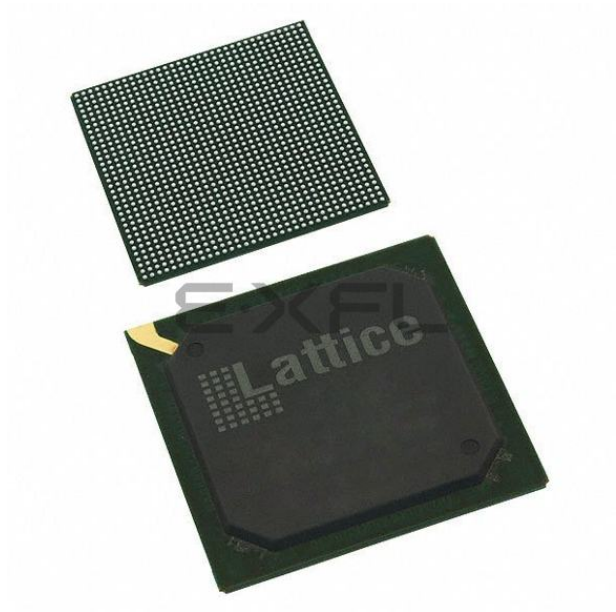
Lattice Semiconductor Corporation - LFE3-95E-7FN1156I Datasheet



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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	11500
Number of Logic Elements/Cells	92000
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/lfe3-95e-7fn1156i

PLL/DLL Cascading

LatticeECP3 devices have been designed to allow certain combinations of PLL and DLL cascading. The allowable combinations are:

- PLL to PLL supported
- PLL to DLL supported

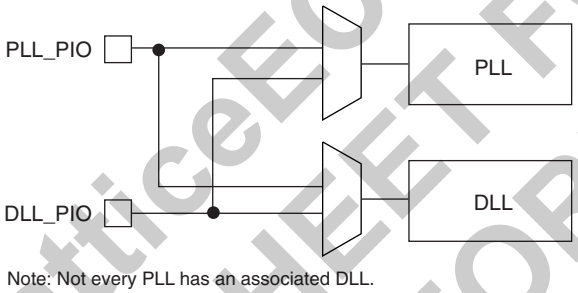
The DLLs in the LatticeECP3 are used to shift the clock in relation to the data for source synchronous inputs. PLLs are used for frequency synthesis and clock generation for source synchronous interfaces. Cascading PLL and DLL blocks allows applications to utilize the unique benefits of both DLLs and PLLs.

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

PLL/DLL PIO Input Pin Connections

All LatticeECP3 devices contains two DLLs and up to ten PLLs, arranged in quadrants. If a PLL and a DLL are next to each other, they share input pins as shown in the Figure 2-7.

Figure 2-7. Sharing of PIO Pins by PLLs and DLLs in LatticeECP3 Devices

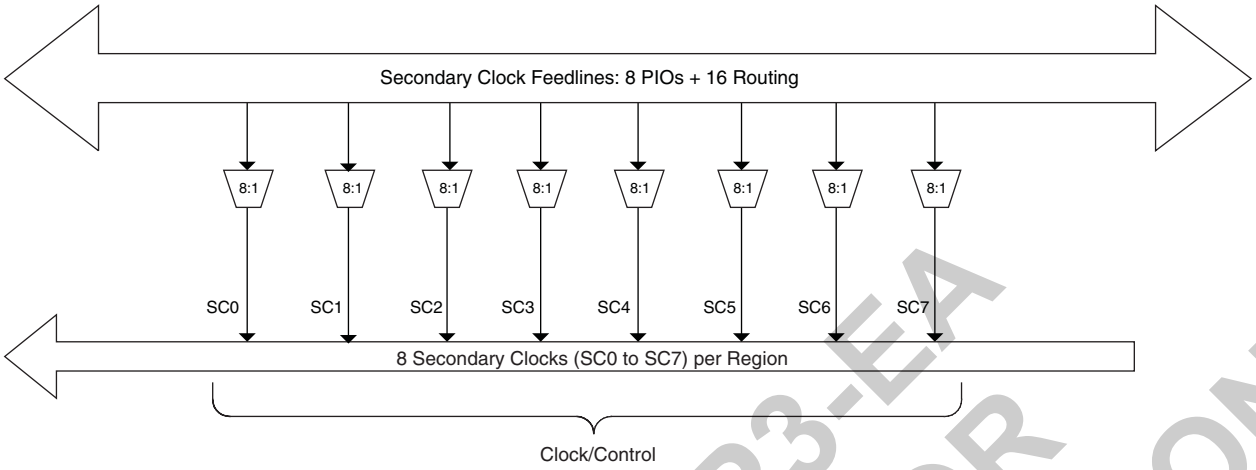


Note: Not every PLL has an associated DLL.

Clock Dividers

LatticeECP3 devices have two clock dividers, one on the left side and one on the right side of the device. These are intended to generate a slower-speed system clock from a high-speed edge clock. The block operates in a ÷2, ÷4 or ÷8 mode and maintains a known phase relationship between the divided down clock and the high-speed clock based on the release of its reset signal. The clock dividers can be fed from selected PLL/DLL outputs, the Slave Delay lines, routing or from an external clock input. The clock divider outputs serve as primary clock sources and feed into the clock distribution network. The Reset (RST) control signal resets input and asynchronously forces all outputs to low. The RELEASE signal releases outputs synchronously to the input clock. For further information on clock dividers, please see TN1178, LatticeECP3 sysCLOCK PLL/DLL Design and Usage Guide. Figure 2-8 shows the clock divider connections.

Figure 2-16. Per Region Secondary Clock Selection



Slice Clock Selection

Figure 2-17 shows the clock selections and Figure 2-18 shows the control selections for Slice0 through Slice2. All the primary clocks and seven secondary clocks are routed to this clock selection mux. Other signals can be used as a clock input to the slices via routing. Slice controls are generated from the secondary clocks/controls or other signals connected via routing.

If none of the signals are selected for both clock and control then the default value of the mux output is 1. Slice 3 does not have any registers; therefore it does not have the clock or control muxes.

Figure 2-17. Slice0 through Slice2 Clock Selection

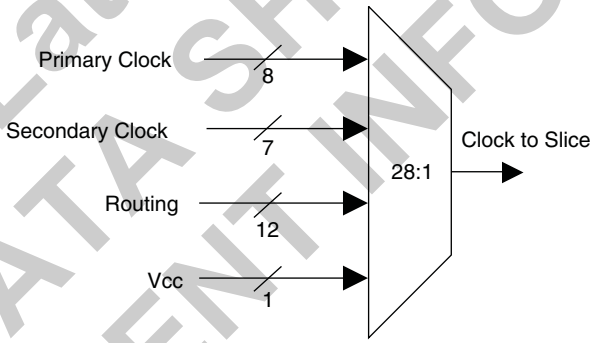


Figure 2-18. Slice0 through Slice2 Control Selection

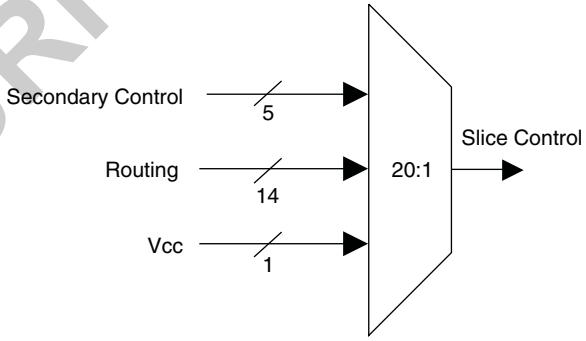


Figure 2-20. Sources of Edge Clock (Left and Right Edges)

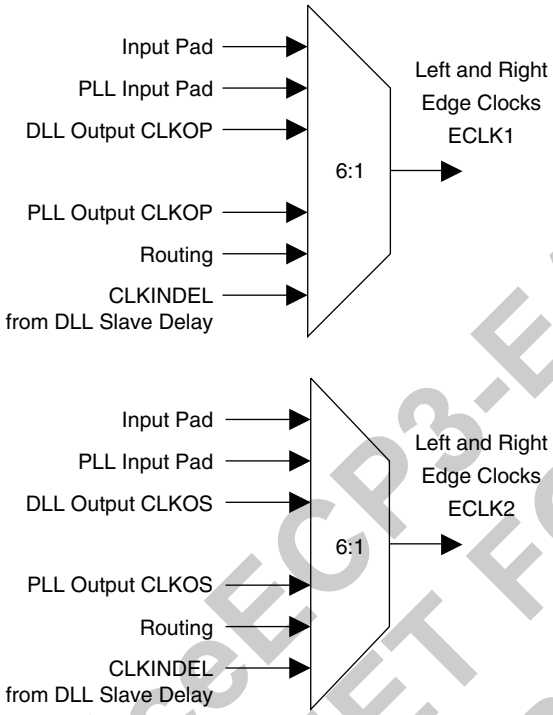
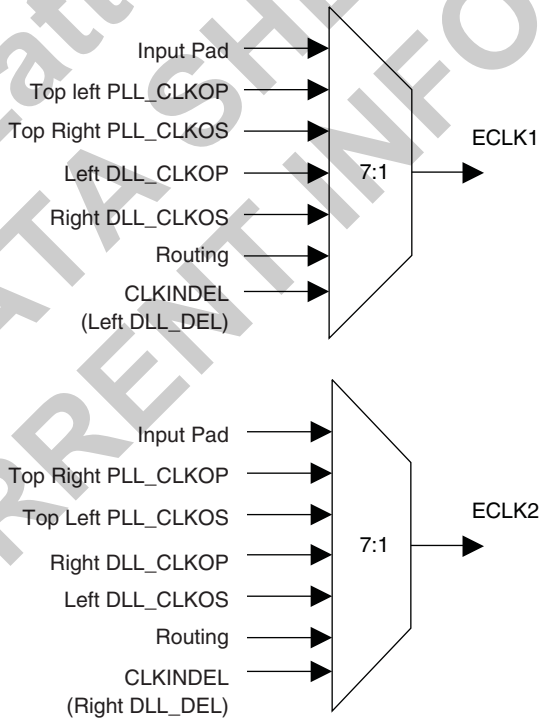


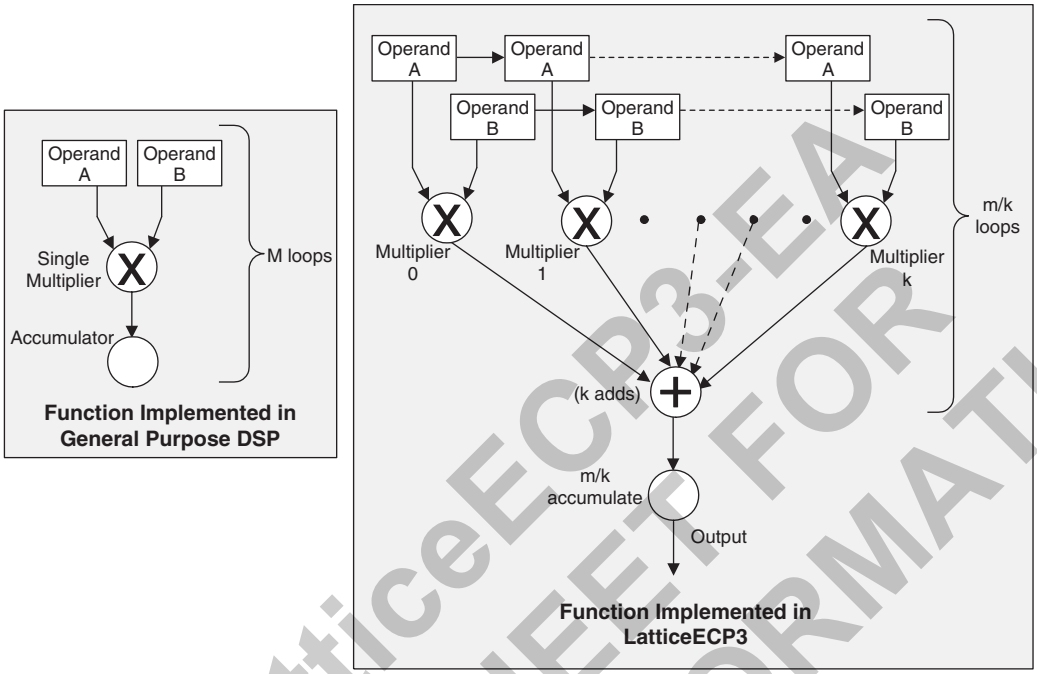
Figure 2-21. Sources of Edge Clock (Top Edge)



The edge clocks have low injection delay and low skew. They are used to clock the I/O registers and thus are ideal for creating I/O interfaces with a single clock signal and a wide data bus. They are also used for DDR Memory or Generic DDR interfaces.

This allows designers to use highly parallel implementations of DSP functions. Designers can optimize DSP performance vs. area by choosing appropriate levels of parallelism. Figure 2-23 compares the fully serial implementation to the mixed parallel and serial implementation.

Figure 2-23. Comparison of General DSP and LatticeECP3 Approaches



LatticeECP3 sysDSP Slice Architecture Features

The LatticeECP3 sysDSP Slice has been significantly enhanced to provide functions needed for advanced processing applications. These enhancements provide improved flexibility and resource utilization.

The LatticeECP3 sysDSP Slice supports many functions that include the following:

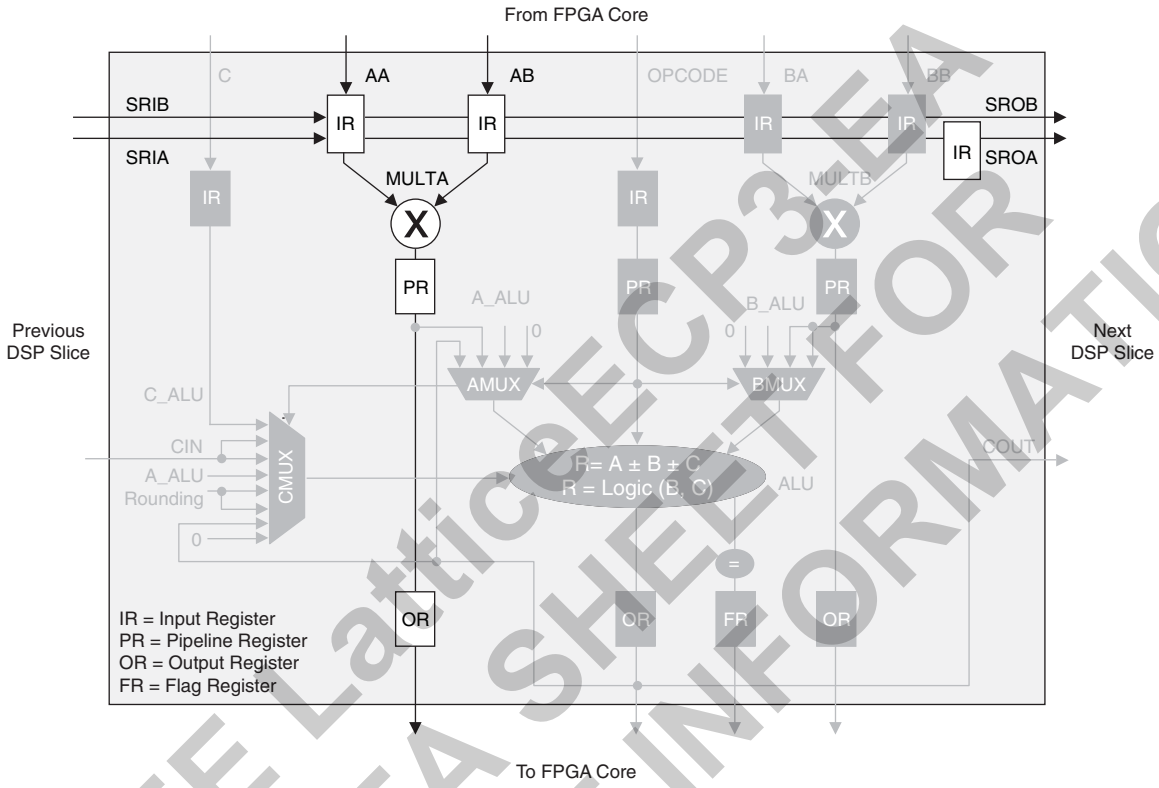
- Multiply (one 18x36, two 18x18 or four 9x9 Multiplies per Slice)
- Multiply (36x36 by cascading across two sysDSP slices)
- Multiply Accumulate (up to 18x36 Multipliers feeding an Accumulator that can have up to 54-bit resolution)
- Two Multiplies feeding one Accumulate per cycle for increased processing with lower latency (two 18x18 Multiplies feed into an accumulator that can accumulate up to 52 bits)
- Flexible saturation and rounding options to satisfy a diverse set of applications situations
- Flexible cascading across DSP slices
  - Minimizes fabric use for common DSP and ALU functions
  - Enables implementation of FIR Filter or similar structures using dedicated sysDSP slice resources only
  - Provides matching pipeline registers
  - Can be configured to continue cascading from one row of sysDSP slices to another for longer cascade chains
- Flexible and Powerful Arithmetic Logic Unit (ALU) Supports:
  - Dynamically selectable ALU OPCODE
  - Ternary arithmetic (addition/subtraction of three inputs)
  - Bit-wise two-input logic operations (AND, OR, NAND, NOR, XOR and XNOR)
  - Eight flexible and programmable ALU flags that can be used for multiple pattern detection scenarios, such

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



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

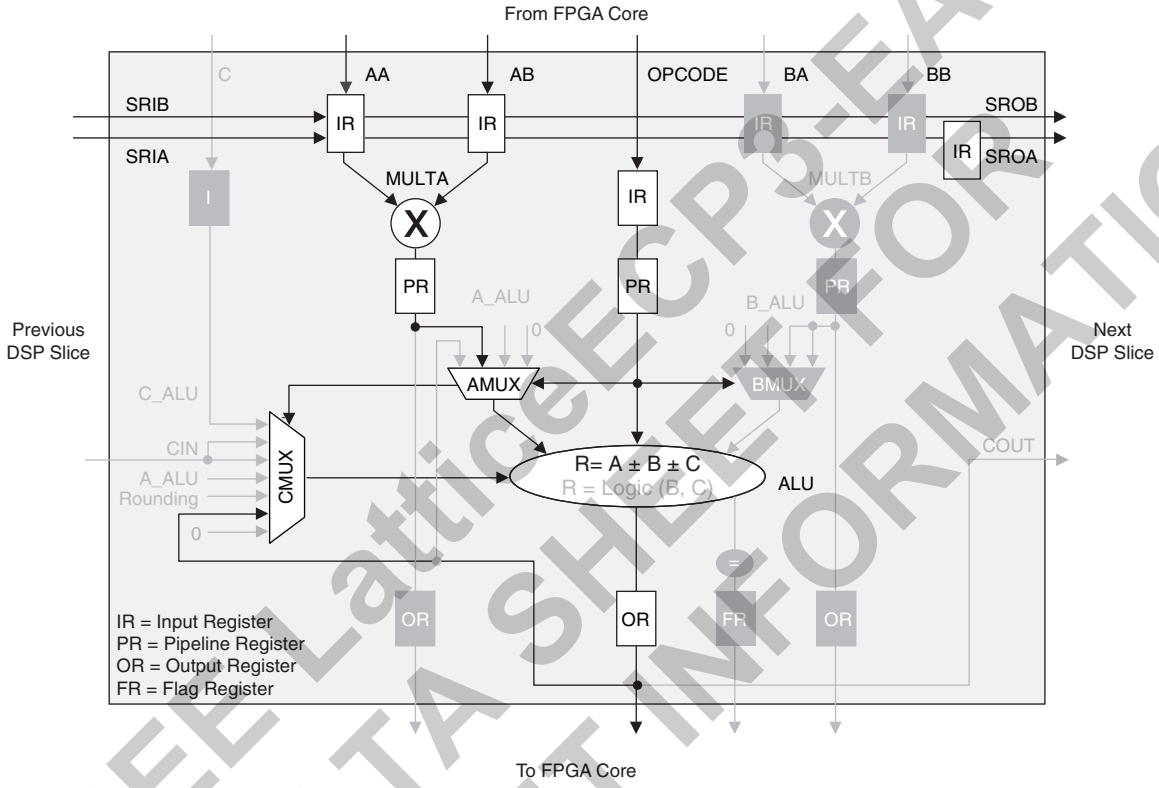
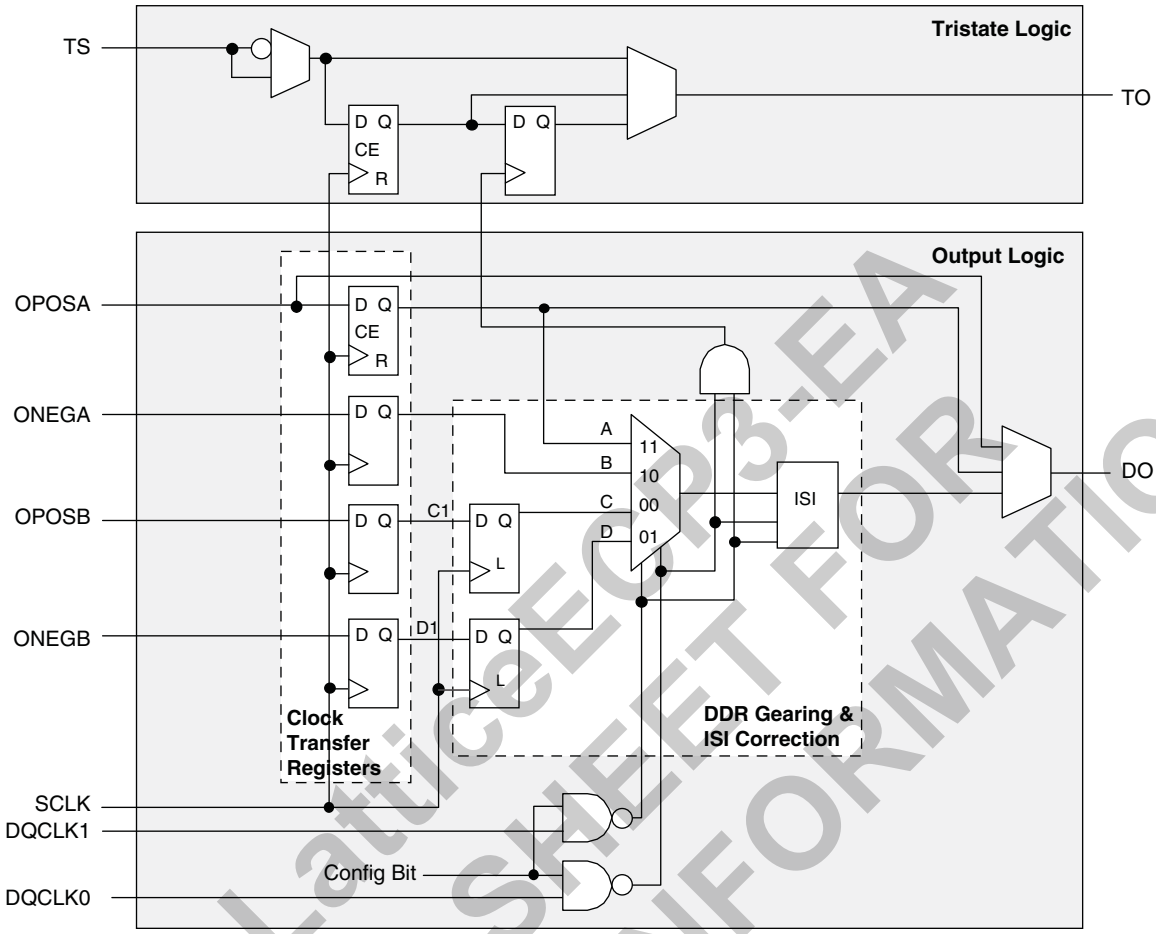


Figure 2-34. ECP3-70/95 (E or EA) Output and Tristate Block for Left and Right Edges



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.

To accomplish write leveling in DDR3, each DQS group has a slightly different delay that is set by DYN DELAY[7:0] in the DQS Write Control logic block. 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.

LatticeECP3 input and output registers can also support DDR gearing that is used to receive and transmit the high speed DDR data from and to the DDR3 Memory.

LatticeECP3 supports the 1.5V SSTL I/O standard required for the DDR3 memory interface. In addition, it supports on-chip termination to VTT on the DDR3 memory input pins. For more information, refer to the sysIO section of this data sheet.

Please see TN1180, LatticeECP3 High-Speed I/O Interface for more information on DDR Memory interface implementation in LatticeECP3.

sysI/O Buffer

Each I/O is associated with a flexible buffer referred to as a sysI/O buffer. These buffers are arranged around the periphery of the device in groups referred to as banks. The sysI/O buffers allow users to implement the wide variety of standards that are found in today's systems including LVDS, BLVDS, HSTL, SSTL Class I & II, LVCMOS, LVTTL, LVPECL, PCI.

sysI/O Buffer Banks

LatticeECP3 devices have six sysI/O buffer banks: six banks for user I/Os arranged two per side. The banks on the bottom side are wraparounds of the banks on the lower right and left sides. The seventh sysI/O buffer bank (Configuration Bank) is located adjacent to Bank 2 and has dedicated/shared I/Os for configuration. When a shared pin is not used for configuration it is available as a user I/O. Each bank is capable of supporting multiple I/O standards. Each sysI/O bank has its own I/O supply voltage (V_{CCIO}). In addition, each bank, except the Configuration Bank, has voltage references, V_{REF1} and V_{REF2}, which allow it to be completely independent from the others. The Configuration Bank top side shares V_{REF1} and V_{REF2} from sysI/O bank 1 and right side shares V_{REF1} and V_{REF2} from sysI/O bank 2. Figure 2-38 shows the seven banks and their associated supplies.

In LatticeECP3 devices, single-ended output buffers and ratioed input buffers (LVTTL, LVCMOS and PCI) are powered using V_{CCIO}. LVTTL, LVCMOS33, LVCMOS25 and LVCMOS12 can also be set as fixed threshold inputs independent of V_{CCIO}.

Each bank can support up to two separate V_{REF} voltages, V_{REF1} and V_{REF2}, that set the threshold for the referenced input buffers. Some dedicated I/O pins in a bank can be configured to be a reference voltage supply pin. Each I/O is individually configurable based on the bank's supply and reference voltages.

Hot Socketing Specifications[1, 3, 4]

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
IDK_HS[2]	Input or I/O Leakage Current	$0 \le V_{IN} \le V_{IH}$ (Max.)	—	—	+/-1	mA
IDK[5]	Input or I/O Leakage Current	$0 \le V_{IN} < V_{CCIO}$	—	—	+/-1	mA
		$V_{CCIO} \le V_{IN} \le V_{CCIO}$ + 0.5V	—	18	—	mA

1. V_{CC}, V_{CCAUX} and V_{CCIO} should rise/fall monotonically.
2. Applicable to general purpose I/O pins in top I/O banks only.
3. I_{DK} is additive to I_{PU}, I_{PW} or I_{BH}.
4. LVCMOS and LVTTL only.
5. Applicable to general purpose I/O pins in left and right I/O banks only.

Hot Socketing Requirements[1, 2]

Description	Min.	Typ.	Max.	Units
Input current per SERDES I/O pin when device is powered down and inputs driven.	—	—	8	mA

1. Assumes the device is powered down, all supplies grounded, both P and N inputs driven by CML driver with maximum allowed VCCOB (1.575V), 8b10b data, internal AC coupling.
2. Each P and N input must have less than the specified maximum input current. For a 16-channel device, the total input current would be 8mA*16 channels *2 input pins per channel = 256mA

ESD Performance

Pin Group	ESD Stress	Min.	Units
All pins	HBM	1000	V
All pins except high-speed serial and XRES[1]	CDM	500	V
High-speed serial inputs	CDM	400	V

1. The XRES pin on the TW device passes CDM testing at 250V.

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.

LVPECL33

The LatticeECP3 devices support the differential LVPECL standard. This standard is emulated using complementary LVCMOS outputs in conjunction with a parallel resistor across the driver outputs. The LVPECL input standard is supported by the LVDS differential input buffer. The scheme shown in Figure 3-3 is one possible solution for point-to-point signals.

Figure 3-3. Differential LVPECL33

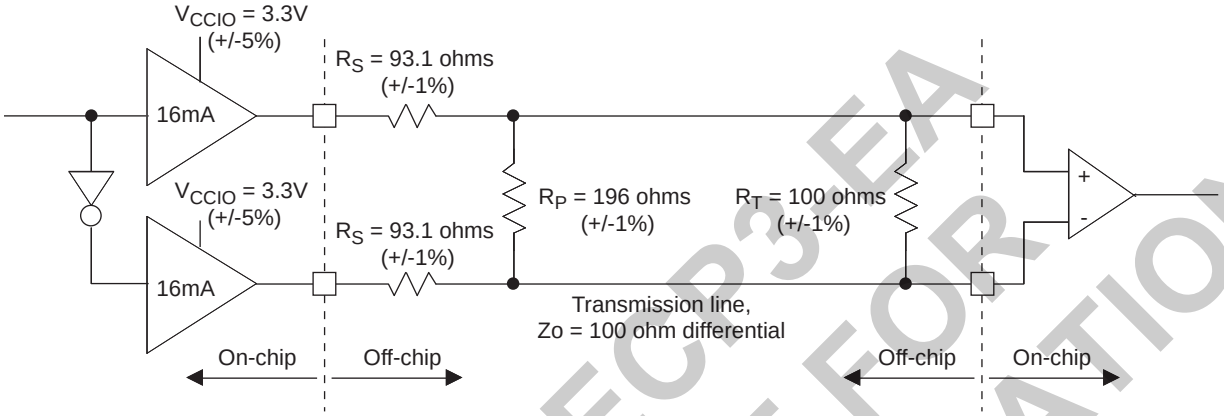


Table 3-3. LVPECL33 DC Conditions[1]

Over Recommended Operating Conditions

Parameter	Description	Typical	Units
V_{CCIO}	Output Driver Supply (+/-5%)	3.30	V
Z_{OUT}	Driver Impedance	10	Ω
R_S	Driver Series Resistor (+/-1%)	93	Ω
R_P	Driver Parallel Resistor (+/-1%)	196	Ω
R_T	Receiver Termination (+/-1%)	100	Ω
V_{OH}	Output High Voltage	2.05	V
V_{OL}	Output Low Voltage	1.25	V
V_{OD}	Output Differential Voltage	0.80	V
V_{CM}	Output Common Mode Voltage	1.65	V
Z_{BACK}	Back Impedance	100.5	Ω
I_{DC}	DC Output Current	12.11	mA

1. For input buffer, see LVDS table.

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)

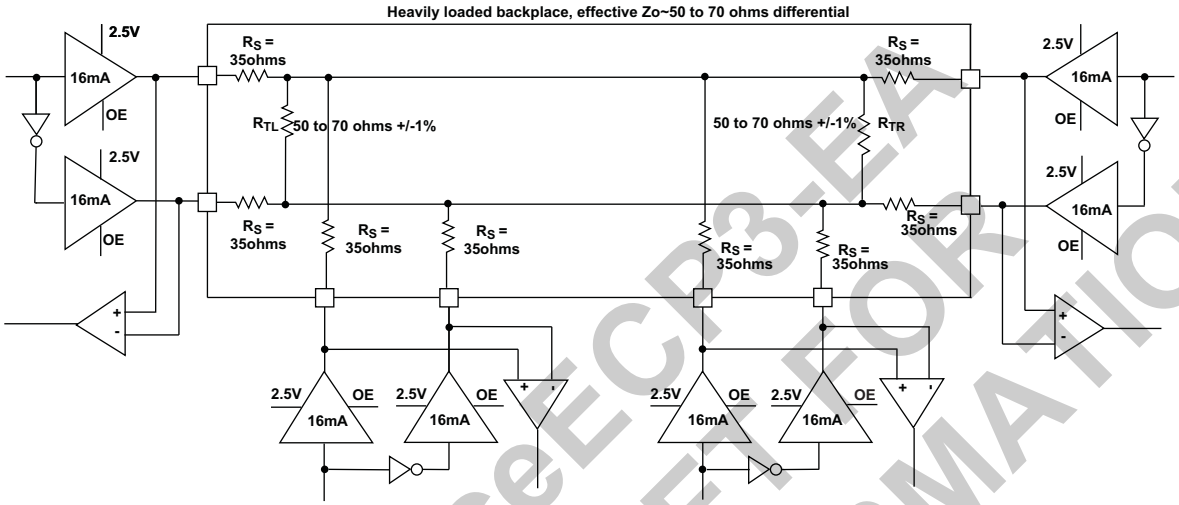


Table 3-5. MLVDS25 DC Conditions[1]

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.

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_IO}	Clock Frequency of I/O and PFU Register	ECP3-70E/95E	—	500	—	420	—	375	Mhz
General I/O Pin Parameters Using Dedicated Clock Input Primary Clock with PLL with Clock Injection Removal Setting[2]									
t_{COPLL}	Clock to Output - PIO Output Register	ECP3-150EA	—	2.5	—	2.7	—	3.1	ns
t_{SUPLL}	Clock to Data Setup - PIO Input Register	ECP3-150EA	0.6	—	0.6	—	0.7	—	ns
t_{HPLL}	Clock to Data Hold - PIO Input Register	ECP3-150EA	0.9	—	1.0	—	1.1	—	ns
t_{SU_DELPLL}	Clock to Data Setup - PIO Input Register with Data Input Delay	ECP3-150EA	1.5	—	1.6	—	1.8	—	ns
t_{H_DELPLL}	Clock to Data Hold - PIO Input Register with Input Data Delay	ECP3-150EA	—	0.1	—	0.1	—	0.1	ns
t_{COPLL}	Clock to Output - PIO Output Register	ECP3-70E/95E	—	2.2	—	2.3	—	2.5	ns
t_{SUPLL}	Clock to Data Setup - PIO Input Register	ECP3-70E/95E	0.6	—	0.7	—	0.8	—	ns
t_{HPLL}	Clock to Data Hold - PIO Input Register	ECP3-70E/95E	0.9	—	1.1	—	1.3	—	ns
t_{SU_DELPLL}	Clock to Data Setup - PIO Input Register with Data Input Delay	ECP3-70E/95E	1.6	—	1.9	—	2.1	—	ns
t_{H_DELPLL}	Clock to Data Hold - PIO Input Register with Input Data Delay	ECP3-70E/95E	0.0	—	0.0	—	0.0	—	ns

Parameter	Description	Device	-8		-7		-6		Units
			Min.	Max.	Min.	Max.	Min.	Max.	
Generic DDR									
Generic DDRX1 Inputs with Clock and Data (>10 Bits Wide) Centered at Pin (GDDRX1_RX.SCLK.Centered) Using PCLK Pin for Clock Input									
Data Left, Right and Top Sides & Clock Left, Right and Top Sides									
t_{SUGDDR}	Data Setup Before CLK	ECP3-150EA		—		—		—	ps
t_{HGDDR}	Data Hold After CLK	ECP3-150EA		—		—		—	ps
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-150EA	—		—		—		MHz
Generic DDRX1 Inputs with Clock in the Center of Data Window, without DLL (GDDRX1_RX.ECLK.Centered)									
t_{SUGDDR}	Data Setup Before CLK	ECP3-70E/95E	515	—	515	—	515	—	ps
t_{HOGDDR}	Data Hold After CLK	ECP3-70E/95E	515	—	515	—	515	—	ps
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-70E/95E	—	250	—	250	—	250	MHz
Generic DDRX1 Inputs with Clock and Data (> 10 Bits Wide) Aligned at Pin (GDDRX1_RX.SCLK.Aligned) using DLL-CLKIN Pin for Clock Input									
Data Left, Right and Top Sides & Clock Left and Right Sides									
$t_{DVACLKGDDR}$	Data Setup Before CLK	ECP3-150EA	—		—		—		UI
$t_{DVECLKGDDR}$	Data Hold After CLK	ECP3-150EA		—		—		—	UI
f_{MAX_GDDR}	DDRX1 Clock Frequency	ECP3-150EA	—		—		—		MHz
Generic DDRX1 Inputs with Clock and Data Aligned, with DLL (GDDRX1_RX.ECLK.Aligned)									
$t_{DVACLKGDDR}$	Data Setup Before CLK	ECP3-70E/95E	—	0.235	—	0.235	—	0.235	UI
$t_{DVECLKGDDR}$	Data Hold After CLK	ECP3-70E/95E	0.765	—	0.765	—	0.765	—	UI

LatticeECP3 Family Timing Adders[1, 2, 3, 4, 5]

Over Recommended Commercial Operating Conditions

Buffer Type	Description	-8	-7	-6	Units
Input Adjusters					
LVDS25E	LVDS, Emulated, VCCIO = 2.5V	0.03	-0.01	-0.03	ns
LVDS25	LVDS, VCCIO = 2.5V	0.03	0.00	-0.04	ns
BLVDS25	BLVDS, Emulated, VCCIO = 2.5V	0.03	0.00	-0.04	ns
MLVDS25	MLVDS, Emulated, VCCIO = 2.5V	0.03	0.00	-0.04	ns
RSDS25	RSDS, VCCIO = 2.5V	0.03	0.00	-0.03	ns
PPLVDS	Point-to-Point LVDS	0.03	-0.01	-0.03	ns
TRLVDS	Transition-Reduced LVDS	0.03	0.00	-0.04	ns
Mini MLVDS	Mini LVDS	0.03	-0.01	-0.03	ns
LVPECL33	LVPECL, Emulated, VCCIO = 3.0V	0.17	0.07	-0.04	ns
HSTL18_I	HSTL_18 class I, VCCIO = 1.8V	0.20	0.17	0.13	ns
HSTL18_II	HSTL_18 class II, VCCIO = 1.8V	0.20	0.17	0.13	ns
HSTL18D_I	Differential HSTL 18 class I	0.20	0.17	0.13	ns
HSTL18D_II	Differential HSTL 18 class II	0.20	0.17	0.13	ns
HSTL15_I	HSTL_15 class I, VCCIO = 1.5V	0.10	0.12	0.13	ns
HSTL15D_I	Differential HSTL 15 class I	0.10	0.12	0.13	ns
SSTL33_I	SSTL_3 class I, VCCIO = 3.0V	0.17	0.23	0.28	ns
SSTL33_II	SSTL_3 class II, VCCIO = 3.0V	0.17	0.23	0.28	ns
SSTL33D_I	Differential SSTL_3 class I	0.17	0.23	0.28	ns
SSTL33D_II	Differential SSTL_3 class II	0.17	0.23	0.28	ns
SSTL25_I	SSTL_2 class I, VCCIO = 2.5V	0.12	0.14	0.16	ns
SSTL25_II	SSTL_2 class II, VCCIO = 2.5V	0.12	0.14	0.16	ns
SSTL25D_I	Differential SSTL_2 class I	0.12	0.14	0.16	ns
SSTL25D_II	Differential SSTL_2 class II	0.12	0.14	0.16	ns
SSTL18_I	SSTL_18 class I, VCCIO = 1.8V	0.08	0.06	0.04	ns
SSTL18_II	SSTL_18 class II, VCCIO = 1.8V	0.08	0.06	0.04	ns
SSTL18D_I	Differential SSTL_18 class I	0.08	0.06	0.04	ns
SSTL18D_II	Differential SSTL_18 class II	0.08	0.06	0.04	ns
SSTL15	SSTL_15, VCCIO = 1.5V	0.087	0.059	0.032	ns
SSTL15D	Differential SSTL_15	0.087	0.025	-0.036	ns
LVTTL33	LVTTL, VCCIO = 3.0V	0.05	0.05	0.05	ns
LVCMOS33	LVCMOS, VCCIO = 3.0V	0.05	0.05	0.05	ns
LVCMOS25	LVCMOS, VCCIO = 2.5V	0.00	0.00	0.00	ns
LVCMOS18	LVCMOS, VCCIO = 1.8V	0.06	0.08	0.11	ns
LVCMOS15	LVCMOS, VCCIO = 1.5V	0.17	0.21	0.25	ns
LVCMOS12	LVCMOS, VCCIO = 1.2V	0.01	0.05	0.08	ns
PCI33	PCI, VCCIO = 3.0V	0.05	0.05	0.05	ns
Output Adjusters					
LVDS25E	LVDS, Emulated, VCCIO = 2.5V	0.15	0.15	0.16	ns
LVDS25	LVDS, VCCIO = 2.5V	0.02	0.08	0.13	ns
BLVDS25	BLVDS, Emulated, VCCIO = 2.5V	0.00	-0.02	-0.04	ns
MLVDS25	MLVDS, Emulated, VCCIO = 2.5V	0.00	-0.01	-0.03	ns

LatticeECP3 Family Timing Adders[1, 2, 3, 4, 5] (Continued)

Over Recommended Commercial Operating Conditions

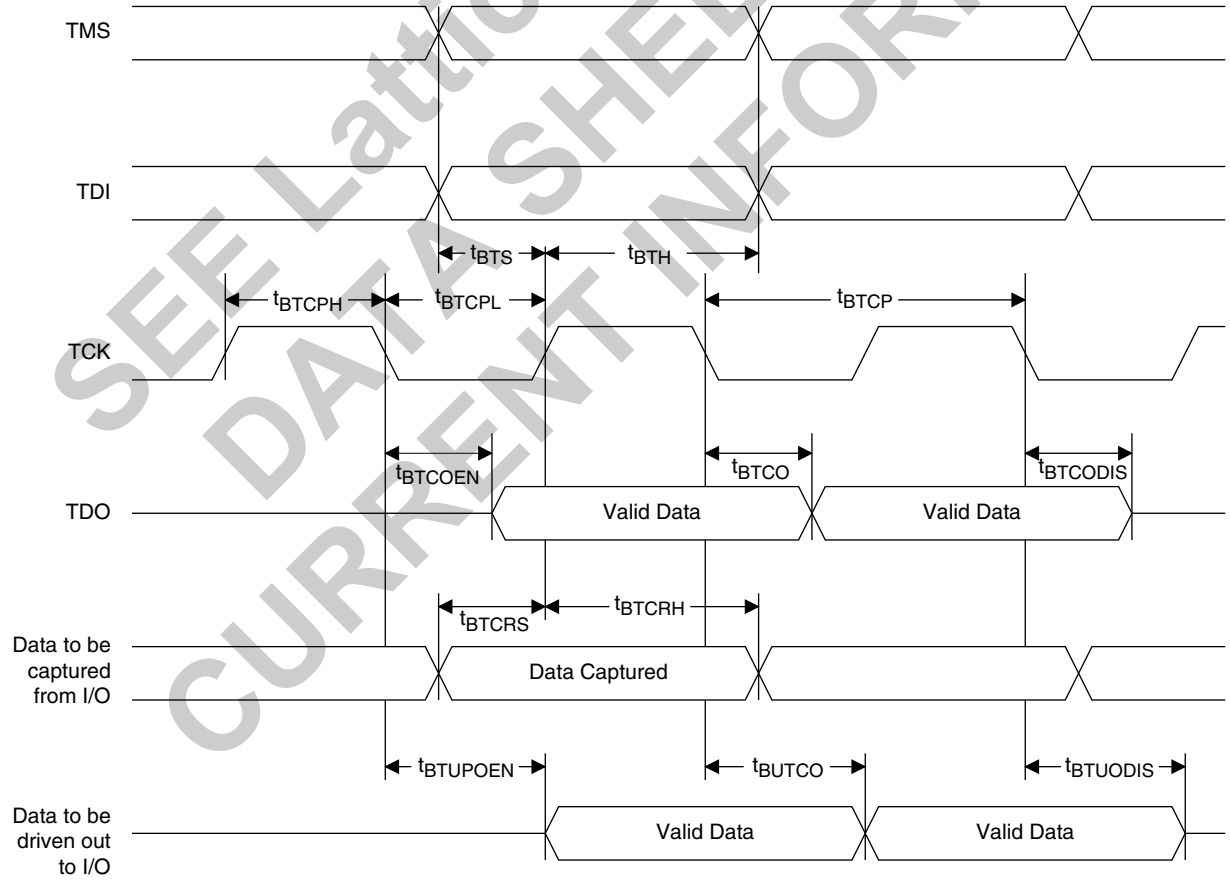
Buffer Type	Description	-8	-7	-6	Units
RSDS25	RSDS, VCCIO = 2.5V	0.05	0.10	0.16	ns
PPLVDS	Point-to-Point LVDS, Emulated, VCCIO = 2.5V	-0.10	-0.05	0.01	ns
LVPECL33	LVPECL, Emulated, VCCIO = 3.0V	-0.02	-0.04	-0.06	ns
HSTL18_I	HSTL_18 class I 8mA drive, VCCIO = 1.8V	-0.19	-0.16	-0.12	ns
HSTL18_II	HSTL_18 class II, VCCIO = 1.8V	-0.30	-0.28	-0.25	ns
HSTL18D_I	Differential HSTL 18 class I 8mA drive	-0.19	-0.16	-0.12	ns
HSTL18D_II	Differential HSTL 18 class II	-0.30	-0.28	-0.25	ns
HSTL15_I	HSTL_15 class I 4mA drive, VCCIO = 1.5V	-0.22	-0.19	-0.16	ns
HSTL15D_I	Differential HSTL 15 class I 4mA drive	-0.22	-0.19	-0.16	ns
SSTL33_I	SSTL_3 class I, VCCIO = 3.0V	0.08	0.13	0.19	ns
SSTL33_II	SSTL_3 class II, VCCIO = 3.0V	-0.20	-0.17	-0.14	ns
SSTL33D_I	Differential SSTL_3 class I	0.08	0.13	0.18	ns
SSTL33D_II	Differential SSTL_3 class II	-0.20	-0.17	-0.14	ns
SSTL25_I	SSTL_2 class I 8mA drive, VCCIO = 2.5V	-0.06	-0.02	0.02	ns
SSTL25_II	SSTL_2 class II 16mA drive, VCCIO = 2.5V	-0.19	-0.15	-0.12	ns
SSTL25D_I	Differential SSTL_2 class I 8mA drive	-0.06	-0.02	0.02	ns
SSTL25D_II	Differential SSTL_2 class II 16mA drive	-0.19	-0.15	-0.12	ns
SSTL18_I	SSTL_1.8 class I, VCCIO = 1.8V	-0.14	-0.10	-0.07	ns
SSTL18_II	SSTL_1.8 class II 8mA drive, VCCIO = 1.8V	-0.20	-0.17	-0.14	ns
SSTL18D_I	Differential SSTL_1.8 class I	-0.14	-0.10	-0.07	ns
SSTL18D_II	Differential SSTL_1.8 class II 8mA drive	-0.20	-0.17	-0.14	ns
SSTL15	SSTL_1.5, VCCIO = 1.5V	0.07	0.08	0.08	ns
SSTL15D	Differential SSTL_15	0.07	0.08	0.08	ns
LVTTL33_4mA	LVTTL 4mA drive, VCCIO = 3.0V	0.21	0.23	0.25	ns
LVTTL33_8mA	LVTTL 8mA drive, VCCIO = 3.0V	0.09	0.09	0.10	ns
LVTTL33_12mA	LVTTL 12mA drive, VCCIO = 3.0V	0.02	0.03	0.03	ns
LVTTL33_16mA	LVTTL 16mA drive, VCCIO = 3.0V	0.12	0.13	0.13	ns
LVTTL33_20mA	LVTTL 20mA drive, VCCIO = 3.0V	0.08	0.08	0.09	ns
LVCMOS33_4mA	LVCMOS 3.3 4mA drive, fast slew rate	0.21	0.23	0.25	ns
LVCMOS33_8mA	LVCMOS 3.3 8mA drive, fast slew rate	0.09	0.09	0.10	ns
LVCMOS33_12mA	LVCMOS 3.3 12mA drive, fast slew rate	0.02	0.03	0.03	ns
LVCMOS33_16mA	LVCMOS 3.3 16mA drive, fast slew rate	0.12	0.13	0.13	ns
LVCMOS33_20mA	LVCMOS 3.3 20mA drive, fast slew rate	0.08	0.08	0.09	ns
LVCMOS25_4mA	LVCMOS 2.5 4mA drive, fast slew rate	0.12	0.12	0.12	ns
LVCMOS25_8mA	LVCMOS 2.5 8mA drive, fast slew rate	0.05	0.05	0.05	ns
LVCMOS25_12mA	LVCMOS 2.5 12mA drive, fast slew rate	0.00	0.00	0.00	ns
LVCMOS25_16mA	LVCMOS 2.5 16mA drive, fast slew rate	0.08	0.08	0.08	ns
LVCMOS25_20mA	LVCMOS 2.5 20mA drive, fast slew rate	0.04	0.04	0.04	ns
LVCMOS18_4mA	LVCMOS 1.8 4mA drive, fast slew rate	0.08	0.09	0.09	ns
LVCMOS18_8mA	LVCMOS 1.8 8mA drive, fast slew rate	0.02	0.01	0.01	ns
LVCMOS18_12mA	LVCMOS 1.8 12mA drive, fast slew rate	-0.03	-0.03	-0.03	ns
LVCMOS18_16mA	LVCMOS 1.8 16mA drive, fast slew rate	0.03	0.03	0.03	ns

JTAG Port Timing Specifications

Over Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
f_{MAX}	TCK clock frequency	—	25	MHz
t_{BTCP}	TCK [BSCAN] clock pulse width	40	—	ns
t_{BTCPH}	TCK [BSCAN] clock pulse width high	20	—	ns
t_{BTCPL}	TCK [BSCAN] clock pulse width low	20	—	ns
t_{BTS}	TCK [BSCAN] setup time	10	—	ns
t_{BTH}	TCK [BSCAN] hold time	8	—	ns
t_{BTRF}	TCK [BSCAN] rise/fall time	50	—	mV/ns
t_{BTCO}	TAP controller falling edge of clock to valid output	—	10	ns
$t_{BTCODIS}$	TAP controller falling edge of clock to valid disable	—	10	ns
t_{BTCOEN}	TAP controller falling edge of clock to valid enable	—	10	ns
t_{BTCRS}	BSCAN test capture register setup time	8	—	ns
t_{BTCRH}	BSCAN test capture register hold time	25	—	ns
t_{BUTCO}	BSCAN test update register, falling edge of clock to valid output	—	25	ns
$t_{BTUODIS}$	BSCAN test update register, falling edge of clock to valid disable	—	25	ns
$t_{BTUPOEN}$	BSCAN test update register, falling edge of clock to valid enable	—	25	ns

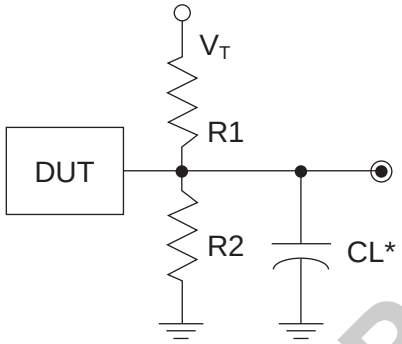
Figure 3-25. JTAG Port Timing Waveforms



Switching Test Conditions

Figure 3-26 shows the output test load that is used for AC testing. The specific values for resistance, capacitance, voltage, and other test conditions are shown in Table 3-23.

Figure 3-26. Output Test Load, LVTTL and LVCMOS Standards



*CL Includes Test Fixture and Probe Capacitance

Table 3-23. Test Fixture Required Components, Non-Terminated Interfaces

Test Condition	R_1	R_2	C_L	Timing Ref.	V_T
LVTTL and other LVCMOS settings (L -> H, H -> L)	∞	∞	0pF	LVCMOS 3.3 = 1.5V	—
				LVCMOS 2.5 = V_{CCIO}/2	—
				LVCMOS 1.8 = V_{CCIO}/2	—
				LVCMOS 1.5 = V_{CCIO}/2	—
				LVCMOS 1.2 = V_{CCIO}/2	—
LVCMOS 2.5 I/O (Z -> H)	∞	1MΩ	0pF	V_{CCIO}/2	—
LVCMOS 2.5 I/O (Z -> L)	1MΩ	∞	0pF	V_{CCIO}/2	V_{CCIO}
LVCMOS 2.5 I/O (H -> Z)	∞	100	0pF	V_{OH} - 0.10	—
LVCMOS 2.5 I/O (L -> Z)	100	∞	0pF	V_{OL} + 0.10	V_{CCIO}

Note: Output test conditions for all other interfaces are determined by the respective standards.

Pin Information Summary

Pin Information Summary		ECP3-17EA		ECP3-35EA			ECP3-70E/EA		
Pin Type		256 ftBGA	484 fpBGA	256 ftBGA	484 fpBGA	672 fpBGA	484 fpBGA	672 fpBGA	1156 fpBGA
General Purpose Inputs/Outputs per Bank	Bank 0	26	36	26	42	48	42	60	86
	Bank 1	14	24	14	36	36	36	48	78
	Bank 2	6	12	6	24	24	24	34	36
	Bank 3	18	44	16	54	59	54	59	86
	Bank 6	20	44	18	63	61	63	67	86
	Bank 7	19	32	19	36	42	36	48	54
	Bank 8	24	24	24	24	24	24	24	24
General Purpose Inputs per Bank	Bank 0	0	0	0	0	0	0	0	0
	Bank 1	0	0	0	0	0	0	0	0
	Bank 2	2	2	2	4	4	4	8	8
	Bank 3	0	0	2	4	4	4	12	12
	Bank 6	0	0	2	4	4	4	12	12
	Bank 7	4	4	4	4	4	4	8	8
	Bank 8	0	0	0	0	0	0	0	0
General Purpose Outputs per Bank	Bank 0	0	0	0	0	0	0	0	0
	Bank 1	0	0	0	0	0	0	0	0
	Bank 2	0	0	0	0	0	0	0	0
	Bank 3	0	0	0	0	0	0	0	0
	Bank 6	0	0	0	0	0	0	0	0
	Bank 7	0	0	0	0	0	0	0	0
	Bank 8	0	0	0	0	0	0	0	0
Total Single-Ended User I/O		133	222	133	295	310	295	380	490
VCC		6	16	6	16	32	16	32	32
VCCAUX		4	8	4	8	12	8	12	16
VTT		4	4	4	4	4	4	4	8
VCCA		4	4	4	4	8	4	8	16
VCCPLL		2	4	2	4	4	4	4	4
VCCIO	Bank 0	2	2	2	2	4	2	4	4
	Bank 1	2	2	2	2	4	2	4	4
	Bank 2	2	2	2	2	4	2	4	4
	Bank 3	2	2	2	2	4	2	4	4
	Bank 6	2	2	2	2	4	2	4	4
	Bank 7	2	2	2	2	4	2	4	4
	Bank 8	2	2	2	2	2	2	2	2
VCCJ		1	1	1	1	1	1	1	1
TAP		4	4	4	4	4	4	4	4
GND, GNDIO		50	98	50	98	139	98	139	233
NC		0	73	0	0	96	0	0	238
Reserved[1]		0	2	0	2	2	2	2	2
SERDES		26	26	26	26	26	26	52	78
Miscellaneous Pins		8	8	8	8	8	8	8	8
Total Bonded Pins		256	484	256	484	672	484	672	1156

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

Lattice ECP3
LFE3-95E
7FN672C
Datecode

Industrial

Lattice ECP3
LFE3-95E
7FN672I
Datecode

LatticeECP3 Family Data Sheet Revision History

Date	Version	Section	Change Summary
February 2009	01.0	—	Initial release.
May 2009	01.1	All	Removed references to Parallel burst mode Flash.
		Introduction	Features - Changed 250 Mbps to 230 Mbps in Embedded SERDES bulleted section and added a footnote to indicate 230 Mbps applies to 8b10b and 10b12b applications.
			Updated data for ECP3-17 in LatticeECP3 Family Selection Guide table.
			Changed embedded memory from 552 to 700 Kbits in LatticeECP3 Family Selection Guide table.
		Architecture	Updated description for CLKFB in General Purpose PLL Diagram.
			Corrected Primary Clock Sources text section.
			Corrected Secondary Clock/Control Sources text section.
			Corrected Secondary Clock Regions table.
			Corrected note below Detailed sysDSP Slice Diagram.
			Corrected Clock, Clock Enable, and Reset Resources text section.
			Corrected ECP3-17 EBR number in Embedded SRAM in the LatticeECP3 Family table.
			Added On-Chip Termination Options for Input Modes table.
			Updated Available SERDES Quads per LatticeECP3 Devices table.
			Updated Simplified Channel Block Diagram for SERDES/PCS Block diagram.
			Updated Device Configuration text section.
			Corrected software default value of MCLK to be 2.5 MHz.
		DC and Switching Characteristics	Updated VCCOB Min/Max data in Recommended Operating Conditions table.
			Corrected footnote 2 in sysIO Recommended Operating Conditions table.
			Added added footnote 7 for t_{SKEW_PRIB} to External Switching Characteristics table.
			Added 2-to-1 Gearing text section and table.
			Updated External Reference Clock Specification (refclkp/refclkn) table.
			LatticeECP3 sysCONFIG Port Timing Specifications - updated t_{DINIT} information.
			Added sysCONFIG Port Timing waveform.
			Serial Input Data Specifications table, delete Typ data for $V_{RX\text{-}DIFF\text{-}S}$.
			Added footnote 4 to sysCLOCK PLL Timing table for t_{PFD}.
			Added SERDES/PCS Block Latency Breakdown table.
			External Reference Clock Specifications table, added footnote 4, add symbol name vREF-IN-DIFF.
			Added SERDES External Reference Clock Waveforms.
			Updated Serial Output Timing and Levels table.
			Pin-to-pin performance table, changed "typically 3% slower" to "typically slower".