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Details	
Product Status	Obsolete
Number of LABs/CLBs	10377
Number of Logic Elements/Cells	220000
Total RAM Bits	15282176
Number of I/O	342
Number of Gates	-
Voltage - Supply	0.82V ~ 0.88V
Mounting Type	Surface Mount
Operating Temperature	-40°C ~ 100°C (TJ)
Package / Case	780-BBGA, FCBGA
Supplier Device Package	780-HBGA (33x33)
Purchase URL	https://www.e-xfl.com/product-detail/intel/5agzme1e3h29i4n

Arria V GX, GT, SX, and ST Device Datasheet

1

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This datasheet describes the electrical characteristics, switching characteristics, configuration specifications, and I/O timing for Arria® V devices.

Arria V devices are offered in commercial and industrial grades. Commercial devices are offered in –C4 (fastest), –C5, and –C6 speed grades. Industrial grade devices are offered in the –I3 and –I5 speed grades.

Related Information

Arria V Device Overview
Provides more information about the densities and packages of devices in the Arria V family.

Electrical Characteristics

The following sections describe the operating conditions and power consumption of Arria V devices.

Operating Conditions

Arria V devices are rated according to a set of defined parameters. To maintain the highest possible performance and reliability of the Arria V devices, you must consider the operating requirements described in this section.

Absolute Maximum Ratings

This section defines the maximum operating conditions for Arria V devices. The values are based on experiments conducted with the devices and theoretical modeling of breakdown and damage mechanisms.

The functional operation of the device is not implied for these conditions.

Symbol	Description	Condition (V)	Overshoot Duration as % of High Time	Unit
Vi (AC)	AC input voltage	3.8	100	%
		3.85	68	%
		3.9	45	%
		3.95	28	%
		4	15	%
		4.05	13	%
		4.1	11	%
		4.15	9	%
		4.2	8	%
		4.25	7	%
		4.3	5.4	%
		4.35	3.2	%
		4.4	1.9	%
		4.45	1.1	%
		4.5	0.6	%
		4.55	0.4	%
		4.6	0.2	%

Recommended Operating Conditions

This section lists the functional operation limits for the AC and DC parameters for Arria V devices.

Recommended Operating Conditions

Table 1-3: Recommended Operating Conditions for Arria V Devices

This table lists the steady-state voltage values expected from Arria V devices. Power supply ramps must all be strictly monotonic, without plateaus.

Symbol	Description	Maximum	Unit
$I_{XCVR\text{-}RX\ (DC)}$	DC current per transceiver receiver (RX) pin	50	mA

Internal Weak Pull-Up Resistor

All I/O pins, except configuration, test, and JTAG pins, have an option to enable weak pull-up.

Table 1-13: Internal Weak Pull-Up Resistor Values for Arria V Devices

Symbol	Description	Condition (V)[11]	Value[12]	Unit
R_{PU}	Value of the I/O pin pull-up resistor before and during configuration, as well as user mode if you have enabled the programmable pull-up resistor option.	V_{CCIO} = 3.3 ±5%	25	kΩ
		V_{CCIO} = 3.0 ±5%	25	kΩ
		V_{CCIO} = 2.5 ±5%	25	kΩ
		V_{CCIO} = 1.8 ±5%	25	kΩ
		V_{CCIO} = 1.5 ±5%	25	kΩ
		V_{CCIO} = 1.35 ±5%	25	kΩ
		V_{CCIO} = 1.25 ±5%	25	kΩ
		V_{CCIO} = 1.2 ±5%	25	kΩ

Related Information

Arria V GT, GX, ST, and SX Device Family Pin Connection Guidelines

Provides more information about the pins that support internal weak pull-up and internal weak pull-down features.

(10) The I/O ramp rate is 10 ns or more. For ramp rates faster than 10 ns, $|I_{IOPIN}| = C\ dv/dt$, in which C is the I/O pin capacitance and dv/dt is the slew rate.

(11) Pin pull-up resistance values may be lower if an external source drives the pin higher than V_{CCIO}.

(12) Valid with ±10% tolerances to cover changes over PVT.

I/O Standard	$V_{IL(DC)}$ (V)		$V_{IH(DC)}$ (V)		$V_{IL(AC)}$ (V)	$V_{IH(AC)}$ (V)	V_{OL} (V)	V_{OH} (V)	I_{OL}[14] (mA)	I_{OH}[14] (mA)
	Min	Max	Min	Max	Max	Min	Max	Min		
HSTL-15 Class II	—	V_{REF} – 0.1	V_{REF} + 0.1	—	V_{REF} – 0.2	V_{REF} + 0.2	0.4	V_{CCIO} – 0.4	16	–16
HSTL-12 Class I	–0.15	V_{REF} – 0.08	V_{REF} + 0.08	V_{CCIO} + 0.15	V_{REF} – 0.15	V_{REF} + 0.15	0.25 × V_{CCIO}	0.75 × V_{CCIO}	8	–8
HSTL-12 Class II	–0.15	V_{REF} – 0.08	V_{REF} + 0.08	V_{CCIO}+ 0.15	V_{REF} – 0.15	V_{REF} + 0.15	0.25 × V_{CCIO}	0.75 × V_{CCIO}	16	–16
HSUL-12	—	V_{REF} – 0.13	V_{REF} + 0.13	—	V_{REF} – 0.22	V_{REF} + 0.22	0.1 × V_{CCIO}	0.9 × V_{CCIO}	—	—

Differential SSTL I/O Standards

Table 1-17: Differential SSTL I/O Standards for Arria V Devices

I/O Standard	V_{CCIO} (V)			$V_{SWING(DC)}$ (V)		$V_{X(AC)}$ (V)			$V_{SWING(AC)}$ (V)	
	Min	Typ	Max	Min	Max	Min	Typ	Max	Min	Max
SSTL-2 Class I, II	2.375	2.5	2.625	0.3	V_{CCIO} + 0.6	$V_{CCIO}/2$ – 0.2	—	$V_{CCIO}/2$ + 0.2	0.62	V_{CCIO} + 0.6
SSTL-18 Class I, II	1.71	1.8	1.89	0.25	V_{CCIO} + 0.6	$V_{CCIO}/2$ – 0.175	—	$V_{CCIO}/2$ + 0.175	0.5	V_{CCIO} + 0.6
SSTL-15 Class I, II	1.425	1.5	1.575	0.2	[15]	$V_{CCIO}/2$ – 0.15	—	$V_{CCIO}/2$ + 0.15	$2(V_{IH(AC)} - V_{REF})$	$2(V_{IL(AC)} - V_{REF})$
SSTL-135	1.283	1.35	1.45	0.18	[15]	$V_{CCIO}/2$ – 0.15	$V_{CCIO}/2$	$V_{CCIO}/2$ + 0.15	$2(V_{IH(AC)} - V_{REF})$	$2(V_{IL(AC)} - V_{REF})$

(14) To meet the I_{OL} and I_{OH} specifications, you must set the current strength settings accordingly. For example, to meet the SSTL15CI specification (8 mA), you should set the current strength settings to 8 mA. Setting at lower current strength may not meet the I_{OL} and I_{OH} specifications in the datasheet.

(15) The maximum value for $V_{SWING(DC)}$ is not defined. However, each single-ended signal needs to be within the respective single-ended limits ($V_{IH(DC)}$ and $V_{IL(DC)}$).

- **Transceiver Specifications for Arria V GT and ST Devices** on page 1-29
  Provides the specifications for transmitter, receiver, and reference clock I/O pin.

Switching Characteristics

This section provides performance characteristics of Arria V core and periphery blocks.

Transceiver Performance Specifications

Transceiver Specifications for Arria V GX and SX Devices

Table 1-20: Reference Clock Specifications for Arria V GX and SX Devices

Symbol/Description	Condition	Transceiver Speed Grade 4			Transceiver Speed Grade 6			Unit
		Min	Typ	Max	Min	Typ	Max	
Supported I/O standards	1.2 V PCML, 1.4 V PCML,1.5 V PCML, 2.5 V PCML, Differential LVPECL[23], HCSL, and LVDS							
Input frequency from REFCLK input pins	—	27	—	710	27	—	710	MHz
Rise time	Measure at ±60 mV of differential signal[24]	—	—	400	—	—	400	ps
Fall time	Measure at ±60 mV of differential signal[24]	—	—	400	—	—	400	ps
Duty cycle	—	45	—	55	45	—	55	%
Peak-to-peak differential input voltage	—	200	—	300[25]/ 2000	200	—	300[25]/ 2000	mV

(23) Differential LVPECL signal levels must comply to the minimum and maximum peak-to-peak differential input voltage specified in this table.
(24) REFCLK performance requires to meet transmitter REFCLK phase noise specification.
(25) The maximum peak-to peak differential input voltage of 300 mV is allowed for DC coupled link.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$t_{CASC\_OUTPJ\_DC}$ (67)(71)	Period jitter for dedicated clock output in cascaded PLLs	$F_{OUT} \geq 100$ MHz	—	—	175	ps (p-p)
		$F_{OUT} < 100$ MHz	—	—	17.5	mUI (p-p)
t_{DRIFT}	Frequency drift after PFDENA is disabled for a duration of 100 µs	—	—	—	±10	%
dK_{BIT}	Bit number of Delta Sigma Modulator (DSM)	—	8	24	32	bits
k_{VALUE}	Numerator of fraction	—	128	8388608	2147483648	—
f_{RES}	Resolution of VCO frequency	f_{INPFD} = 100 MHz	390625	5.96	0.023	Hz

Related Information

Memory Output Clock Jitter Specifications on page 1-57
Provides more information about the external memory interface clock output jitter specifications.

(71) The cascaded PLL specification is only applicable with the following conditions:
- Upstream PLL: 0.59 MHz ≤ Upstream PLL BW < 1 MHz
- Downstream PLL: Downstream PLL BW > 2 MHz

Table 1-38: Memory Block Performance Specifications for Arria V Devices

Memory	Mode	Resources Used		Performance			Unit
		ALUTs	Memory	–I3, –C4	–I5, –C5	–C6	
MLAB	Single port, all supported widths	0	1	500	450	400	MHz
	Simple dual-port, all supported widths	0	1	500	450	400	MHz
	Simple dual-port with read and write at the same address	0	1	400	350	300	MHz
	ROM, all supported width	—	—	500	450	400	MHz
M10K Block	Single-port, all supported widths	0	1	400	350	285	MHz
	Simple dual-port, all supported widths	0	1	400	350	285	MHz
	Simple dual-port with the read-during-write option set to **Old Data**, all supported widths	0	1	315	275	240	MHz
	True dual port, all supported widths	0	1	400	350	285	MHz
	ROM, all supported widths	0	1	400	350	285	MHz

Internal Temperature Sensing Diode Specifications

Table 1-39: Internal Temperature Sensing Diode Specifications for Arria V Devices

Temperature Range	Accuracy	Offset Calibrated Option	Sampling Rate	Conversion Time	Resolution	Minimum Resolution with no Missing Codes
–40 to 100°C	±8°C	No	1 MHz	< 100 ms	8 bits	8 bits

Periphery Performance

This section describes the periphery performance, high-speed I/O, and external memory interface.

Actual achievable frequency depends on design and system specific factors. Ensure proper timing closure in your design and perform HSPICE/IBIS simulations based on your specific design and system setup to determine the maximum achievable frequency in your system.

Memory Output Clock Jitter Specifications

Table 1-45: Memory Output Clock Jitter Specifications for Arria V Devices

The memory output clock jitter measurements are for 200 consecutive clock cycles, as specified in the JEDEC DDR2/DDR3 SDRAM standard.

The memory output clock jitter is applicable when an input jitter of 30 ps (p-p) is applied with bit error rate (BER) 10^{-12}, equivalent to 14 sigma.

Altera recommends using the UniPHY intellectual property (IP) with PHYCLK connections for better jitter performance.

Parameter	Clock Network	Symbol	–I3, –C4		–I5, –C5		–C6		Unit
			Min	Max	Min	Max	Min	Max	
Clock period jitter	PHYCLK	$t_{JIT(per)}$	–41	41	–50	50	–55	55	ps
Cycle-to-cycle period jitter	PHYCLK	$t_{JIT(cc)}$	63		90		94		ps

OCT Calibration Block Specifications

Table 1-46: OCT Calibration Block Specifications for Arria V Devices

Symbol	Description	Min	Typ	Max	Unit
OCTUSRCLK	Clock required by OCT calibration blocks	—	—	20	MHz
T_{OCTCAL}	Number of OCTUSRCLK clock cycles required for R_S OCT/R_T OCT calibration	—	1000	—	Cycles
$T_{OCTSHIFT}$	Number of OCTUSRCLK clock cycles required for OCT code to shift out	—	32	—	Cycles
T_{RS_RT}	Time required between the dyn_term_ctrl and oe signal transitions in a bidirectional I/O buffer to dynamically switch between R_S OCT and R_T OCT	—	2.5	—	ns

HPS PLL Input Jitter

Use the following equation to determine the maximum input jitter (peak-to-peak) the HPS PLLs can tolerate. The divide value (N) is the value programmed into the denominator field of the VCO register for each PLL. The PLL input reference clock is divided by this value. The range of the denominator is 1 to 64.

Maximum input jitter = Input clock period × Divide value (N) × 0.02

Table 1-50: Examples of Maximum Input Jitter

Input Reference Clock Period	Divide Value (N)	Maximum Jitter	Unit
40 ns	1	0.8	ns
40 ns	2	1.6	ns
40 ns	4	3.2	ns

Quad SPI Flash Timing Characteristics

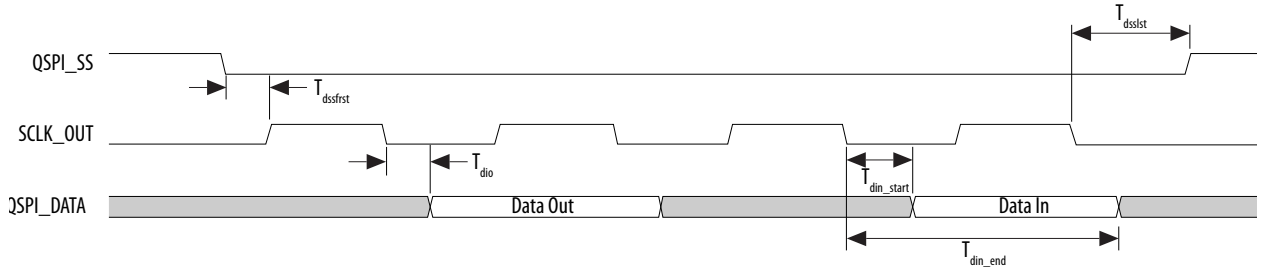
Table 1-51: Quad Serial Peripheral Interface (SPI) Flash Timing Requirements for Arria V Devices

Symbol	Description	Min	Typ	Max	Unit
F_{clk}	SCLK_OUT clock frequency (External clock)	—	—	108	MHz
T_{qspi_clk}	QSPI_CLK clock period (Internal reference clock)	2.32	—	—	ns
$T_{dutycycle}$	SCLK_OUT duty cycle	45	—	55	%
$T_{dssfrst}$	Output delay QSPI_SS valid before first clock edge	—	1/2 cycle of SCLK_OUT	—	ns
T_{dsslst}	Output delay QSPI_SS valid after last clock edge	–1	—	1	ns
T_{dio}	I/O data output delay	–1	—	1	ns
T_{din_start}	Input data valid start	—	—	$(2 + R_{delay}) \times T_{qspi\_clk} - 7.52$ (85)	ns

Symbol	Description	Min	Typ	Max	Unit
T_{din_end}	Input data valid end	$(2 + R_{delay}) \times T_{qspi\_clk} - 1.21$ (85)	—	—	ns

Figure 1-8: Quad SPI Flash Timing Diagram

This timing diagram illustrates clock polarity mode 0 and clock phase mode 0.



Related Information

Quad SPI Flash Controller Chapter, Arria V Hard Processor System Technical Reference Manual
Provides more information about Rdelay.

SPI Timing Characteristics

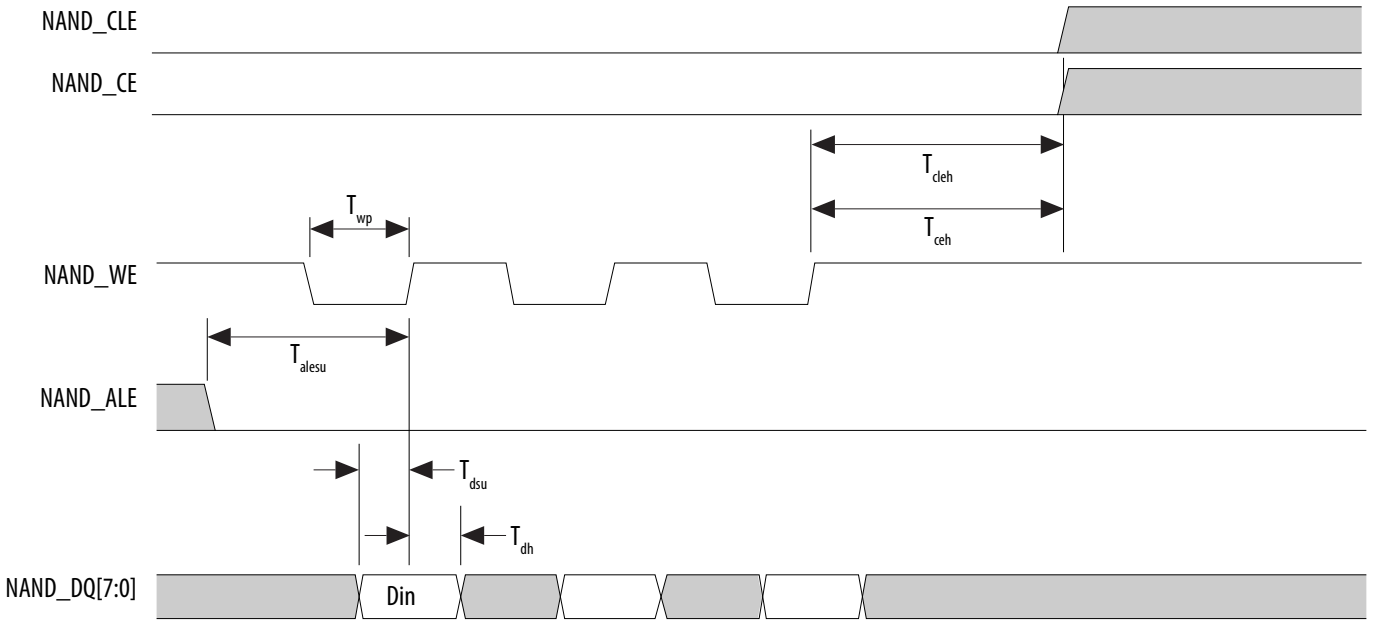
Table 1-52: SPI Master Timing Requirements for Arria V Devices

The setup and hold times can be used for Texas Instruments SSP mode and National Semiconductor Microwire mode.

Symbol	Description	Min	Max	Unit
T_{clk}	CLK clock period	16.67	—	ns
T_{su}	SPI Master-in slave-out (MISO) setup time	8.35 (86)	—	ns

(85) R_{delay} is set by programming the register `qspiregs.rddatacap`. For the SoC EDS software version 13.1 and later, Altera provides automatic Quad SPI calibration in the preloader. For more information about R_{delay}, refer to the Quad SPI Flash Controller chapter in the Arria V Hard Processor System Technical Reference Manual.

Figure 1-19: NAND Data Write Timing Diagram



Date	Version	Changes

June 2015	2015.06.16	• Added the supported data rates for the following output standards using true LVDS output buffer types in the High-Speed I/O Specifications for Arria V Devices table:
		  • True RSDS output standard: data rates of up to 360 Mbps
		  • True mini-LVDS output standard: data rates of up to 400 Mbps
		• Added note in the condition for Transmitter—Emulated Differential I/O Standards f_{HSDR} data rate parameter in the High-Speed I/O Specifications for Arria V Devices table. Note: When using True LVDS RX channels for emulated LVDS TX channel, only serialization factors 1 and 2 are supported.
		• Changed Queued Serial Peripheral Interface (QSPI) to Quad Serial Peripheral Interface (SPI) Flash.
		• Updated T_h location in I^2C Timing Diagram.
		• Updared T_{wp} location in NAND Address Latch Timing Diagram.
		• Corrected the unit for t_{DH} from ns to s in FPP Timing Parameters When DCLK-to-DATA[] Ratio is >1 for Arria V Devices table.
		• Updated the maximum value for t_{CO} from 4 ns to 2 ns in AS Timing Parameters for AS ×1 and ×4 Configurations in Arria V Devices table.
		• Moved the following timing diagrams to the Configuration, Design Security, and Remote System Upgrades in Arria V Devices chapter.
		  • FPP Configuration Timing Waveform When DCLK-to-DATA[] Ratio is 1
		  • FPP Configuration Timing Waveform When DCLK-to-DATA[] Ratio is >1
		  • AS Configuration Timing Waveform
		  • PS Configuration Timing Waveform

Date	Version	Changes
July 2014	3.8	• Added a note in Table 3, Table 4, and Table 5: The power supply value describes the budget for the DC (static) power supply tolerance and does not include the dynamic tolerance requirements. Refer to the PDN tool for the additional budget for the dynamic tolerance requirements. • Updated V_{CC_HPS} specification in Table 5. • Added a note in Table 19: Differential inputs are powered by V_{CCPD} which requires 2.5 V. • Updated "Minimum differential eye opening at the receiver serial input pins" specification in Table 20 and Table 21. • Updated description in "HPS PLL Specifications" section. • Updated VCO range maximum specification in Table 39. • Updated T_d and T_h specifications in Table 45. • Added T_h specification in Table 47 and Figure 13. • Updated a note in Figure 20, Figure 21, and Figure 23 as follows: Do not leave DCLK floating after configuration. DCLK is ignored after configuration is complete. It can toggle high or low if required. • Removed "Remote update only in AS mode" specification in Table 58. • Added DCLK device initialization clock source specification in Table 60. • Added description in "Configuration Files" section: The IOCSR `.rbf` size is specifically for the Configuration via Protocol (CvP) feature. • Removed $f_{MAX\_RU\_CLK}$ specification in Table 63.
February 2014	3.7	• Updated $V_{CCRSTCLK\_HPS}$ maximum specification in Table 1. • Added $V_{CC\_AUX\_SHARED}$ specification in Table 1.
December 2013	3.6	• Added "HPS PLL Specifications". • Added Table 24, Table 39, and Table 40. • Updated Table 1, Table 3, Table 5, Table 19, Table 20, Table 21, Table 38, Table 41, Table 42, Table 43, Table 44, Table 45, Table 46, Table 47, Table 48, Table 49, Table 50, Table 51, Table 55, Table 56, and Table 59. • Updated Figure 7, Figure 13, Figure 15, Figure 16, and Figure 19. • Removed table: GPIO Pulse Width for Arria V Devices.

Date	Version	Changes
June 2012	2.0	• Updated for the Quartus II software v12.0 release: • Restructured document. • Updated "Supply Current and Power Consumption" section. • Updated Table 20, Table 21, Table 24, Table 25, Table 26, Table 35, Table 39, Table 43, and Table 52. • Added Table 22, Table 23, and Table 33. • Added Figure 1–1 and Figure 1–2. • Added "Initialization" and "Configuration Files" sections.
February 2012	1.3	• Updated Table 2–1. • Updated Transceiver-FPGA Fabric Interface rows in Table 2–20. • Updated V_{CCP} description.
December 2011	1.2	Updated Table 2–1 and Table 2–3.
November 2011	1.1	• Updated Table 2–1, Table 2–19, Table 2–26, and Table 2–36. • Added Table 2–5. • Added Figure 2–4.
August 2011	1.0	Initial release.

Symbol/Description	Conditions	Transceiver Speed Grade 2			Transceiver Speed Grade 3			Unit
		Min	Typ	Max	Min	Typ	Max	
`fixedclk` clock frequency	PCIe Receiver Detect	—	100 or 125	—	—	100 or 125	—	MHz
Reconfiguration clock (`mgmt_clk_clk`) frequency	—	100	—	125	100	—	125	MHz

Related Information

Arria V Device Overview

For more information about device ordering codes.

Receiver

Table 2-24: Receiver Specifications for Arria V GZ Devices

Speed grades shown refer to the PMA Speed Grade in the device ordering code. The maximum data rate could be restricted by the Core/PCS speed grade. Contact your Altera Sales Representative for the maximum data rate specifications in each speed grade combination offered. For more information about device ordering codes, refer to the *Arria V Device Overview*.

Symbol/Description	Conditions	Transceiver Speed Grade 2			Transceiver Speed Grade 3			Unit
		Min	Typ	Max	Min	Typ	Max	
Supported I/O Standards	1.4-V PCML, 1.5-V PCML, 2.5-V PCML, LVPECL, and LVDS							
Data rate (Standard PCS) (143), (144)	—	600	—	9900	600	—	8800	Mbps
Data rate (10G PCS) (143), (144)	—	600	—	12500	600	—	10312.5	Mbps
Absolute V_{MAX} for a receiver pin (145)	—	—	—	1.2	—	—	1.2	V
Absolute V_{MIN} for a receiver pin	—	–0.4	—	—	–0.4	—	—	V

(143) The line data rate may be limited by PCS-FPGA interface speed grade.
(144) To support data rates lower than the minimum specification through oversampling, use the CDR in LTR mode only.
(145) The device cannot tolerate prolonged operation at this absolute maximum.

Symbol	V_{OD} Setting	V_{OD} Value (mV)	V_{OD} Setting	V_{OD} Value (mV)
V_{OD} **differential peak to peak typical**	15	300	47	940
	16	320	48	960
	17	340	49	980
	18	360	50	1000
	19	380	51	1020
	20	400	52	1040
	21	420	53	1060
	22	440	54	1080
	23	460	55	1100
	24	480	56	1120
	25	500	57	1140
	26	520	58	1160
	27	540	59	1180
	28	560	60	1200
	29	580	61	1220
	30	600	62	1240
	31	620	63	1260

Symbol	Parameter	Min	Typ	Max	Unit
f_{OUT} (169)	Output frequency for an internal global or regional clock (C3, I3L speed grade)	—	—	650	MHz
	Output frequency for an internal global or regional clock (C4, I4 speed grade)	—	—	580	MHz
f_{OUT_EXT} (169)	Output frequency for an external clock output (C3, I3L speed grade)	—	—	667	MHz
	Output frequency for an external clock output (C4, I4 speed grade)	—	—	533	MHz
$t_{OUTDUTY}$	Duty cycle for a dedicated external clock output (when set to 50%)	45	50	55	%
t_{FCOMP}	External feedback clock compensation time	—	—	10	ns
$f_{DYCONFIGCLK}$	Dynamic configuration clock for `mgmt_clk` and `scanclk`	—	—	100	MHz
t_{LOCK}	Time required to lock from the end-of-device configuration or deassertion of `areset`	—	—	1	ms
t_{DLOCK}	Time required to lock dynamically (after switchover or reconfiguring any non-post-scale counters/ delays)	—	—	1	ms
f_{CLBW}	PLL closed-loop low bandwidth	—	0.3	—	MHz
	PLL closed-loop medium bandwidth	—	1.5	—	MHz
	PLL closed-loop high bandwidth (170)	—	4	—	MHz
t_{PLL_PSERR}	Accuracy of PLL phase shift	—	—	±50	ps
t_{ARESET}	Minimum pulse width on the `areset` signal	10	—	—	ns

(169) This specification is limited by the lower of the two: I/O f_{MAX} or f_{OUT} of the PLL.
(170) High bandwidth PLL settings are not supported in external feedback mode.

Memory	Mode	Resources Used		Performance				Unit
		ALUTs	Memory	C3	C4	I3L	I4	
M20K Block	Single-port, all supported widths	0	1	650	550	500	450	MHz
	Simple dual-port, all supported widths	0	1	650	550	500	450	MHz
	Simple dual-port with the read-during-write option set to **Old Data**, all supported widths	0	1	455	400	455	400	MHz
	Simple dual-port with ECC enabled, 512 × 32	0	1	400	350	400	350	MHz
	Simple dual-port with ECC and optional pipeline registers enabled, 512 × 32	0	1	500	450	500	450	MHz
	True dual port, all supported widths	0	1	650	550	500	450	MHz
	ROM, all supported widths	0	1	650	550	500	450	MHz

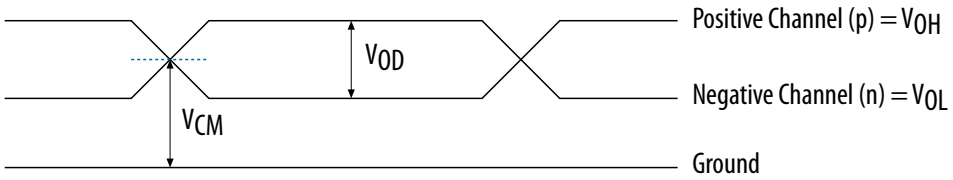
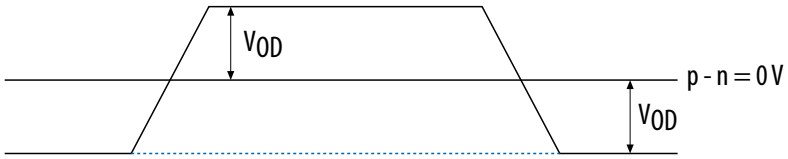
Temperature Sensing Diode Specifications

Table 2-37: Internal Temperature Sensing Diode Specification

Temperature Range	Accuracy	Offset Calibrated Option	Sampling Rate	Conversion Time	Resolution	Minimum Resolution with no Missing Codes
–40°C to 100°C	±8°C	No	1 MHz, 500 kHz	< 100 ms	8 bits	8 bits

Table 2-38: External Temperature Sensing Diode Specifications for Arria V GZ Devices

Description	Min	Typ	Max	Unit
I_{bias}, diode source current	8	—	200	µA
$V_{bias,}$ voltage across diode	0.3	—	0.9	V
Series resistance	—	—	< 1	Ω

Term	Definition
	Single-Ended Waveform  **Differential Waveform** 
f_{HSCLK}	Left and right PLL input clock frequency.
f_{HSDR}	High-speed I/O block—Maximum and minimum LVDS data transfer rate (f_{HSDR} = 1/TUI), non-DPA.
$f_{HSDRDPA}$	High-speed I/O block—Maximum and minimum LVDS data transfer rate ($f_{HSDRDPA}$ = 1/TUI), DPA.
J	High-speed I/O block—Deserialization factor (width of parallel data bus).