Welcome to E-XFL.COM

Understanding Embedded - FPGAs (Field Programmable Gate Array)

Embedded - FPGAs, or Field Programmable Gate Arrays, are advanced integrated circuits that offer unparalleled flexibility and performance for digital systems. Unlike traditional fixed-function logic devices, FPGAs can be programmed and reprogrammed to execute a wide array of logical operations, enabling customized functionality tailored to specific applications. This reprogrammability allows developers to iterate designs quickly and implement complex functions without the need for custom hardware.

Applications of Embedded - FPGAs

The versatility of Embedded - FPGAs makes them indispensable in numerous fields. In telecommunications.

Details	
Product Status	Obsolete
Number of LABs/CLBs	5184
Number of Logic Elements/Cells	51840
Total RAM Bits	442368
Number of I/O	488
Number of Gates	2392000
Voltage - Supply	2.375V ~ 2.625V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 85°C (TJ)
Package / Case	652-BBGA
Supplier Device Package	652-BGA (45x45)
Purchase URL	https://www.e-xfl.com/product-detail/intel/ep20k1500cb652c8

...and More Features

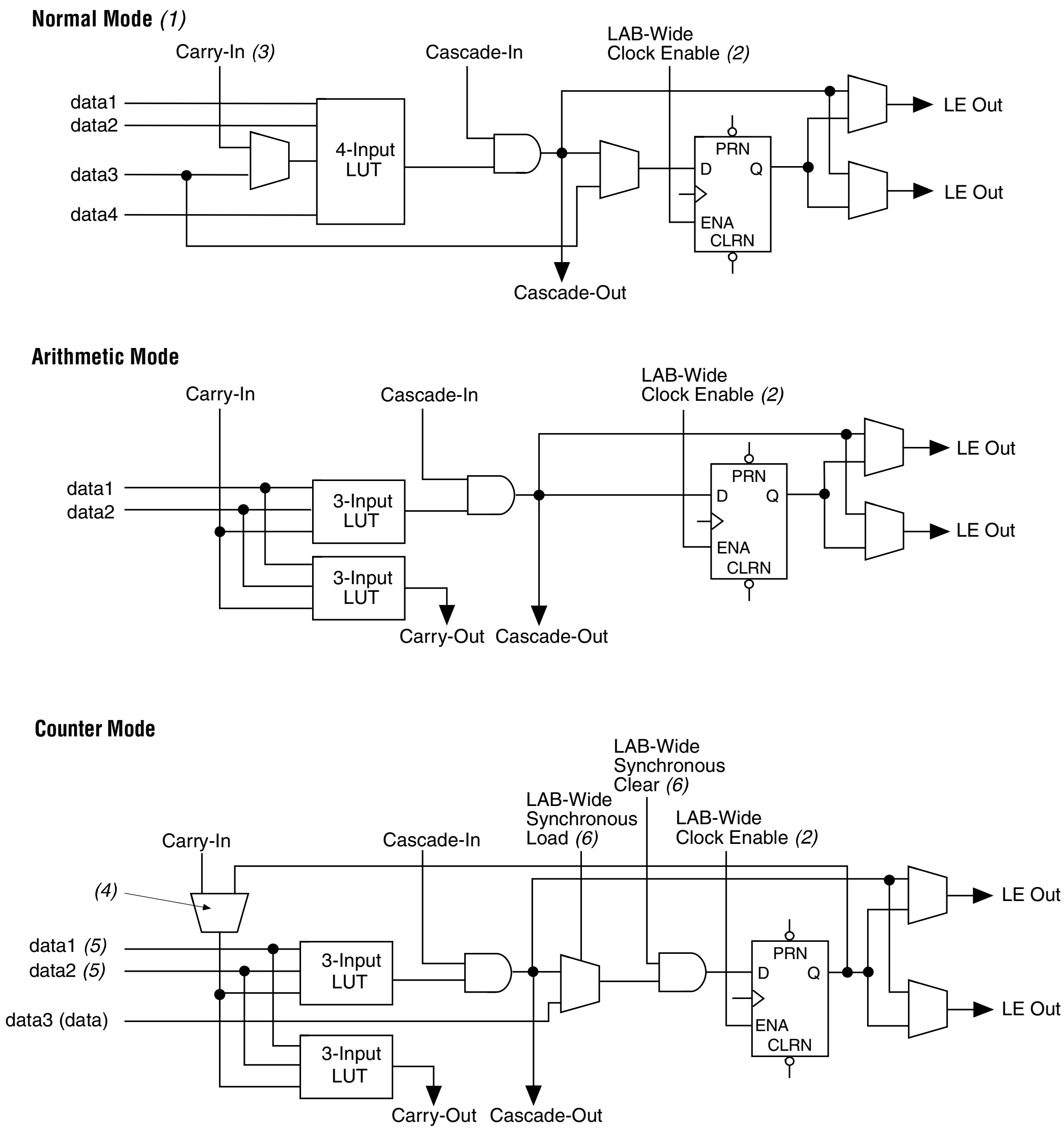
- Low-power operation design
  - 1.8-V supply voltage (see Table 2)
  - Copper interconnect reduces power consumption
  - MultiVolt™ I/O support for 1.8-V, 2.5-V, and 3.3-V interfaces
  - ESBs offering programmable power-saving mode
- Flexible clock management circuitry with up to four phase-locked loops (PLLs)
  - Built-in low-skew clock tree
  - Up to eight global clock signals
  - ClockLock™ feature reducing clock delay and skew
  - ClockBoost™ feature providing clock multiplication and division
  - ClockShift™ feature providing programmable clock phase and delay shifting
- Powerful I/O features
  - Compliant with peripheral component interconnect Special Interest Group (PCI SIG) ***PCI Local Bus Specification, Revision 2.2*** for 3.3-V operation at 33 or 66 MHz and 32 or 64 bits
  - Support for high-speed external memories, including DDR synchronous dynamic RAM (SDRAM) and ZBT static RAM (SRAM)
  - 16 input and 16 output LVDS channels
  - Direct connection from I/O pins to local interconnect providing fast t_{CO} and t_{SU} times for complex logic
  - MultiVolt I/O support for 1.8-V, 2.5-V, and 3.3-V interfaces
  - Programmable clamp to V_{CCIO}
  - Individual tri-state output enable control for each pin
  - Programmable output slew-rate control to reduce switching noise
  - Support for advanced I/O standards, including low-voltage differential signaling (LVDS), LVPECL, PCI-X, AGP, CTT, SSTL-3 and SSTL-2, GTL+, and HSTL Class I
  - Supports hot-socketing operation
  - Pull-up on I/O pins before and during configuration

Table 2. APEX 20KC Supply Voltages

Feature	Voltage
Internal supply voltage (V_{CCINT})	1.8 V
MultiVolt I/O interface voltage levels (V_{CCIO})	1.8 V, 2.5 V, 3.3 V, 5.0 V *(1)*

Note:
(1) APEX 20KC devices can be 5.0-V tolerant by using an external resistor.

Figure 8. APEX 20KC LE Operating Modes



Notes:

(1) LEs in normal mode support register packing.
(2) There are two LAB-wide clock enables per LAB.
(3) When using the carry-in in normal mode, the packed register feature is unavailable.
(4) A register feedback multiplexer is available on LE1 of each LAB.
(5) The `DATA1` and `DATA2` input signals can supply counter enable, up or down control, or register feedback signals for LEs other than the second LE in an LAB.
(6) The LAB-wide synchronous clear and LAB wide synchronous load affect all registers in an LAB.

Normal Mode

The normal mode is suitable for general logic applications, combinatorial functions, or wide decoding functions that can take advantage of a cascade chain. In normal mode, four data inputs from the LAB local interconnect and the carry-in are inputs to a four-input LUT. The Quartus II Compiler automatically selects the carry-in or the DATA3 signal as one of the inputs to the LUT. The LUT output can be combined with the cascade-in signal to form a cascade chain through the cascade-out signal. LEs in normal mode support packed registers.

Arithmetic Mode

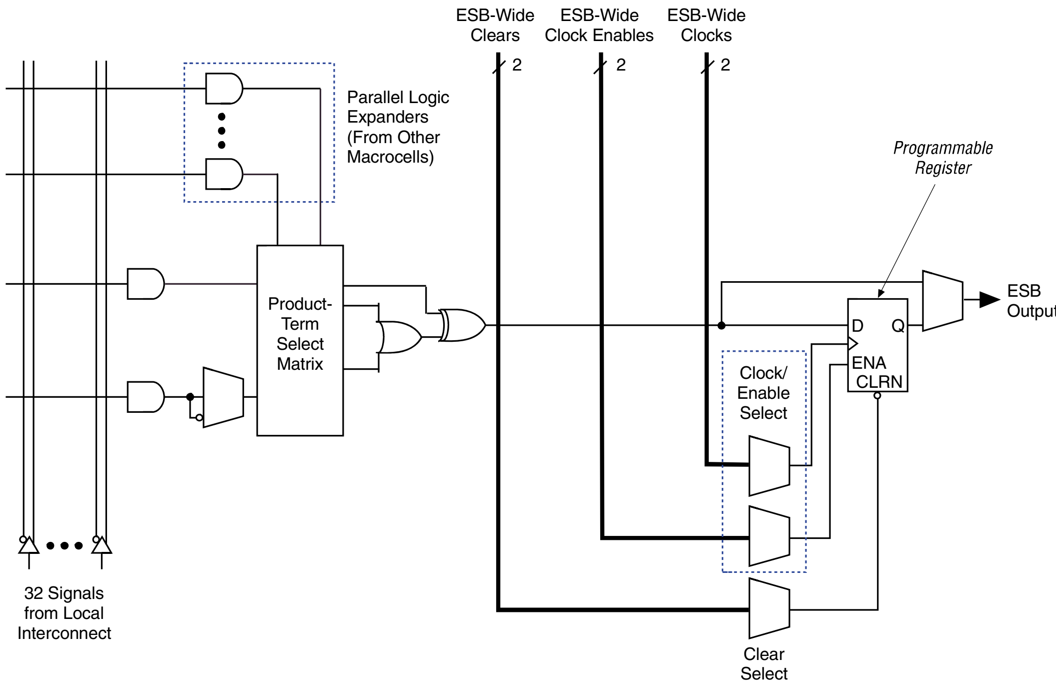
The arithmetic mode is ideal for implementing adders, accumulators, and comparators. An LE in arithmetic mode uses two 3-input LUTs. One LUT computes a three-input function; the other generates a carry output. As shown in Figure 8, the first LUT uses the carry-in signal and two data inputs from the LAB local interconnect to generate a combinatorial or registered output. For example, when implementing an adder, this output is the sum of three signals: DATA1, DATA2, and carry-in. The second LUT uses the same three signals to generate a carry-out signal, thereby creating a carry chain. The arithmetic mode also supports simultaneous use of the cascade chain. LEs in arithmetic mode can drive out registered and unregistered versions of the LUT output.

The Quartus II software implements parameterized functions that use the arithmetic mode automatically where appropriate; the designer does not need to specify how the carry chain will be used.

Counter Mode

The counter mode offers clock enable, counter enable, synchronous up/down control, synchronous clear, and synchronous load options. The counter enable and synchronous up/down control signals are generated from the data inputs of the LAB local interconnect. The synchronous clear and synchronous load options are LAB-wide signals that affect all registers in the LAB. Consequently, if any of the LEs in an LAB use the counter mode, other LEs in that LAB must be used as part of the same counter or be used for a combinatorial function. The Quartus II software automatically places any registers that are not used by the counter into other LABs.

Figure 14. APEX 20KC Macrocell



For registered functions, each macrocell register can be programmed individually to implement D, T, JK, or SR operation with programmable clock control. The register can be bypassed for combinatorial operation. During design entry, the designer specifies the desired register type; the Quartus II software then selects the most efficient register operation for each registered function to optimize resource utilization. The Quartus II software or other synthesis tools can also select the most efficient register operation automatically when synthesizing HDL designs.

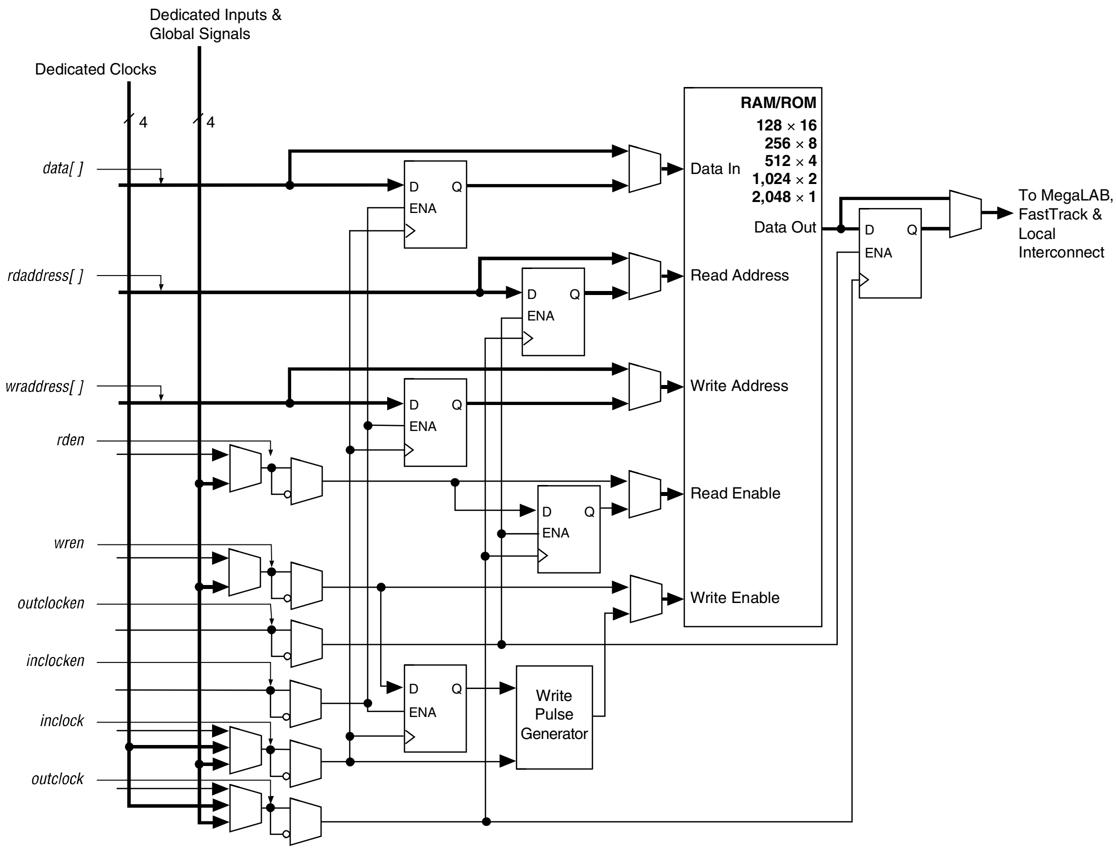
Each programmable register can be clocked by one of two ESB-wide clocks. The ESB-wide clocks can be generated from device dedicated clock pins, global signals, or local interconnect. Each clock also has an associated clock enable, generated from the local interconnect. The clock and clock enable signals are related for a particular ESB; any macrocell using a clock also uses the associated clock enable.

If both the rising and falling edges of a clock are used in an ESB, both ESB-wide clock signals are used.

Read/Write Clock Mode

The read/write clock mode contains two clocks. One clock controls all registers associated with writing: data input, WE, and write address. The other clock controls all registers associated with reading: read enable (RE), read address, and data output. The ESB also supports clock enable and asynchronous clear signals; these signals also control the read and write registers independently. Read/write clock mode is commonly used for applications where reads and writes occur at different system frequencies. Figure 20 shows the ESB in read/write clock mode.

Figure 20. ESB in Read/Write Clock Mode Note (1)



Note:

(1) All registers can be cleared asynchronously by ESB local interconnect signals, global signals, or the chip-wide reset.

Open-drain output pins on APEX 20KC devices (with a series resistor and a pull-up resistor to the 5.0-V supply) can drive 5.0-V CMOS input pins that require a V_{IH} of 3.5 V. When the pin is inactive, the trace will be pulled up to 5.0 V by the resistor. The open-drain pin will only drive low or tri-state; it will never drive high. The rise time is dependent on the value of the pull-up resistor and load impedance. The I_{OL} current specification should be considered when selecting a pull-up resistor.

ClockLock & ClockBoost Features

APEX 20KC devices support the ClockLock and ClockBoost clock management features, which are implemented with PLLs. The ClockLock circuitry uses a synchronizing PLL that reduces the clock delay and skew within a device. This reduction minimizes clock-to-output and setup times while maintaining zero hold times. The ClockBoost circuitry, which provides a clock multiplier, allows the designer to enhance device area efficiency by sharing resources within the device. The ClockBoost circuitry allows the designer to distribute a low-speed clock and multiply that clock on-device. APEX 20KC devices include a high-speed clock tree; unlike ASICs, the user does not have to design and optimize the clock tree. The ClockLock and ClockBoost features work in conjunction with the APEX 20KC device's high-speed clock to provide significant improvements in system performance and bandwidth. APEX 20KC devices in -7 and -8 speed grades include the ClockLock feature.

The ClockLock and ClockBoost features in APEX 20KC devices are enabled through the Quartus II software. External devices are not required to use these features.

APEX 20KC ClockLock Feature

APEX 20KC devices include up to four PLLs, which can be used independently. Two PLLs are designed for either general-purpose use or LVDS use (on devices that support LVDS I/O pins). The remaining two PLLs are designed for general-purpose use. The EP20K100C and EP20K200C devices have two PLLs; the EP20K400C and larger devices have four PLLs.

The following sections describe some of the features offered by the APEX 20KC PLLs.

External PLL Feedback

The ClockLock circuit's output can be driven off-chip to clock other devices in the system; further, the feedback loop of the PLL can be routed off-chip. This feature allows the designer to exercise fine control over the I/O interface between the APEX 20KC device and another high-speed device, such as SDRAM.

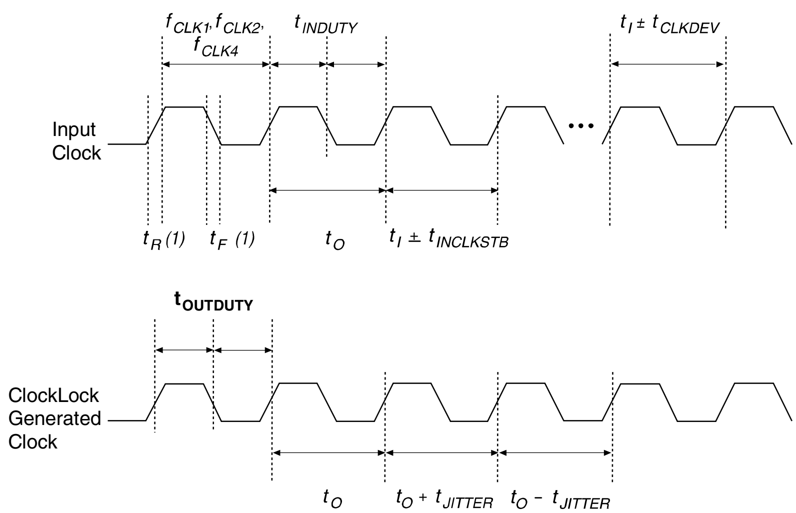
ClockLock & ClockBoost Timing Parameters

For the ClockLock and ClockBoost circuitry to function properly, the incoming clock must meet certain requirements. If these specifications are not met, the circuitry may not lock onto the incoming clock, which generates an erroneous clock within the device. The clock generated by the ClockLock and ClockBoost circuitry must also meet certain specifications. If the incoming clock meets these requirements during configuration, the APEX 20KC ClockLock and ClockBoost circuitry will lock onto the clock during configuration. The circuit will be ready for use immediately after configuration. In APEX 20KC devices, the clock input standard is programmable, so the PLL cannot respond to the clock until the device is configured. The PLL locks onto the input clock as soon as configuration is complete. Figure 29 shows the incoming and generated clock specifications.

For more information on ClockLock and ClockBoost circuitry, see *Application Note 115: Using the ClockLock and ClockBoost PLL Features in APEX Devices*.

Figure 29. Specifications for the Incoming & Generated Clocks

The t_I parameter refers to the nominal input clock period; the t_O parameter refers to the nominal output clock period.



Note:

(1) Rise and fall times are measured from 10% to 90%.

Figure 30. APEX 20KC JTAG Waveforms

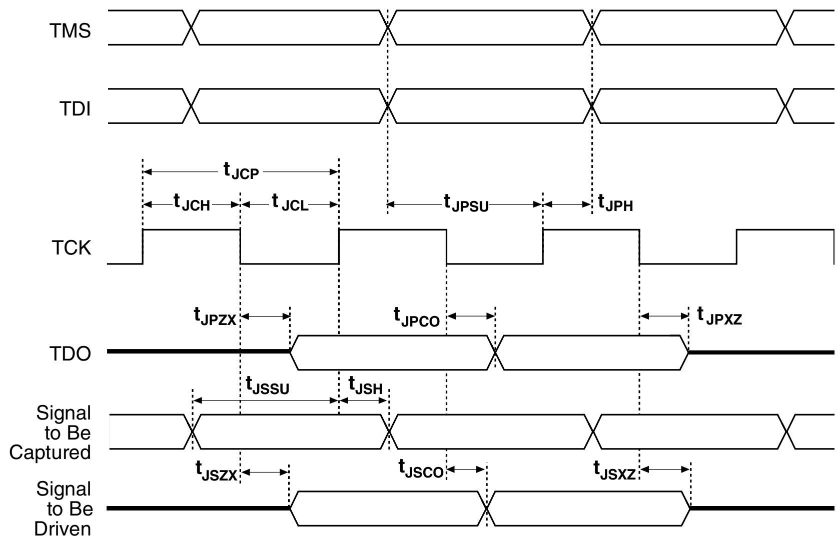


Table 16 shows the JTAG timing parameters and values for APEX 20KC devices.

Table 16. APEX 20KC JTAG Timing Parameters & Values

Symbol	Parameter	Min	Max	Unit
t_{JCP}	TCK clock period	100		ns
t_{JCH}	TCK clock high time	50		ns
t_{JCL}	TCK clock low time	50		ns
t_{JPSU}	JTAG port setup time	20		ns
t_{JPH}	JTAG port hold time	45		ns
t_{JPCO}	JTAG port clock to output		25	ns
t_{JPZX}	JTAG port high impedance to valid output		25	ns
t_{JPXZ}	JTAG port valid output to high impedance		25	ns
t_{JSSU}	Capture register setup time	20		ns
t_{JSH}	Capture register hold time	45		ns
t_{JSCO}	Update register clock to output		35	ns
t_{JSZX}	Update register high impedance to valid output		35	ns
t_{JSXZ}	Update register valid output to high impedance		35	ns

For more information, see the following documents:

- *Application Note 39 (IEEE Std. 1149.1 (JTAG) Boundary-Scan Testing in Altera Devices)*
- *Jam Programming & Test Language Specification*

Table 28. GTL+ I/O Specifications

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
V_{TT}	Termination voltage		1.35	1.5	1.65	V
V_{REF}	Reference voltage		0.88	1.0	1.12	V
V_{IH}	High-level input voltage		V_{REF} + 0.1			V
V_{IL}	Low-level input voltage				V_{REF} – 0.1	V
V_{OL}	Low-level output voltage	I_{OL} = 36 mA *(2)*			0.65	V

Table 29. SSTL-2 Class I Specifications

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
V_{CCIO}	I/O supply voltage		2.375	2.5	2.625	V
V_{TT}	Termination voltage		V_{REF} – 0.04	V_{REF}	V_{REF} + 0.04	V
V_{REF}	Reference voltage		1.15	1.25	1.35	V
V_{IH}	High-level input voltage		V_{REF} + 0.18		V_{CCIO} + 0.3	V
V_{IL}	Low-level input voltage		–0.3		V_{REF} – 0.18	V
V_{OH}	High-level output voltage	I_{OH} = –7.6 mA *(1)*	V_{TT} + 0.57			V
V_{OL}	Low-level output voltage	I_{OL} = 7.6 mA *(2)*			V_{TT} – 0.57	V

Table 34. LVPECL Specifications

Symbol	Parameter	Minimum	Typical	Maximum	Units
V_{CCIO}	Output Supply Voltage	3.135	3.3	3.465	V
V_{IH}	Low-level input voltage	1300		1700	mV
V_{IL}	High-level input voltage	2100		2600	mV
V_{OH}	Low-level output voltage	1450		1650	mV
V_{OL}	High-level output voltage	2275		2420	mV
V_{ID}	Input voltage differential	400	600	950	mV
V_{OD}	Output voltage differential	625	800	950	mV
t_r, t_f	Rise/fall time (20 to 80%)	85		325	ps
t_{DSKEW}	Differential skew			25	ps
t_O	Output load		150		Ω
R_L	Receiver differential input resistor		100		Ω

Table 35. 3.3-V AGP I/O Specifications

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
V_{CCIO}	I/O supply voltage		3.15	3.3	3.45	V
V_{REF}	Reference voltage		$0.39 \times V_{CCIO}$		$0.41 \times V_{CCIO}$	V
V_{IH}	High-level input voltage		$0.5 \times V_{CCIO}$		$V_{CCIO} + 0.5$	V
V_{IL}	Low-level input voltage				$0.3 \times V_{CCIO}$	V
V_{OH}	High-level output voltage	$I_{OUT} = -500\ \mu A$	$0.9 \times V_{CCIO}$		3.6	V
V_{OL}	Low-level output voltage	$I_{OUT} = 1500\ \mu A$			$0.1 \times V_{CCIO}$	V
I_I	Input pin leakage current	$0 < V_{IN} < V_{CCIO}$	–10		10	μA

Table 36. CTT I/O Specifications

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
V_{CCIO}	I/O supply voltage		3.0	3.3	3.6	V
V_{TT}/V_{REF} *(3)*	Termination and reference voltage		1.35	1.5	1.65	V
V_{IH}	High-level input voltage		V_{REF} + 0.2			V
V_{IL}	Low-level input voltage				V_{REF} – 0.2	V
I_I	Input pin leakage current	$0 < V_{IN} < V_{CCIO}$	–10		10	μA
V_{OH}	High-level output voltage	I_{OH} = –8 mA *(1)*	V_{REF} + 0.4			V
V_{OL}	Low-level output voltage	I_{OL} = 8 mA *(2)*			V_{REF} – 0.4	V
I_O	Output leakage current (when output is high Z)	$GND \leq V_{OUT} \leq V_{CCIO}$	–10		10	μA

Notes to tables:

(1) The I_{OH} parameter refers to high-level output current.
(2) The I_{OL} parameter refers to low-level output current. This parameter applies to open-drain pins as well as output pins.
(3) V_{REF} specifies center point of switching range.

Figure 32 shows the output drive characteristics of APEX 20KC devices.

Figure 33 shows the f_{MAX} timing model for APEX 20KC devices.

Figure 33. f_{MAX} Timing Model

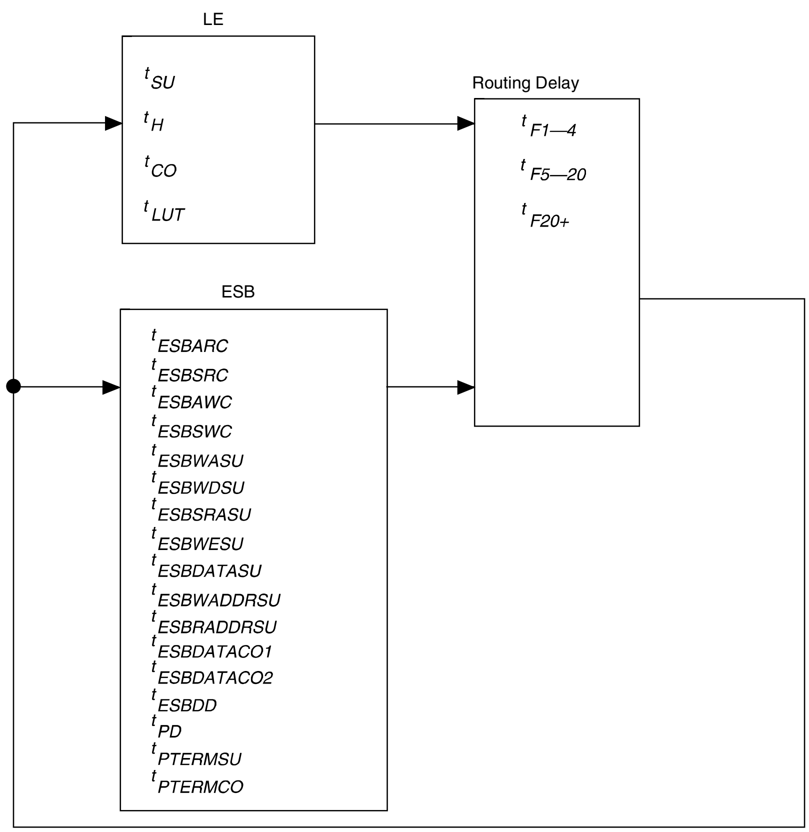


Figure 34 shows the timing model for bidirectional I/O pin timing.

Table 50. EP20K200C f_{MAX} ESB Timing Parameters Note (1)							
Symbol	-7 Speed Grade		-8 Speed Grade (2)		-9 Speed Grade (2)		Unit
	Min	Max	Min	Max	Min	Max	
t_{ESBARC}		1.4					ns
t_{ESBSRC}		2.5					ns
t_{ESBAWC}		3.1					ns
t_{ESBSWC}		3.0					ns
$t_{ESBWASU}$	0.5						ns
t_{ESBWAH}	0.5						ns
$t_{ESBWDSU}$	0.6						ns
t_{ESBWDH}	0.5						ns
$t_{ESBRASU}$	1.4						ns
t_{ESBRAH}	0.0						ns
$t_{ESBWESU}$	2.3						ns
$t_{ESBDATASU}$	0.0						ns
$t_{ESBWADDRSU}$	0.2						ns
$t_{ESBRADDRSU}$	0.2						ns
$t_{ESBDATACO1}$		1.0					ns
$t_{ESBDATACO2}$		2.3					ns
t_{ESBDD}		2.7					ns
t_{PD}		1.6					ns
$t_{PTERMSU}$	1.0						ns
$t_{PTERMCO}$		1.0					ns

Table 51. EP20K200C f_{MAX} Routing Delays Note (1)							
Symbol	-7 Speed Grade		-8 Speed Grade (2)		-9 Speed Grade (2)		Unit
	Min	Max	Min	Max	Min	Max	
t_{F1-4}	0.2						ns
t_{F5-20}	0.9						ns
t_{F20+}	1.0						ns

Table 56. EP20K400C f_{MAX} ESB Timing Parameters *Note (1)*							
Symbol	-7 Speed Grade		-8 Speed Grade *(2)*		-9 Speed Grade *(2)*		Unit
	Min	Max	Min	Max	Min	Max	
t_{ESBARC}		1.3					ns
t_{ESBSRC}		2.3					ns
t_{ESBAWC}		2.9					ns
t_{ESBSWC}		2.7					ns
$t_{ESBWASU}$	0.4						ns
t_{ESBWAH}	0.4						ns
$t_{ESBWDSU}$	0.6						ns
t_{ESBWDH}	0.4						ns
$t_{ESBRASU}$	1.3						ns
t_{ESBRAH}	0.0						ns
$t_{ESBWESU}$	2.0						ns
$t_{ESBDATASU}$	0.0						ns
$t_{ESBWADDRSU}$	0.1						ns
$t_{ESBRADDRSU}$	0.1						ns
$t_{ESBDATACO1}$		1.0					ns
$t_{ESBDATACO2}$		2.0					ns
t_{ESBDD}		2.4					ns
t_{PD}		1.4					ns
$t_{PTERMSU}$	0.9						ns
$t_{PTERMCO}$		1.0					ns

Table 57. EP20K400C f_{MAX} Routing Delays *Note (1)*							
Symbol	-7 Speed Grade		-8 Speed Grade *(2)*		-9 Speed Grade *(2)*		Unit
	Min	Max	Min	Max	Min	Max	
t_{F1-4}	0.2						ns
t_{F5-20}	0.9						ns
t_{F20+}	2.2						ns

Table 64. EP20K600C Minimum Pulse Width Timing Parameters *Note (1)*							
Symbol	**-7 Speed Grade**		**-8 Speed Grade** *(2)*		**-9 Speed Grade** *(2)*		**Unit**
	Min	**Max**	**Min**	**Max**	**Min**	**Max**	
t_{CH}	2.3						ns
t_{CL}	2.3						ns
t_{CLRP}	0.2						ns
t_{PREP}	0.2						ns
t_{ESBCH}	2.3						ns
t_{ESBCL}	2.3						ns
t_{ESBWP}	1.1						ns
t_{ESBRP}	0.9						ns

Table 65. EP20K600C External Timing Parameters							
Symbol	**-7 Speed Grade**		**-8 Speed Grade** *(2)*		**-9 Speed Grade** *(2)*		**Unit**
	Min	**Max**	**Min**	**Max**	**Min**	**Max**	
t_{INSU}	2.2						ns
t_{INH}	0.0						ns
t_{OUTCO}	2.0	5.0					ns
$t_{INSUPLL}$	3.3						ns
t_{INHPLL}	0.0						ns
$t_{OUTCOPLL}$	0.5	2.1					ns

Table 74. EP20K1500C f_{MAX} ESB Timing Parameters *Note (1)*							
Symbol	-7 Speed Grade		-8 Speed Grade *(2)*		-9 Speed Grade *(2)*		Unit
	Min	Max	Min	Max	Min	Max	
t_{ESBARC}		1.3					ns
t_{ESBSRC}		2.3					ns
t_{ESBAWC}		2.9					ns
t_{ESBSWC}		2.7					ns
$t_{ESBWASU}$	0.4						ns
t_{ESBWAH}	0.4						ns
$t_{ESBWDSU}$	0.6						ns
t_{ESBWDH}	0.4						ns
$t_{ESBRASU}$	1.3						ns
t_{ESBRAH}	0.0						ns
$t_{ESBWESU}$	2.0						ns
$t_{ESBDATASU}$	0.0						ns
$t_{ESBWADDRSU}$	0.1						ns
$t_{ESBRADDRSU}$	0.1						ns
$t_{ESBDATACO1}$		1.0					ns
$t_{ESBDATACO2}$		2.0					ns
t_{ESBDD}		2.4					ns
t_{PD}		1.4					ns
$t_{PTERMSU}$	0.9						ns
$t_{PTERMCO}$		1.0					ns

Table 75. EP20K1500C f_{MAX} Routing Delays *Note (1)*							
Symbol	-7 Speed Grade		-8 Speed Grade *(2)*		-9 Speed Grade *(2)*		Unit
	Min	Max	Min	Max	Min	Max	
t_{F1-4}	0.2						ns
t_{F5-20}	1.4						ns
t_{F20+}	2.8						ns

Table 76. EP20K1500C Minimum Pulse Width Timing Parameters Note (1)

Symbol	-7 Speed Grade		-8 Speed Grade (2)		-9 Speed Grade (2)		Unit
	Min	Max	Min	Max	Min	Max	
t_{CH}	2.0						ns
t_{CL}	2.0						ns
t_{CLRP}	0.2						ns
t_{PREP}	0.2						ns
t_{ESBCH}	2.0						ns
t_{ESBCL}	2.0						ns
t_{ESBWP}	1.0						ns
t_{ESBRP}	0.8						ns

Table 77. EP20K1500C External Timing Parameters

Symbol	-7 Speed Grade		-8 Speed Grade (2)		-9 Speed Grade (2)		Unit
	Min	Max	Min	Max	Min	Max	
t_{INSU}	2.1						ns
t_{INH}	0.0						ns
t_{OUTCO}	2.0	5.0					ns
$t_{INSUPLL}$	3.2						ns
t_{INHPLL}	0.0						ns
$t_{OUTCOPLL}$	0.5	2.1					ns

Table 78. EP20K1500C External Bidirectional Timing Parameters

Symbol	-7 Speed Grade		-8 Speed Grade (2)		-9 Speed Grade (2)		Unit
	Min	Max	Min	Max	Min	Max	
$t_{INSUBIDIR}$	2.6						ns
$t_{INHBIDIR}$	0.0						ns
$t_{OUTCOBIDIR}$	2.0	5.0					ns
$t_{XZBIDIR}$		7.1					ns
$t_{ZXBIDIR}$		7.1					ns
$t_{INSUBIDIRPLL}$	3.9						ns
$t_{INHBIDIRPLL}$	0.0						ns
$t_{OUTCOBIDIRPLL}$	0.5	2.1					ns
$t_{XZBIDIRPLL}$		4.2					ns
$t_{ZXBIDIRPLL}$		4.2					ns

Notes to tables:

(1) Timing information is preliminary. Final timing information will be released in a future version of this data sheet.

(2) Timing information for these devices will be released in a future version of this data sheet.

Tables 79 and 80 show selectable I/O standard input and output delays for APEX 20KC devices. If you select an I/O standard input or output delay other than LVCMOS, add the delay for the selected speed grade to the LVCMOS value.

Power Consumption

To estimate device power consumption, use the interactive power estimator on the Altera web site at **http://www.altera.com**.

Configuration & Operation

The APEX 20KC architecture supports several configuration schemes. This section summarizes the device operating modes and available device configuration schemes.

Operating Modes

The APEX architecture uses SRAM configuration elements that require configuration data to be loaded each time the circuit powers up. The process of physically loading the SRAM data into the device is called configuration. During initialization, which occurs immediately after configuration, the device resets registers, enables I/O pins, and begins to operate as a logic device. The I/O pins are tri-stated during power-up, and before and during configuration. Together, the configuration and initialization processes are called *command mode*; normal device operation is called *user mode*.

Before and during device configuration, all I/O pins are pulled to V_{CCIO} by a built-in weak pull-up resistor.

SRAM configuration elements allow APEX 20KC 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. In-field upgrades can be performed by distributing new configuration files.

Configuration Schemes

The configuration data for an APEX 20KC device can be loaded with one of five configuration schemes (see Table 81), chosen on the basis of the target application. An EPC16, EPC2, or EPC1 configuration device, intelligent controller, or the JTAG port can be used to control the configuration of an APEX 20KC device. When a configuration device is used, the system can configure automatically at system power-up.

ALTERA

101 Innovation Drive
San Jose, CA 95134
(408) 544-7000
http://www.altera.com
Applications Hotline:
(800) 800-EPLD
Customer Marketing:
(408) 544-7104
Literature Services:
lit_req@altera.com

Copyright © 2001 Altera Corporation. All rights reserved. AMPP, Altera, APEX, APEX 20K, APEX 20KC, APEX 20KE, ByteBlasterMV, ClockBoost, ClockLock, ClockShift, FastRow, FastTrack, FineLine BGA, MasterBlaster, MegaCore, MegaLAB, MultiCore, MultiVolt, NativeLink, Quartus, Quartus II, SignalTap, True-LVDS, Turbo Bit, and specific device designations are trademarks and/or service marks of Altera Corporation in the United States and other countries. Altera acknowledges the trademarks of other organizations for their respective products or services mentioned in this document. Altera products are protected under numerous U.S. and foreign patents and pending applications, maskwork rights, and copyrights. Altera warrants performance of its semiconductor products to current specifications in accordance with Altera's standard warranty, but reserves the right to make changes to any products and services at any time without notice. Altera assumes no responsibility or liability arising out of the application or use of any information, product, or service described herein except as expressly agreed to in writing by Altera Corporation. Altera customers are advised to obtain the latest version of device specifications before relying on any published information and before placing orders for products or services.

nsai
I.S. EN ISO 9001

Printed on Recycled Paper.