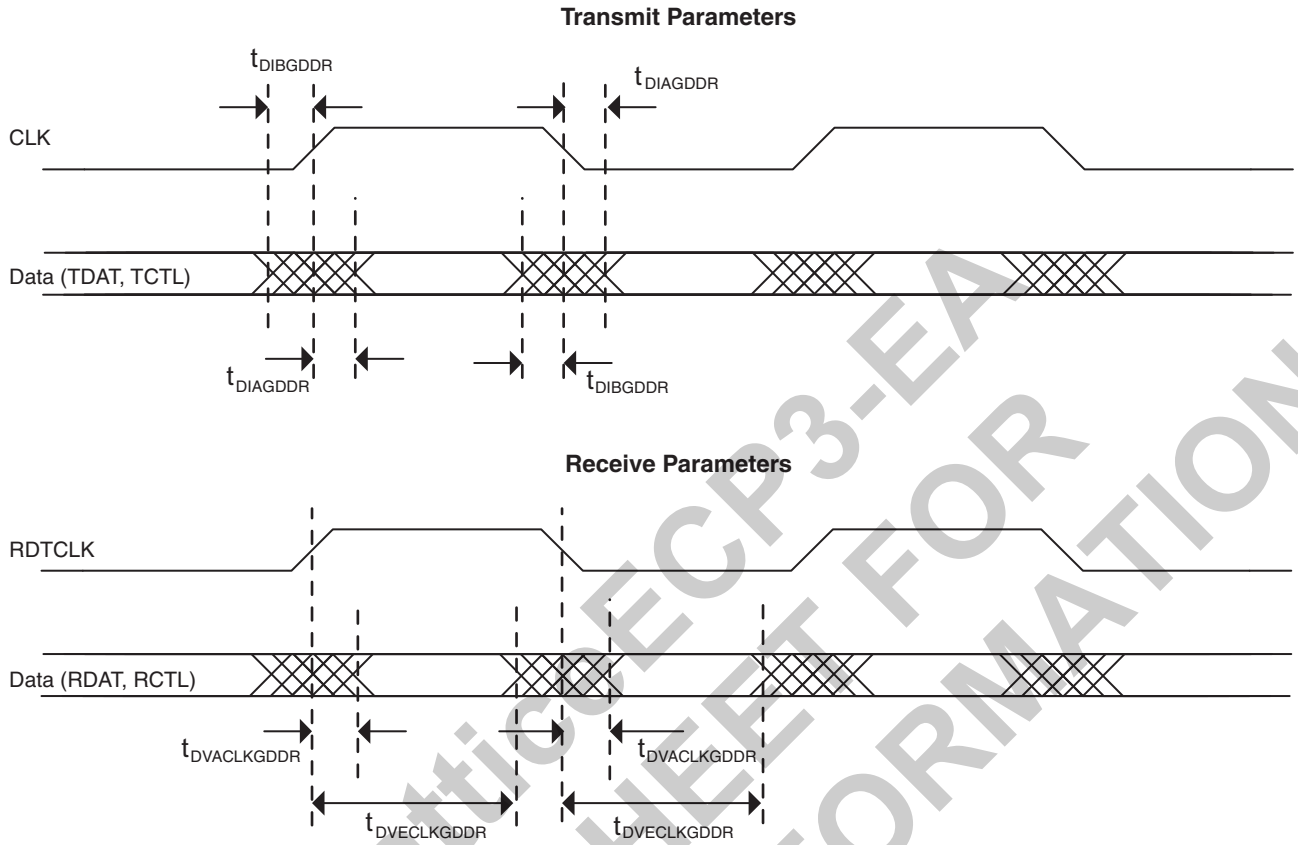


Figure 3-7. DDR/DDR2/DDR3 SDRAM

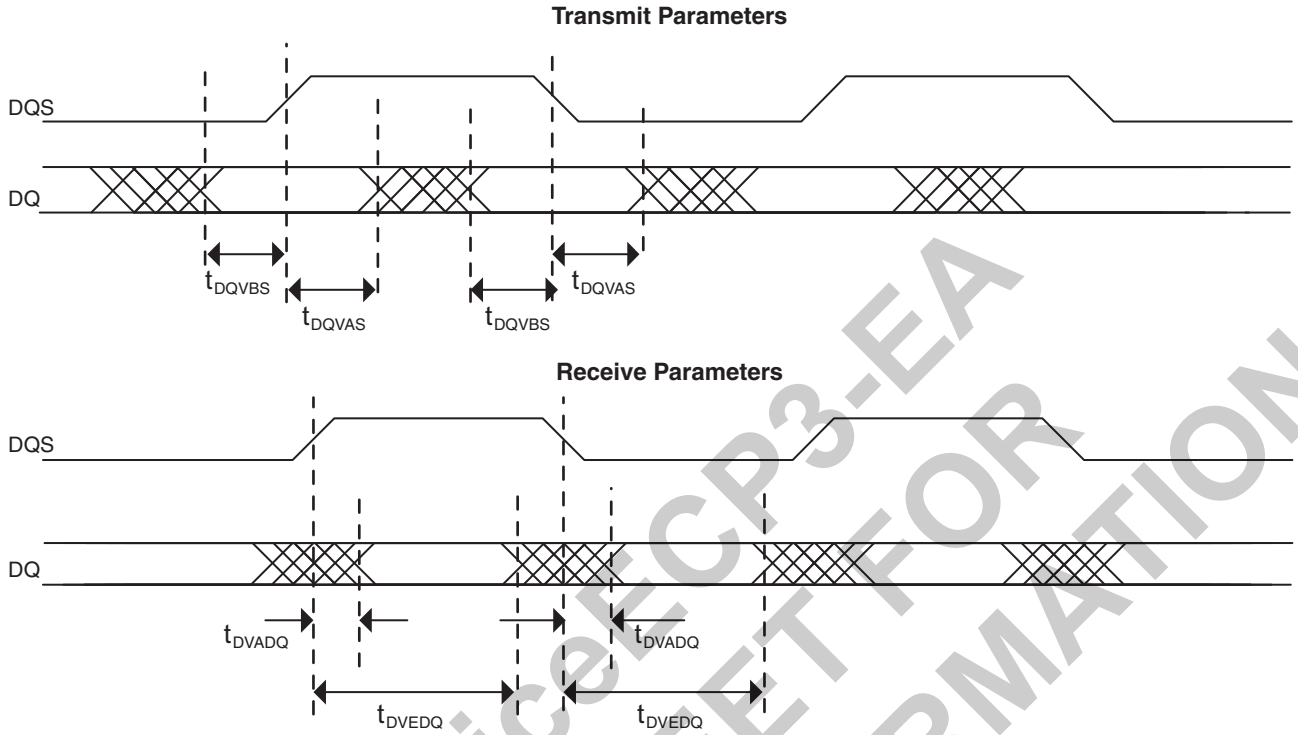
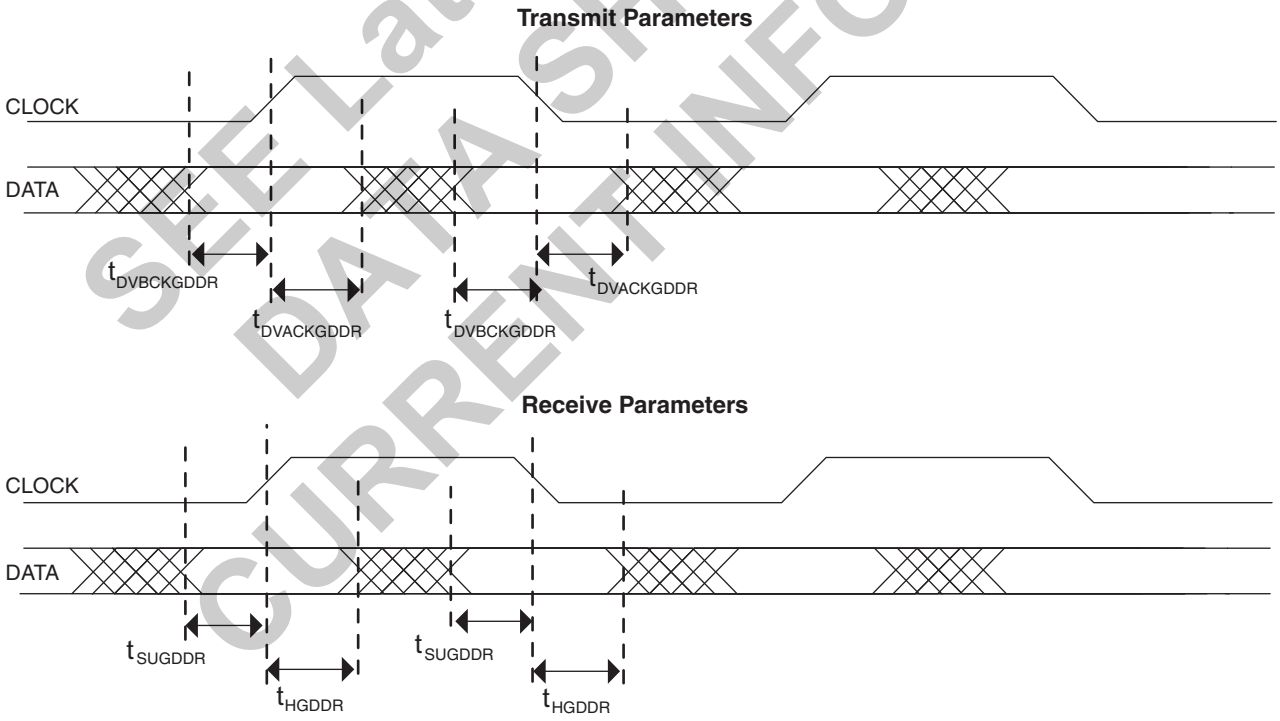


Figure 3-8. Generic DDR/DDR2 Parameters (With Clock Center on Data Window)



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 High Speed Data Receiver

Table 3-9. Serial Input Data Specifications

Symbol	Description		Min.	Typ.	Max.	Units
$RX\text{-}CID_S$	Stream of nontransitions[1] (CID = Consecutive Identical Digits) @ 10^{-12} BER	3.125G	—	—	136	Bits
		2.5G	—	—	144	
		1.485G	—	—	160	
		622M	—	—	204	
		270M	—	—	228	
		155M	—	—	296	
$V_{RX\text{-}DIFF\text{-}S}$	Differential input sensitivity		150	—	1760	mV, p-p
$V_{RX\text{-}IN}$	Input levels		0	—	V_{CCA} +0.5[4]	V
$V_{RX\text{-}CM\text{-}DC}$	Input common mode range (DC coupled)		0.6	—	V_{CCA}	V
$V_{RX\text{-}CM\text{-}AC}$	Input common mode range (AC coupled)[3]		0.1	—	V_{CCA} +0.2	V
$T_{RX\text{-}RELOCK}$	SCDR re-lock time[2]		—	1000	—	Bits
$Z_{RX\text{-}TERM}$	Input termination 50/75 Ohm/High Z		-20%	50/75/HiZ	+20%	Ohms
$RL_{RX\text{-}RL}$	Return loss (without package)		10	—	—	dB

1. This is the number of bits allowed without a transition on the incoming data stream when using DC coupling.
2. This is the typical number of bit times to re-lock to a new phase or frequency within +/- 300 ppm, assuming 8b10b encoded data.
3. AC coupling is used to interface to LVPECL and LVDS. LVDS interfaces are found in laser drivers and Fibre Channel equipment. LVDS interfaces are generally found in 622 Mbps SERDES devices.
4. Up to 1.76V.

Input Data Jitter Tolerance

A receiver's ability to tolerate incoming signal jitter is very dependent on jitter type. High speed serial interface standards have recognized the dependency on jitter type and have specifications to indicate tolerance levels for different jitter types as they relate to specific protocols. Sinusoidal jitter is considered to be a worst case jitter type.

Table 3-10. Receiver Total Jitter Tolerance Specification

Description	Frequency	Condition	Min.	Typ.	Max.	Units
Deterministic	3.125 Gbps	600 mV differential eye	—	—	0.47	UI, p-p
Random		600 mV differential eye	—	—	0.18	UI, p-p
Total		600 mV differential eye	—	—	0.65	UI, p-p
Deterministic	2.5 Gbps	600 mV differential eye	—	—	0.47	UI, p-p
Random		600 mV differential eye	—	—	0.18	UI, p-p
Total		600 mV differential eye	—	—	0.65	UI, p-p
Deterministic	1.25 Gbps	600 mV differential eye	—	—	0.47	UI, p-p
Random		600 mV differential eye	—	—	0.18	UI, p-p
Total		600 mV differential eye	—	—	0.65	UI, p-p
Deterministic	622 Mbps	600 mV differential eye	—	—	0.47	UI, p-p
Random		600 mV differential eye	—	—	0.18	UI, p-p
Total		600 mV differential eye	—	—	0.65	UI, p-p

Note: Values are measured with CJPAT, all channels operating, FPGA Logic active, I/Os around SERDES pins quiet, voltages are nominal, room temperature.

PCI Express Electrical and Timing Characteristics

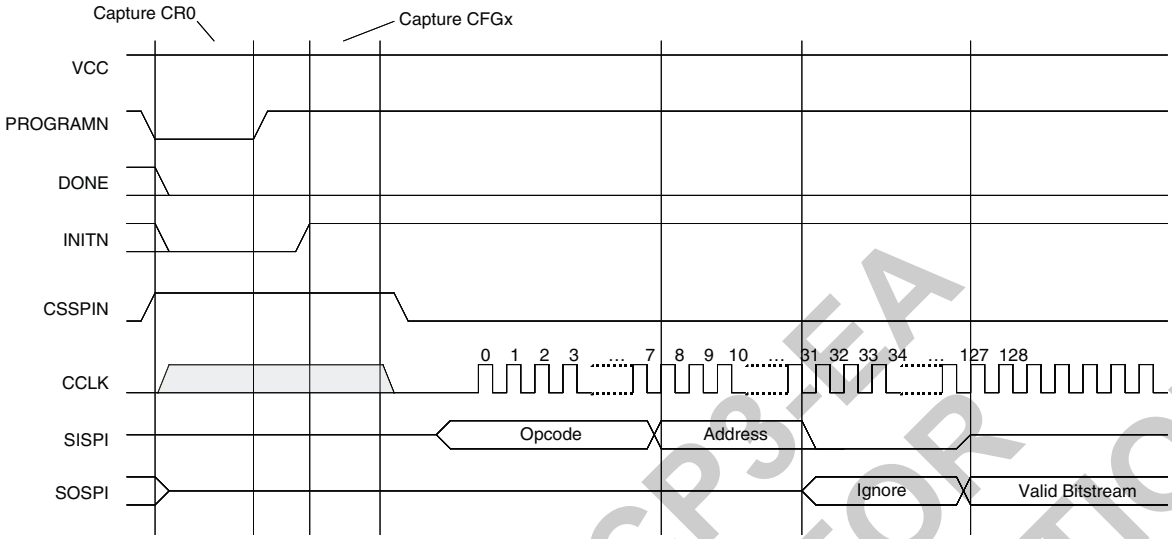
AC and DC Characteristics

Over Recommended Operating Conditions

Symbol	Description	Test Conditions	Min	Typ	Max	Units
Transmit[1]						
UI	Unit interval		399.88	400	400.12	ps
$V_{TX-DIFF\_P-P}$	Differential peak-to-peak output voltage		0.8	1.0	1.2	V
$V_{TX-DE-RATIO}$	De-emphasis differential output voltage ratio		-3	-3.5	-4	dB
$V_{TX-CM-AC\_P}$	RMS AC peak common-mode output voltage		—	—	20	mV
$V_{TX-RCV-DETECT}$	Amount of voltage change allowed during receiver detection		—	—	600	mV
$V_{TX-DC-CM}$	Tx DC common mode voltage		0	—	V_{CCOB} + 5%	V
$I_{TX-SHORT}$	Output short circuit current	V_{TX-D+}=0.0V V_{TX-D-}=0.0V	—	—	90	mA
$Z_{TX-DIFF-DC}$	Differential output impedance		80	100	120	Ohms
$RL_{TX-DIFF}$	Differential return loss		10	—	—	dB
RL_{TX-CM}	Common mode return loss		6.0	—	—	dB
$T_{TX-RISE}$	Tx output rise time	20 to 80%	0.125	—	—	UI
$T_{TX-FALL}$	Tx output fall time	20 to 80%	0.125	—	—	UI
$L_{TX-SKEW}$	Lane-to-lane static output skew for all lanes in port/link		—	—	1.3	ns
T_{TX-EYE}	Transmitter eye width		0.75	—	—	UI
$T_{TX-EYE-MEDIAN-TO-MAX-JITTER}$	Maximum time between jitter median and maximum deviation from median		—	—	0.125	UI
Receive[1, 2]						
UI	Unit Interval		399.88	400	400.12	ps
$V_{RX-DIFF\_P-P}$	Differential peak-to-peak input voltage		0.34[3]	—	1.2	V
$V_{RX-IDLE-DET-DIFF\_P-P}$	Idle detect threshold voltage		65	—	340[3]	mV
$V_{RX-CM-AC\_P}$	Receiver common mode voltage for AC coupling		—	—	150	mV
$Z_{RX-DIFF-DC}$	DC differential input impedance		80	100	120	Ohms
Z_{RX-DC}	DC input impedance		40	50	60	Ohms
$Z_{RX-HIGH-IMP-DC}$	Power-down DC input impedance		200K	—	—	Ohms
$RL_{RX-DIFF}$	Differential return loss		10	—	—	dB
RL_{RX-CM}	Common mode return loss		6.0	—	—	dB
$T_{RX-IDLE-DET-DIFF-ENTERTIME}$	Maximum time required for receiver to recognize and signal an unexpected idle on link		—	—	—	ms

1. Values are measured at 2.5 Gbps.
2. Measured with external AC-coupling on the receiver.
3.Not in compliance with PCI Express 1.1 standard.

Figure 3-24. Master SPI Configuration Waveforms



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

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-70E-6FN484I[1]	1.2V	-6	Lead-Free fpBGA	484	IND	67
LFE3-70E-7FN484I[1]	1.2V	-7	Lead-Free fpBGA	484	IND	67
LFE3-70E-8FN484I[1]	1.2V	-8	Lead-Free fpBGA	484	IND	67
LFE3-70E-6FN672I[1]	1.2V	-6	Lead-Free fpBGA	672	IND	67
LFE3-70E-7FN672I[1]	1.2V	-7	Lead-Free fpBGA	672	IND	67
LFE3-70E-8FN672I[1]	1.2V	-8	Lead-Free fpBGA	672	IND	67
LFE3-70E-6FN1156I[1]	1.2V	-6	Lead-Free fpBGA	1156	IND	67
LFE3-70E-7FN1156I[1]	1.2V	-7	Lead-Free fpBGA	1156	IND	67
LFE3-70E-8FN1156I[1]	1.2V	-8	Lead-Free fpBGA	1156	IND	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-6FN484I	1.2V	-6	Lead-Free fpBGA	484	IND	92
LFE3-95EA-7FN484I	1.2V	-7	Lead-Free fpBGA	484	IND	92
LFE3-95EA-8FN484I	1.2V	-8	Lead-Free fpBGA	484	IND	92
LFE3-95EA-6FN672I	1.2V	-6	Lead-Free fpBGA	672	IND	92
LFE3-95EA-7FN672I	1.2V	-7	Lead-Free fpBGA	672	IND	92
LFE3-95EA-8FN672I	1.2V	-8	Lead-Free fpBGA	672	IND	92
LFE3-95EA-6FN1156I	1.2V	-6	Lead-Free fpBGA	1156	IND	92
LFE3-95EA-7FN1156I	1.2V	-7	Lead-Free fpBGA	1156	IND	92
LFE3-95EA-8FN1156I	1.2V	-8	Lead-Free fpBGA	1156	IND	92

Part Number	Voltage	Grade	Package	Pins	Temp.	LUTs (K)
LFE3-95E-6FN484I[1]	1.2V	-6	Lead-Free fpBGA	484	IND	92
LFE3-95E-7FN484I[1]	1.2V	-7	Lead-Free fpBGA	484	IND	92
LFE3-95E-8FN484I[1]	1.2V	-8	Lead-Free fpBGA	484	IND	92
LFE3-95E-6FN672I[1]	1.2V	-6	Lead-Free fpBGA	672	IND	92
LFE3-95E-7FN672I[1]	1.2V	-7	Lead-Free fpBGA	672	IND	92
LFE3-95E-8FN672I[1]	1.2V	-8	Lead-Free fpBGA	672	IND	92
LFE3-95E-6FN1156I[1]	1.2V	-6	Lead-Free fpBGA	1156	IND	92
LFE3-95E-7FN1156I[1]	1.2V	-7	Lead-Free fpBGA	1156	IND	92
LFE3-95E-8FN1156I[1]	1.2V	-8	Lead-Free fpBGA	1156	IND	92

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

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

Date	Version	Section	Change Summary
May 2009 (cont.)	01.1 (cont.)	DC and Switching Characteristics (cont.)	Updated timing information
			Updated SERDES minimum frequency.
			Added data to the following tables: External Switching Characteristics, Internal Switching Characteristics, Family Timing Adders, Maximum I/O Buffer Speed, DLL Timing, High Speed Data Transmitter, Channel Output Jitter, Typical Building Block Function Performance, Register-to-Register Performance, and Power Supply Requirements.
			Updated Serial Input Data Specifications table.
			Updated Transmit table, Serial Rapid I/O Type 2 Electrical and Timing Characteristics section.
		Pinout Information	Updated Signal Description tables.
			Updated Pin Information Summary tables and added footnote 1.
July 2009	01.2	Multiple	Changed references of “multi-boot” to “dual-boot” throughout the data sheet.
		Architecture	Updated On-Chip Programmable Termination bullets.
			Updated On-Chip Termination Options for Input Modes table.
			Updated On-Chip Termination figure.
		DC and Switching Characterisitcs	Changed min/max data for FREF_PPM and added footnote 4 in SERDES External Reference Clock Specification table.
			Updated SERDES minimum frequency.
		Pinout Information	Corrected MCLK to be I/O and CCLK to be I in Signal Descriptions table
August 2009	01.3	DC and Switching Characterisitcs	Corrected truncated numbers for V_{CCIB} and V_{CCOB} in Recommended Operating Conditions table.
September 2009	01.4	Architecture	Corrected link in sysMEM Memory Block section.
			Updated information for On-Chip Programmable Termination and modified corresponding figure.
			Added footnote 2 to On-Chip Programmable Termination Options for Input Modes table.
			Corrected Per Quadrant Primary Clock Selection figure.
		DC and Switching Characterisitcs	Modified -8 Timing data for 1024x18 True-Dual Port RAM (Read-Before-Write, EBR Output Registers)
			Added ESD Performance table.
			LatticeECP3 External Switching Characteristics table - updated data for $t_{DIBGDDR}$, t_{W_PRI}, t_{W_EDGE} and $t_{SKEW\_EDGE\_DQS}$.
			LatticeECP3 Internal Switching Characteristics table - updated data for t_{COO_PIO} and added footnote #4.
			sysCLOCK PLL Timing table - updated data for f_{OUT}.
			External Reference Clock Specification (refclkp/refclkn) table - updated data for $V_{REF-IN-SE}$ and $V_{REF-IN-DIFF}$.
			LatticeECP3 sysCONFIG Port Timing Specifications table - updated data for t_{MWC}.
			Added TRLVDS DC Specification table and diagram.
			Updated Mini LVDS table.
November 2009	01.5	Introduction	Updated Embedded SERDES features.
			Added SONET/SDH to Embedded SERDES protocols.
		Architecture	Updated Figure 2-4, General Purpose PLL Diagram.
			Updated SONET/SDH to SERDES and PCS protocols.