Intel - EPF10K100ARI240-3N 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	624
Number of Logic Elements/Cells	4992
Total RAM Bits	24576
Number of I/O	189
Number of Gates	158000
Voltage - Supply	3V ~ 3.6V
Mounting Type	Surface Mount
Operating Temperature	-40°C ~ 85°C (TA)
Package / Case	240-BFQFP Exposed Pad
Supplier Device Package	240-RQFP (32x32)
Purchase URL	https://www.e-xfl.com/product-detail/intel/epf10k100ari240-3n

Notes to tables:
(1) FLEX 10K and FLEX 10KA device package types include plastic J-lead chip carrier (PLCC), thin quad flat pack (TQFP), plastic quad flat pack (PQFP), power quad flat pack (RQFP), ball-grid array (BGA), pin-grid array (PGA), and FineLine BGA™ packages.
(2) This option is supported with a 256-pin FineLine BGA package. By using SameFrame pin migration, all FineLine BGA packages are pin compatible. For example, a board can be designed to support both 256-pin and 484-pin FineLine BGA packages. The Altera software automatically avoids conflicting pins when future migration is set.

General Description

Altera's FLEX 10K devices are the industry's first embedded PLDs. Based on reconfigurable CMOS SRAM elements, the Flexible Logic Element MatriX (FLEX) architecture incorporates all features necessary to implement common gate array megafunctions. With up to 250,000 gates, the FLEX 10K family provides the density, speed, and features to integrate entire systems, including multiple 32-bit buses, into a single device.

FLEX 10K devices are reconfigurable, which allows 100% testing prior to shipment. As a result, the designer is not required to generate test vectors for fault coverage purposes. Additionally, the designer does not need to manage inventories of different ASIC designs; FLEX 10K devices can be configured on the board for the specific functionality required.

Table 6 shows FLEX 10K performance for some common designs. All performance values were obtained with Synopsys DesignWare or LPM functions. No special design technique was required to implement the applications; the designer simply inferred or instantiated a function in a Verilog HDL, VHDL, Altera Hardware Description Language (AHDL), or schematic design file.

Table 6. FLEX 10K & FLEX 10KA Performance

Application	Resources Used		Performance				Units
	LEs	EABs	-1 Speed Grade	-2 Speed Grade	-3 Speed Grade	-4 Speed Grade	
16-bit loadable counter *(1)*	16	0	204	166	125	95	MHz
16-bit accumulator *(1)*	16	0	204	166	125	95	MHz
16-to-1 multiplexer *(2)*	10	0	4.2	5.8	6.0	7.0	ns
256 × 8 RAM read cycle speed *(3)*	0	1	172	145	108	84	MHz
256 × 8 RAM write cycle speed *(3)*	0	1	106	89	68	63	MHz

Notes:
(1) The speed grade of this application is limited because of clock high and low specifications.
(2) This application uses combinatorial inputs and outputs.
(3) This application uses registered inputs and outputs.

For more information, see the following documents:

- *Configuration Devices for APEX & FLEX Devices Data Sheet*
- *BitBlaster Serial Download Cable Data Sheet*
- *ByteBlasterMV Parallel Port Download Cable Data Sheet*
- *Application Note 116 (Configuring APEX 20K, FLEX 10K & FLEX 6000 Devices)*

FLEX 10K devices are supported by Altera development systems; single, integrated packages that offer schematic, text (including AHDL), and waveform design entry, compilation and logic synthesis, full simulation and worst-case timing analysis, and device configuration. The Altera software provides EDIF 2 0 0 and 3 0 0, LPM, VHDL, Verilog HDL, and other interfaces for additional design entry and simulation support from other industry-standard PC- and UNIX workstation-based EDA tools.

The Altera software works easily with common gate array EDA tools for synthesis and simulation. For example, the Altera software can generate Verilog HDL files for simulation with tools such as Cadence Verilog-XL. Additionally, the Altera software contains EDA libraries that use device-specific features such as carry chains which are used for fast counter and arithmetic functions. For instance, the Synopsys Design Compiler library supplied with the Altera development systems include DesignWare functions that are optimized for the FLEX 10K architecture.

The Altera development systems run on Windows-based PCs and Sun SPARCstation, and HP 9000 Series 700/800 workstations.

See the *MAX+PLUS II Programmable Logic Development System & Software Data Sheet* for more information.

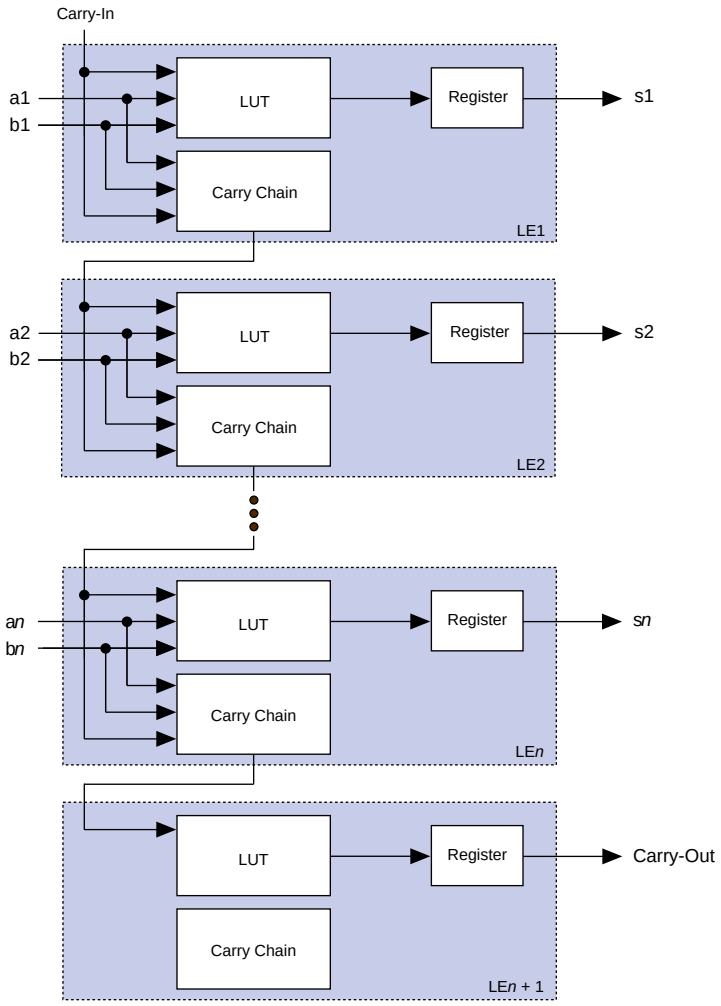
Functional Description

Each FLEX 10K device contains an embedded array to implement memory and specialized logic functions, and a logic array to implement general logic.

The embedded array consists of a series of EABs. When implementing memory functions, each EAB provides 2,048 bits, which can be used to create RAM, ROM, dual-port RAM, or first-in first-out (FIFO) functions. When implementing logic, each EAB can contribute 100 to 600 gates towards complex logic functions, such as multipliers, microcontrollers, state machines, and DSP functions. EABs can be used independently, or multiple EABs can be combined to implement larger functions.

Figure 7 shows how an *n*-bit full adder can be implemented in *n* + 1 LEs with the carry chain. One portion of the LUT generates the sum of two bits using the input signals and the carry-in signal; the sum is routed to the output of the LE. The register can either be bypassed for simple adders or be used for an accumulator function. The carry chain logic generates the carry-out signal, which is routed directly to the carry-in signal of the next-higher-order bit. The final carry-out signal is routed to an LE, where it can be used as a general-purpose signal.

Figure 7. Carry Chain Operation (n-bit Full Adder)



LE Operating Modes

The FLEX 10K LE can operate in the following four modes:

- Normal mode
- Arithmetic mode
- Up/down counter mode
- Clearable counter mode

Each of these modes uses LE resources differently. In each mode, seven available inputs to the LE—the four data inputs from the LAB local interconnect, the feedback from the programmable register, and the carry-in and cascade-in from the previous LE—are directed to different destinations to implement the desired logic function. Three inputs to the LE provide clock, clear, and preset control for the register. The Altera software, in conjunction with parameterized functions such as LPM and DesignWare functions, automatically chooses the appropriate mode for common functions such as counters, adders, and multipliers. If required, the designer can also create special-purpose functions which use a specific LE operating mode for optimal performance.

The architecture provides a synchronous clock enable to the register in all four modes. The Altera software can set `DATA1` to enable the register synchronously, providing easy implementation of fully synchronous designs.

Figure 9 shows the LE operating modes.

For improved routing, the row interconnect is comprised of a combination of full-length and half-length channels. The full-length channels connect to all LABs in a row; the half-length channels connect to the LABs in half of the row. The EAB can be driven by the half-length channels in the left half of the row and by the full-length channels. The EAB drives out to the full-length channels. In addition to providing a predictable, row-wide interconnect, this architecture provides increased routing resources. Two neighboring LABs can be connected using a half-row channel, thereby saving the other half of the channel for the other half of the row.

Table 7 summarizes the FastTrack Interconnect resources available in each FLEX 10K device.

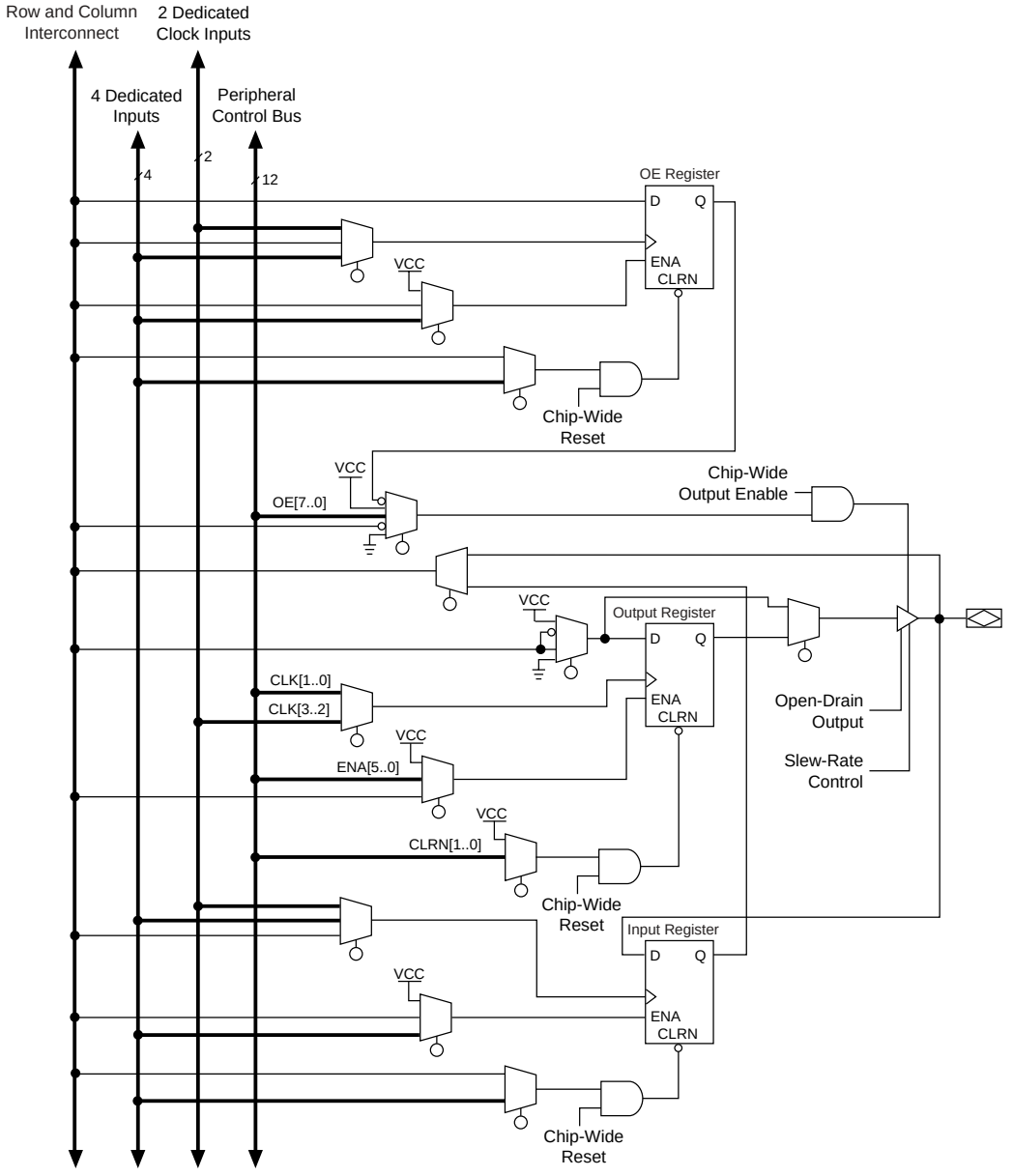
Table 7. FLEX 10K FastTrack Interconnect Resources

Device	Rows	Channels per Row	Columns	Channels per Column
EPF10K10 EPF10K10A	3	144	24	24
EPF10K20	6	144	24	24
EPF10K30 EPF10K30A	6	216	36	24
EPF10K40	8	216	36	24
EPF10K50 EPF10K50V	10	216	36	24
EPF10K70	9	312	52	24
EPF10K100 EPF10K100A	12	312	52	24
EPF10K130V	16	312	52	32
EPF10K250A	20	456	76	40

In addition to general-purpose I/O pins, FLEX 10K devices have six dedicated input pins that provide low-skew signal distribution across the device. These six inputs can be used for global clock, clear, preset, and peripheral output enable and clock enable control signals. These signals are available as control signals for all LABs and IOEs in the device.

The dedicated inputs can also be used as general-purpose data inputs because they can feed the local interconnect of each LAB in the device. However, the use of dedicated inputs as data inputs can introduce additional delay into the control signal network.

Figure 13. Bidirectional I/O Registers



Each IOE selects the clock, clear, clock enable, and output enable controls from a network of I/O control signals called the peripheral control bus. The peripheral control bus uses high-speed drivers to minimize signal skew across devices; it provides up to 12 peripheral control signals that can be allocated as follows:

- Up to eight output enable signals
- Up to six clock enable signals
- Up to two clock signals
- Up to two clear signals

If more than six clock enable or eight output enable signals are required, each IOE on the device can be controlled by clock enable and output enable signals driven by specific LEs. In addition to the two clock signals available on the peripheral control bus, each IOE can use one of two dedicated clock pins. Each peripheral control signal can be driven by any of the dedicated input pins or the first LE of each LAB in a particular row. In addition, an LE in a different row can drive a column interconnect, which causes a row interconnect to drive the peripheral control signal. The chip-wide reset signal will reset all IOE registers, overriding any other control signals.

Tables 8 and 9 list the sources for each peripheral control signal, and the rows that can drive global signals. These tables also show how the output enable, clock enable, clock, and clear signals share 12 peripheral control signals.

Signals on the peripheral control bus can also drive the four global signals, referred to as GLOBAL0 through GLOBAL3 in Tables 8 and 9. The internally generated signal can drive the global signal, providing the same low-skew, low-delay characteristics for an internally generated signal as for a signal driven by an input. This feature is ideal for internally generated clear or clock signals with high fan-out. When a global signal is driven by internal logic, the dedicated input pin that drives that global signal cannot be used. The dedicated input pin should be driven to a known logic state (such as ground) and not be allowed to float.

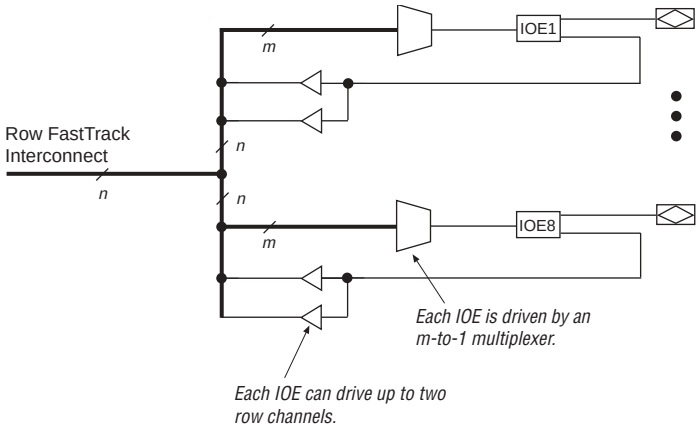
When the chip-wide output enable pin is held low, it will tri-state all pins on the device. This option can be set in the Global Project Device Options menu. Additionally, the registers in the IOE can be reset by holding the chip-wide reset pin low.

Row-to-IOE Connections

When an IOE is used as an input signal, it can drive two separate row channels. The signal is accessible by all LEs within that row. When an IOE is used as an output, the signal is driven by a multiplexer that selects a signal from the row channels. Up to eight IOEs connect to each side of each row channel. See Figure 14.

Figure 14. FLEX 10K Row-to-IOE Connections

The values for m and n are provided in Table 10.



Notes to tables:

(1) See the *Operating Requirements for Altera Devices Data Sheet*.
(2) Minimum DC input voltage is –0.5 V. During transitions, the inputs may undershoot to –2.0 V for input currents less than 100 mA and periods shorter than 20 ns.
(3) Numbers in parentheses are for industrial-temperature-range devices.
(4) Maximum V_{CC} rise time is 100 ms. V_{CC} must rise monotonically.
(5) Typical values are for T_A = 25° C and V_{CC} = 5.0 V.
(6) These values are specified under the Recommended Operation Condition shown in Table 18 on page 45.
(7) The I_{OH} parameter refers to high-level TTL or CMOS output current.
(8) The I_{OL} parameter refers to low-level TTL or CMOS output current. This parameter applies to open-drain pins as well as output pins.
(9) This value is specified for normal device operation. The value may vary during power-up.
(10) Capacitance is sample-tested only.

Figure 20 shows the typical output drive characteristics of FLEX 10K devices with 5.0-V and 3.3-V V_{CCIO}. The output driver is compliant with the 5.0-V ***PCI Local Bus Specification, Revision 2.2*** (for 5.0-V V_{CCIO}).

Figure 20. Output Drive Characteristics of FLEX 10K Devices

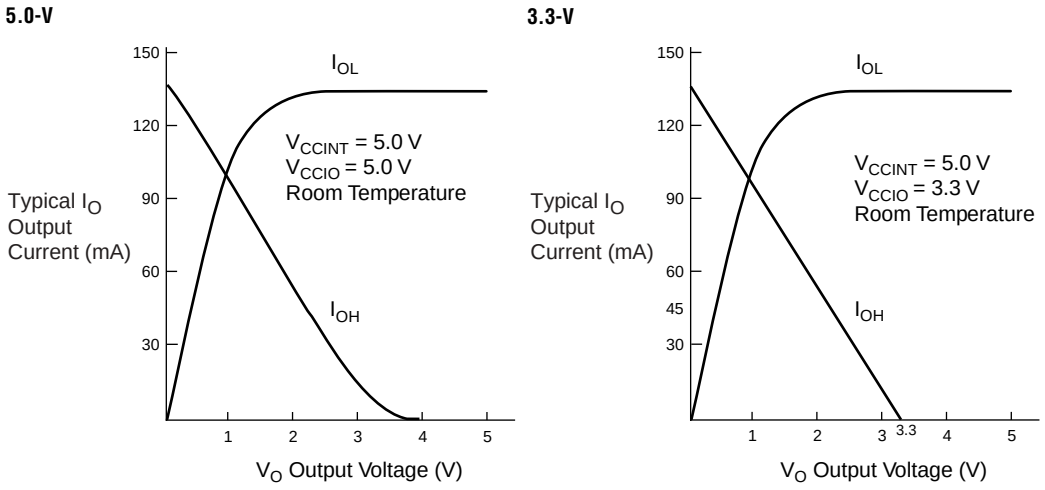


Figure 22 shows the typical output drive characteristics of EPF10K10A, EPF10K30A, EPF10K100A, and EPF10K250A devices with 3.3-V and 2.5-V V_{CCIO}. The output driver is compliant with the 3.3-V ***PCI Local Bus Specification, Revision 2.2*** (with 3.3-V V_{CCIO}). Moreover, device analysis shows that the EPF10K10A, EPF10K30A, and EPF 10K100A devices can drive a 5.0-V PCI bus with eight or fewer loads.

Figure 22. Output Drive Characteristics for EPF10K10A, EPF10K30A & EPF10K100A Devices

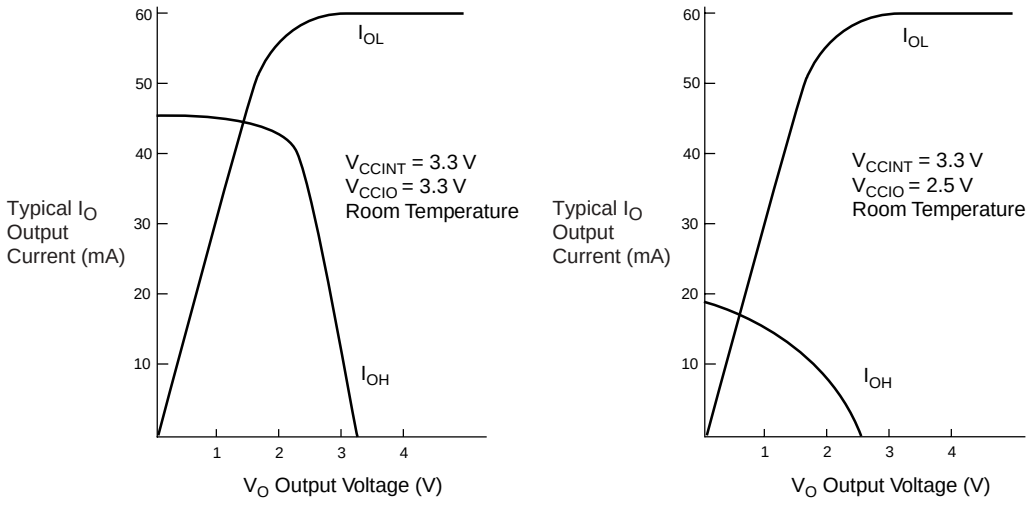
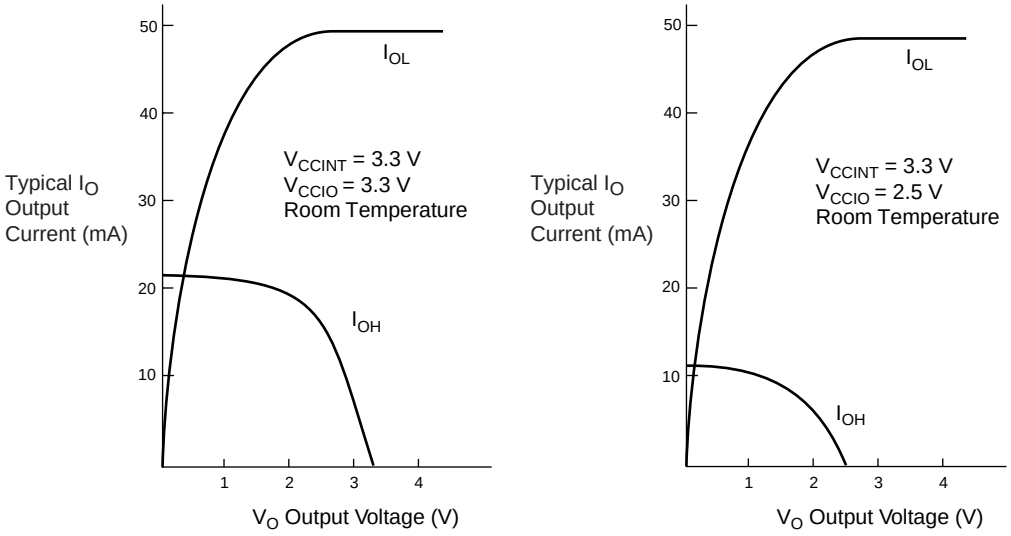


Figure 23 shows the typical output drive characteristics of the EPF10K250A device with 3.3-V and 2.5-V V_{CCIO}.

Figure 23. Output Drive Characteristics for EPF10K250A Device



Timing Model

The continuous, high-performance FastTrack Interconnect routing resources ensure predictable performance and accurate simulation and timing analysis. This predictable performance contrasts with that of FPGAs, which use a segmented connection scheme and therefore have unpredictable performance.

Device performance can be estimated by following the signal path from a source, through the interconnect, to the destination. For example, the registered performance between two LEs on the same row can be calculated by adding the following parameters:

- LE register clock-to-output delay (t_{CO})
- Interconnect delay ($t_{SAMEROW}$)
- LE look-up table delay (t_{LUT})
- LE register setup time (t_{SU})

The routing delay depends on the placement of the source and destination LEs. A more complex registered path may involve multiple combinatorial LEs between the source and destination LEs.

Table 36. Interconnect Timing Microparameters *Note (1)*

Symbol	Parameter	Conditions
$t_{DIN2IOE}$	Delay from dedicated input pin to IOE control input	*(7)*
$t_{DCLK2LE}$	Delay from dedicated clock pin to LE or EAB clock	*(7)*
$t_{DIN2DATA}$	Delay from dedicated input or clock to LE or EAB data	*(7)*
$t_{DCLK2IOE}$	Delay from dedicated clock pin to IOE clock	*(7)*
t_{DIN2LE}	Delay from dedicated input pin to LE or EAB control input	*(7)*
$t_{SAMELAB}$	Routing delay for an LE driving another LE in the same LAB	
$t_{SAMEROW}$	Routing delay for a row IOE, LE, or EAB driving a row IOE, LE, or EAB in the same row	*(7)*
$t_{SAMECOLUMN}$	Routing delay for an LE driving an IOE in the same column	*(7)*
$t_{DIFFROW}$	Routing delay for a column IOE, LE, or EAB driving an LE or EAB in a different row	*(7)*
$t_{TWOROWS}$	Routing delay for a row IOE or EAB driving an LE or EAB in a different row	*(7)*
$t_{LEPERIPH}$	Routing delay for an LE driving a control signal of an IOE via the peripheral control bus	*(7)*
$t_{LABCARRY}$	Routing delay for the carry-out signal of an LE driving the carry-in signal of a different LE in a different LAB	
$t_{LABCASC}$	Routing delay for the cascade-out signal of an LE driving the cascade-in signal of a different LE in a different LAB	

Table 37. External Timing Parameters *Notes (8), (10)*

Symbol	Parameter	Conditions
t_{DRR}	Register-to-register delay via four LEs, three row interconnects, and four local interconnects	*(9)*
t_{INSU}	Setup time with global clock at IOE register	
t_{INH}	Hold time with global clock at IOE register	
t_{OUTCO}	Clock-to-output delay with global clock at IOE register	

Table 38. External Bidirectional Timing Parameters *Note (10)*

Symbol	Parameter	Condition
$t_{INSUBIDIR}$	Setup time for bidirectional pins with global clock at adjacent LE register	
$t_{INHBIDIR}$	Hold time for bidirectional pins with global clock at adjacent LE register	
$t_{OUTCOBIDIR}$	Clock-to-output delay for bidirectional pins with global clock at IOE register	
$t_{XZBIDIR}$	Synchronous IOE output buffer disable delay	
$t_{ZXBIDIR}$	Synchronous IOE output buffer enable delay, slow slew rate = off	

Table 49. EPF10K30, EPF10K40 & EPF10K50 Device IOE Timing Microparameters *Note (1)*

Symbol	-3 Speed Grade		-4 Speed Grade		Unit
	Min	Max	Min	Max	
t_{IOD}		0.4		0.6	ns
t_{IOC}		0.5		0.9	ns
t_{IOCO}		0.4		0.5	ns
t_{IOCOMB}		0.0		0.0	ns
t_{IOSU}	3.1		3.5		ns
t_{IOH}	1.0		1.9		ns
t_{IOCLR}		1.0		1.2	ns
t_{OD1}		3.3		3.6	ns
t_{OD2}		5.6		6.5	ns
t_{OD3}		7.0		8.3	ns
t_{XZ}		5.2		5.5	ns
t_{ZX1}		5.2		5.5	ns
t_{ZX2}		7.5		8.4	ns
t_{ZX3}		8.9		10.2	ns
t_{INREG}		7.7		10.0	ns
t_{IOFD}		3.3		4.0	ns
t_{INCOMB}		3.3		4.0	ns

Table 68. EPF10K100 Device Interconnect Timing Microparameters *Note (1)*

Symbol	-3DX Speed Grade		-3 Speed Grade		-4 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
$t_{DIN2IOE}$		10.3		10.3		12.2	ns
t_{DIN2LE}		4.8		4.8		6.0	ns
$t_{DIN2DATA}$		7.3		7.3		11.0	ns
$t_{DCLK2IOE}$ without ClockLock or ClockBoost circuitry		6.2		6.2		7.7	ns
$t_{DCLK2IOE}$ with ClockLock or ClockBoost circuitry		2.3		–		–	ns
$t_{DCLK2LE}$ without ClockLock or ClockBoost circuitry		4.8		4.8		6.0	ns
$t_{DCLK2LE}$ with ClockLock or ClockBoost circuitry		2.3		–		–	ns
$t_{SAMELAB}$		0.4		0.4		0.5	ns
$t_{SAMEROW}$		4.9		4.9		5.5	ns
$t_{SAMECOLUMN}$		5.1		5.1		5.4	ns
$t_{DIFFROW}$		10.0		10.0		10.9	ns
$t_{TWOROWS}$		14.9		14.9		16.4	ns
$t_{LEPERIPH}$		6.9		6.9		8.1	ns
$t_{LABCARRY}$		0.9		0.9		1.1	ns
$t_{LABCASC}$		3.0		3.0		3.2	ns

Notes to tables:
(1) All timing parameters are described in Tables 32 through 38 in this data sheet.
(2) Using an LE to register the signal may provide a lower setup time.
(3) This parameter is specified by characterization.

Tables 78 through 84 show EPF10K130V device internal and external timing parameters.

Table 78. EPF10K130V Device LE Timing Microparameters *Note (1)*

Symbol	-2 Speed Grade		-3 Speed Grade		-4 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
t_{LUT}		1.3		1.8		2.3	ns
t_{CLUT}		0.5		0.7		0.9	ns
t_{RLUT}		1.2		1.7		2.2	ns
t_{PACKED}		0.5		0.6		0.7	ns
t_{EN}		0.6		0.8		1.0	ns
t_{CICO}		0.2		0.3		0.4	ns
t_{CGEN}		0.3		0.4		0.5	ns
t_{CGENR}		0.7		1.0		1.3	ns
t_{CASC}		0.9		1.2		1.5	ns
t_{C}		1.9		2.4		3.0	ns
t_{CO}		0.6		0.9		1.1	ns
t_{COMB}		0.5		0.7		0.9	ns
t_{SU}	0.2		0.2		0.3		ns
t_{H}	0.0		0.0		0.0		ns
t_{PRE}		2.4		3.1		3.9	ns
t_{CLR}		2.4		3.1		3.9	ns
t_{CH}	4.0		4.0		4.0		ns
t_{CL}	4.0		4.0		4.0		ns

Table 79. EPF10K130V Device IOE Timing Microparameters *Note (1)*

Symbol	-2 Speed Grade		-3 Speed Grade		-4 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
t_{IOD}		1.3		1.6		2.0	ns
t_{IOC}		0.4		0.5		0.7	ns
t_{IOCO}		0.3		0.4		0.5	ns
t_{IOCOMB}		0.0		0.0		0.0	ns
t_{IOSU}	2.6		3.3		3.8		ns
t_{IOH}	0.0		0.0		0.0		ns
t_{IOCLR}		1.7		2.2		2.7	ns
t_{OD1}		3.5		4.4		5.0	ns
t_{OD2}		–		–		–	ns
t_{OD3}		8.2		8.1		9.7	ns
t_{XZ}		4.9		6.3		7.4	ns
t_{ZX1}		4.9		6.3		7.4	ns
t_{ZX2}		–		–		–	ns
t_{ZX3}		9.6		10.0		12.1	ns
t_{INREG}		7.9		10.0		12.6	ns
t_{IOFD}		6.2		7.9		9.9	ns
t_{INCOMB}		6.2		7.9		9.9	ns

Table 80. EPF10K130V Device EAB Internal Microparameters *Note (1)*

Symbol	-2 Speed Grade		-3 Speed Grade		-4 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
$t_{EABDATA1}$		1.9		2.4		2.4	ns
$t_{EABDATA2}$		3.7		4.7		4.7	ns
t_{EABWE1}		1.9		2.4		2.4	ns
t_{EABWE2}		3.7		4.7		4.7	ns
t_{EABCLK}		0.7		0.9		0.9	ns
t_{EABCO}		0.5		0.6		0.6	ns
$t_{EABBYPASS}$		0.6		0.8		0.8	ns
t_{EABSU}	1.4		1.8		1.8		ns
t_{EABH}	0.0		0.0		0.0		ns
t_{AA}		5.6		7.1		7.1	ns
t_{WP}	3.7		4.7		4.7		ns
t_{WDSU}	4.6		5.9		5.9		ns
t_{WDH}	0.0		0.0		0.0		ns
t_{WASU}	3.9		5.0		5.0		ns
t_{WAH}	0.0		0.0		0.0		ns
t_{WO}		5.6		7.1		7.1	ns
t_{DD}		5.6		7.1		7.1	ns
t_{EABOUT}		2.4		3.1		3.1	ns
t_{EABCH}	4.0		4.0		4.0		ns
t_{EABCL}	4.0		4.7		4.7		ns

Table 107. EPF10K250A Device IOE Timing Microparameters *Note (1)*

Symbol	-1 Speed Grade		-2 Speed Grade		-3 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
t_{IOD}		1.2		1.3		1.6	ns
t_{IOC}		0.4		0.4		0.5	ns
t_{IOCO}		0.8		0.9		1.1	ns
t_{IOCOMB}		0.7		0.7		0.8	ns
t_{IOSU}	2.7		3.1		3.6		ns
t_{IOH}	0.2		0.3		0.3		ns
t_{IOCLR}		1.2		1.3		1.6	ns
t_{OD1}		3.2		3.6		4.2	ns
t_{OD2}		5.9		6.7		7.8	ns
t_{OD3}		8.7		9.8		11.5	ns
t_{XZ}		3.8		4.3		5.0	ns
t_{ZX1}		3.8		4.3		5.0	ns
t_{ZX2}		6.5		7.4		8.6	ns
t_{ZX3}		9.3		10.5		12.3	ns
t_{INREG}		8.2		9.3		10.9	ns
t_{IOFD}		9.0		10.2		12.0	ns
t_{INCOMB}		9.0		10.2		12.0	ns

Table 110. EPF10K250A Device Interconnect Timing Microparameters *Note (1)*

Symbol	-1 Speed Grade		-2 Speed Grade		-3 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
$t_{DIN2IOE}$		7.8		8.5		9.4	ns
t_{DIN2LE}		2.7		3.1		3.5	ns
$t_{DIN2DATA}$		1.6		1.6		1.7	ns
$t_{DCLK2IOE}$		3.6		4.0		4.6	ns
$t_{DCLK2LE}$		2.7		3.1		3.5	ns
$t_{SAMELAB}$		0.2		0.3		0.3	ns
$t_{SAMEROW}$		6.7		7.3		8.2	ns
$t_{SAMECOLUMN}$		2.5		2.7		3.0	ns
$t_{DIFFROW}$		9.2		10.0		11.2	ns
$t_{TWOROWS}$		15.9		17.3		19.4	ns
$t_{LEPERIPH}$		7.5		8.1		8.9	ns
$t_{LABCARRY}$		0.3		0.4		0.5	ns
$t_{LABCASC}$		0.4		0.4		0.5	ns

Table 111. EPF10K250A Device External Reference Timing Parameters *Note (1)*

Symbol	-1 Speed Grade		-2 Speed Grade		-3 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
t_{DRR}		15.0		17.0		20.0	ns
t_{INSU} *(2), (3)*	6.9		8.0		9.4		ns
t_{INH} *(3)*	0.0		0.0		0.0		ns
t_{OUTCO} *(3)*	2.0	8.0	2.0	8.9	2.0	10.4	ns

Table 112. EPF10K250A Device External Bidirectional Timing Parameters *Note (1)*

Symbol	-1 Speed Grade		-2 Speed Grade		-3 Speed Grade		Unit
	Min	Max	Min	Max	Min	Max	
$t_{INSUBIDIR}$	9.3		10.6		12.7		ns
$t_{INHBIDIR}$	0.0		0.0		0.0		ns
$t_{OUTCOBIDIR}$	2.0	8.0	2.0	8.9	2.0	10.4	ns
$t_{XZBIDIR}$		10.8		12.2		14.2	ns
$t_{ZXBIDIR}$		10.8		12.2		14.2	ns

SRAM configuration elements allow FLEX 10K devices to be reconfigured in-circuit by loading new configuration data into the device. Real-time reconfiguration is performed by forcing the device into command mode with a device pin, loading different configuration data, reinitializing the device, and resuming user-mode operation.

The entire reconfiguration process may be completed in less than 320 ms using an EPF10K250A device with a DCLK frequency of 10 MHz. This process can be used to reconfigure an entire system dynamically. In-field upgrades can be performed by distributing new configuration files.

Refer to the configuration device data sheet to obtain the POR delay when using a configuration device method.

Programming Files

Despite being function- and pin-compatible, FLEX 10KA and FLEX 10KE devices are not programming- or configuration-file compatible with FLEX 10K devices. A design should be recompiled before it is transferred from a FLEX 10K device to an equivalent FLEX 10KA or FLEX 10KE device. This recompilation should be performed to create a new programming or configuration file and to check design timing on the faster FLEX 10KA or FLEX 10KE device. The programming or configuration files for EPF10K50 devices can program or configure an EPF10K50V device. However, Altera recommends recompiling a design for the EPF10K50V device when transferring it from the EPF10K50 device.

Configuration Schemes

The configuration data for a FLEX 10K device can be loaded with one of five configuration schemes (see Table 116), chosen on the basis of the target application. An EPC1, EPC2, EPC16, or EPC1441 configuration device, intelligent controller, or the JTAG port can be used to control the configuration of a FLEX 10K device, allowing automatic configuration on system power-up.