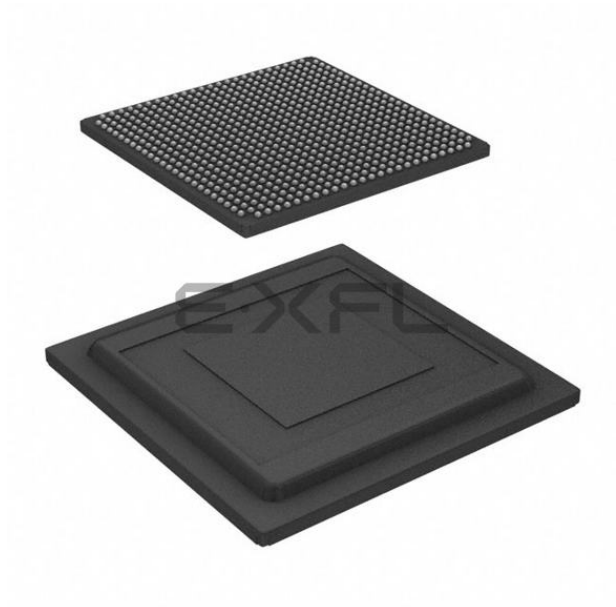

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Embedded - FPGAs, or Field Programmable Gate Arrays, are advanced integrated circuits that offer unparalleled flexibility and performance for digital systems. Unlike traditional fixed-function logic devices, FPGAs can be programmed and reprogrammed 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.

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

Details	
Product Status	Obsolete
Number of LABs/CLBs	8962
Number of Logic Elements/Cells	190000
Total RAM Bits	13284352
Number of I/O	336
Number of Gates	-
Voltage - Supply	1.07V ~ 1.13V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 85°C (TJ)
Package / Case	672-BBGA, FCBGA
Supplier Device Package	672-FBGA (27x27)
Purchase URL	https://www.e-xfl.com/product-detail/intel/5agxba5d4f27c4n

Contents

Symbol	Description	Condition	Minimum[7]	Typical	Maximum[7]	Unit
V_{CCPD_HPS} [8]	HPS I/O pre-driver power supply	3.3 V	3.135	3.3	3.465	V
		3.0 V	2.85	3.0	3.15	V
		2.5 V	2.375	2.5	2.625	V
V_{CCIO_HPS}	HPS I/O buffers power supply	3.3 V	3.135	3.3	3.465	V
		3.0 V	2.85	3.0	3.15	V
		2.5 V	2.375	2.5	2.625	V
		1.8 V	1.71	1.8	1.89	V
		1.5 V	1.425	1.5	1.575	V
		1.35 V [9]	1.283	1.35	1.418	V
		1.2 V	1.14	1.2	1.26	V
$V_{CCRSTCLK\_HPS}$	HPS reset and clock input pins power supply	3.3 V	3.135	3.3	3.465	V
		3.0 V	2.85	3.0	3.15	V
		2.5 V	2.375	2.5	2.625	V
		1.8 V	1.71	1.8	1.89	V
V_{CCPLL_HPS}	HPS PLL analog voltage regulator power supply	—	2.375	2.5	2.625	V

(7) 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.

(8) V_{CCPD_HPS} must be 2.5 V when V_{CCIO_HPS} is 2.5, 1.8, 1.5, or 1.2 V. V_{CCPD_HPS} must be 3.0 V when V_{CCIO_HPS} is 3.0 V. V_{CCPD_HPS} must be 3.3 V when V_{CCIO_HPS} is 3.3 V.

(9) V_{CCIO_HPS} 1.35 V is supported for HPS row I/O bank only.

I/O Pin Leakage Current

Table 1-6: I/O Pin Leakage Current for Arria V Devices

Symbol	Description	Condition	Min	Typ	Max	Unit
I_I	Input pin	V_I = 0 V to $V_{CCIOMAX}$	–30	—	30	µA
I_{OZ}	Tri-stated I/O pin	V_O = 0 V to $V_{CCIOMAX}$	–30	—	30	µA

Bus Hold Specifications

Table 1-7: Bus Hold Parameters for Arria V Devices

The bus-hold trip points are based on calculated input voltages from the JEDEC standard.

Parameter	Symbol	Condition	V_{CCIO} (V)												Unit
			1.2		1.5		1.8		2.5		3.0		3.3		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Bus-hold, low, sustaining current	I_{SUSL}	$V_{IN} > V_{IL}$ (max)	8	—	12	—	30	—	50	—	70	—	70	—	µA
Bus-hold, high, sustaining current	I_{SUSH}	$V_{IN} < V_{IH}$ (min)	–8	—	–12	—	–30	—	–50	—	–70	—	–70	—	µA
Bus-hold, low, overdrive current	I_{ODL}	0 V < V_{IN} < V_{CCIO}	—	125	—	175	—	200	—	300	—	500	—	500	µA
Bus-hold, high, overdrive current	I_{ODH}	0 V < V_{IN} < V_{CCIO}	—	–125	—	–175	—	–200	—	–300	—	–500	—	–500	µA

Symbol	V_{OD} Setting[58]	V_{OD} Value (mV)	V_{OD} Setting[58]	V_{OD} Value (mV)
	25	500	53	1060
	26	520	54	1080
	27	540	55	1100
	28	560	56	1120
	29	580	57	1140
	30	600	58	1160
	31	620	59	1180
	32	640	60	1200
	33	660		

Transmitter Pre-Emphasis Levels

The following table lists the simulation data on the transmitter pre-emphasis levels in dB for the first post tap under the following conditions:

- Low-frequency data pattern—five 1s and five 0s
- Data rate—2.5 Gbps

The levels listed are a representation of possible pre-emphasis levels under the specified conditions only and the pre-emphasis levels may change with data pattern and data rate.

Arria V devices only support 1st post tap pre-emphasis with the following conditions:

- The 1st post tap pre-emphasis settings must satisfy $|B| + |C| \leq 60$ where $|B| = V_{OD}$ setting with termination value, $R_{TERM} = 100\ \Omega$ and $|C|$ = 1st post tap pre-emphasis setting.
- $|B| - |C| > 5$ for data rates < 5 Gbps and $|B| - |C| > 8.25$ for data rates > 5 Gbps.
- $(V_{MAX}/V_{MIN} - 1)\% < 600\%$, where $V_{MAX} = |B| + |C|$ and $V_{MIN} = |B| - |C|$.

Exception for PCIe Gen2 design: V_{OD} setting = 43 and pre-emphasis setting = 19 are allowed for PCIe Gen2 design with transmit de-emphasis – 6dB setting (`pipe_txdeemp` = 1'b0) using Altera PCIe Hard IP and PIPE IP cores.

[58] Convert these values to their binary equivalent form if you are using the dynamic reconfiguration mode for PMA analog controls.

Protocol	Sub-protocol	Data Rate (Mbps)
SONET	SONET 155	155.52
	SONET 622	622.08
	SONET 2488	2,488.32
Gigabit-capable passive optical network (GPON)	GPON 155	155.52
	GPON 622	622.08
	GPON 1244	1,244.16
	GPON 2488	2,488.32
QSGMII	QSGMII 5000	5,000

Core Performance Specifications

Clock Tree Specifications

Table 1-35: Clock Tree Specifications for Arria V Devices

Parameter	Performance			Unit
	–I3, –C4	–I5, –C5	–C6	
Global clock and Regional clock	625	625	525	MHz
Peripheral clock	450	400	350	MHz

PLL Specifications

Table 1-36: PLL Specifications for Arria V Devices

This table lists the Arria V PLL block specifications. Arria V PLL block does not include HPS PLL.

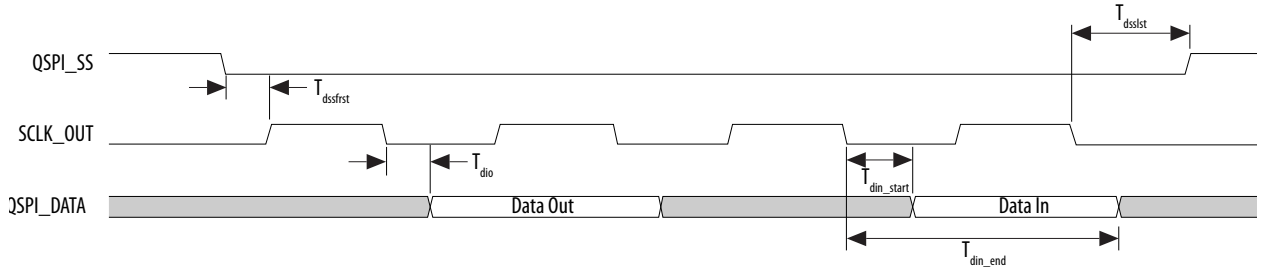
Symbol	Parameter	Condition	Min	Typ	Max	Unit
f_{OUT_EXT}	Output frequency for external clock output	–3 speed grade	—	—	670[63]	MHz
		–4 speed grade	—	—	670[63]	MHz
		–5 speed grade	—	—	622[63]	MHz
		–6 speed grade	—	—	500[63]	MHz
$t_{OUTDUTY}$	Duty cycle for external clock output (when set to 50%)	—	45	50	55	%
t_{FCOMP}	External feedback clock compensation time	—	—	—	10	ns
$t_{DYCONFIGCLK}$	Dynamic configuration clock for `mgmt_clk` and `scanclk`	—	—	—	100	MHz
t_{LOCK}	Time required to lock from 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 bandwidth	Low	—	0.3	—	MHz
		Medium	—	1.5	—	MHz
		High[64]	—	4	—	MHz
t_{PLL_PSERR}	Accuracy of PLL phase shift	—	—	—	±50	ps
t_{ARESET}	Minimum pulse width on the `areset` signal	—	10	—	—	ns
t_{INCCJ}[65][66]	Input clock cycle-to-cycle jitter	$F_{REF} \geq 100$ MHz	—	—	0.15	UI (p-p)
		$F_{REF} < 100$ MHz	—	—	±750	ps (p-p)

(64) High bandwidth PLL settings are not supported in external feedback mode.
(65) A high input jitter directly affects the PLL output jitter. To have low PLL output clock jitter, you must provide a clean clock source with jitter < 120 ps.
(66) F_{REF} is f_{IN}/N, specification applies when $N = 1$.

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

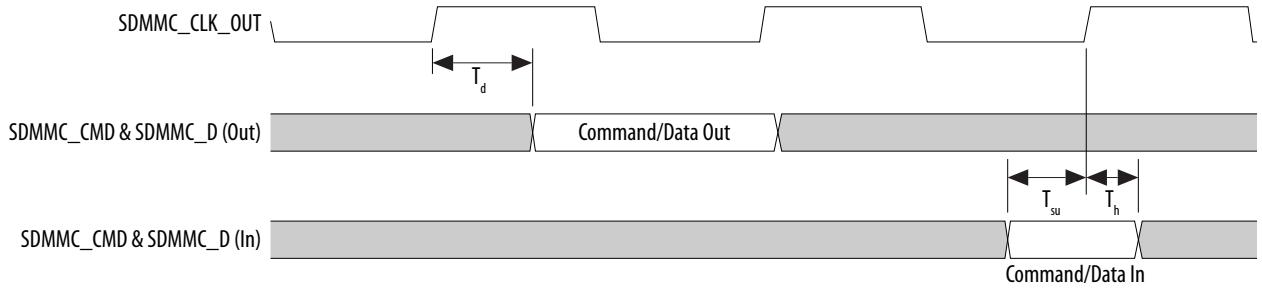
Table 1-52: SPI Master Timing Requirements for Arria V Devices

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 1-11: SD/MMC Timing Diagram



Related Information

Booting and Configuration Chapter, Arria V Hard Processor System Technical Reference Manual
Provides more information about CSEL pin settings in the SD/MMC Controller CSEL Pin Settings table.

USB Timing Characteristics

PHYs that support LPM mode may not function properly with the USB controller due to a timing issue. It is recommended that designers use the MicroChip USB3300 PHY device that has been proven to be successful on the development board.

Table 1-55: USB Timing Requirements for Arria V Devices

Symbol	Description	Min	Typ	Max	Unit
T_{clk}	USB CLK clock period	—	16.67	—	ns
T_d	CLK to USB_STP/USB_DATA[7:0] output delay	4.4	—	11	ns
T_{su}	Setup time for USB_DIR/USB_NXT/USB_DATA[7:0]	2	—	—	ns
T_h	Hold time for USB_DIR/USB_NXT/USB_DATA[7:0]	1	—	—	ns

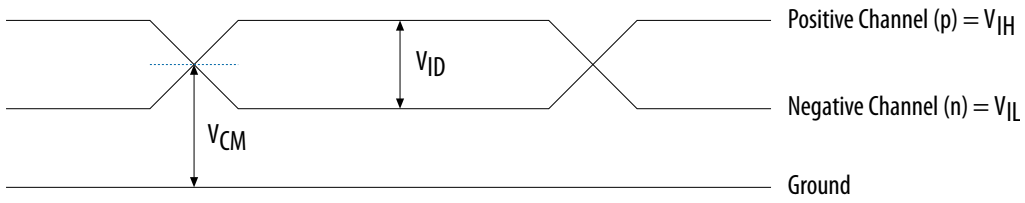
Symbol	Parameter	Typical	Unit
D_{OUTBUF}	Rising and/or falling edge delay	0 (default)	ps
		50	ps
		100	ps
		150	ps

Glossary

Table 1-78: Glossary

Term	Definition
Differential I/O standards	Receiver Input Waveforms

Single-Ended Waveform



Differential Waveform

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

January 2015	2015.01.30	• Updated the description for $V_{CC\_AUX\_SHARED}$ to "HPS auxiliary power supply" in the following tables:
		  • Absolute Maximum Ratings for Arria V Devices
		  • HPS Power Supply Operating Conditions for Arria V SX and ST Devices
		• Added statement in I/O Standard Specifications: You must perform timing closure analysis to determine the maximum achievable frequency for general purpose I/O standards.
		• Updated the conditions for transceiver reference clock rise time and fall time: Measure at ±60 mV of differential signal. Added a note to the conditions: `REFCLK` performance requires to meet transmitter `REFCLK` phase noise specification.
		• Updated the description in Periphery Performance Specifications to mention that proper timing closure is required in design.
		• Updated HPS Clock Performance main_base_clk specifications from 525 MHz (for –I3 speed grade) and 462 MHz (for –C4 speed grade) to 400 MHz.
		• Updated HPS PLL VCO maximum frequency to 1,600 MHz (for –C5, –I5, and –C6 speed grades), 1,850 MHz (for –C4 speed grade), and 2,100 MHz (for –I3 speed grade).
		• Changed the symbol for HPS PLL input jitter divide value from NR to N.
		• Removed "Slave select pulse width (Texas Instruments SSP mode)" parameter from the following tables:
		  • SPI Master Timing Requirements for Arria V Devices
		  • SPI Slave Timing Requirements for Arria V Devices
		• Added descriptions to USB Timing Characteristics section in HPS Specifications: PHYs that support LPM mode may not function properly with the USB controller due to a timing issue. It is recommended that designers use the MicroChip USB3300 PHY device that has been proven to be successful on the development board.
		• Added HPS JTAG timing specifications.
		• Updated FPGA JTAG timing specifications note as follows: A 1-ns adder is required for each V_{CCIO} voltage step down from 3.0 V. For example, t_{JPCO} = 13 ns if V_{CCIO} of the TDO I/O bank = 2.5 V, or 14 ns if it equals 1.8 V.
		• Updated the value in the V_{ICM} (AC Coupled) row and in note 6 from 650 mV to 750 mV in the Transceiver Specifications for Arria V GT and ST Devices table.

Lower number refers to faster speed grade.

L = Low power devices.

Transceiver Speed Grade	Core Speed Grade			
	C3	C4	I3L	I4
2	Yes	—	Yes	—
3	—	Yes	—	Yes

Absolute Maximum Ratings

Absolute maximum ratings define the maximum operating conditions for Arria V GZ 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.

Caution: Conditions other than those listed in the following table may cause permanent damage to the device. Additionally, device operation at the absolute maximum ratings for extended periods of time may have adverse effects on the device.

Table 2-2: Absolute Maximum Ratings for Arria V GZ Devices

Symbol	Description	Minimum	Maximum	Unit
V_{CC}	Power supply for core voltage and periphery circuitry	–0.5	1.35	V
V_{CCPT}	Power supply for programmable power technology	–0.5	1.8	V
V_{CCPGM}	Power supply for configuration pins	–0.5	3.9	V
V_{CC_AUX}	Auxiliary supply for the programmable power technology	–0.5	3.4	V
V_{CCBAT}	Battery back-up power supply for design security volatile key register	–0.5	3.9	V
V_{CCPD}	I/O pre-driver power supply	–0.5	3.9	V
V_{CCIO}	I/O power supply	–0.5	3.9	V
V_{CCD_FPLL}	PLL digital power supply	–0.5	1.8	V
V_{CCA_FPLL}	PLL analog power supply	–0.5	3.4	V

Symbol	Description	Condition	Minimum[114]	Typical	Maximum [114]	Unit
V_I	DC input voltage	—	–0.5	—	3.6	V
V_O	Output voltage	—	0	—	V_{CCIO}	V
T_J	Operating junction temperature	Commercial	0	—	85	°C
		Industrial	–40	—	100	°C
t_{RAMP}	Power supply ramp time	Standard POR	200 µs	—	100 ms	—
		Fast POR	200 µs	—	4 ms	—

Recommended Transceiver Power Supply Operating Conditions

Table 2-6: Recommended Transceiver Power Supply Operating Conditions for Arria V GZ Devices

Symbol	Description	Minimum [118]	Typical	Maximum[118]	Unit
V_{CCA_GXBL} [119], [120]	Transceiver channel PLL power supply (left side)	2.85	3.0	3.15	V
		2.375	2.5	2.625	
V_{CCA_GXBR} [119], [120]	Transceiver channel PLL power supply (right side)	2.85	3.0	3.15	V
		2.375	2.5	2.625	
V_{CCHIP_L}	Transceiver hard IP power supply (left side)	0.82	0.85	0.88	V
V_{CCHSSI_L}	Transceiver PCS power supply (left side)	0.82	0.85	0.88	V
V_{CCHSSI_R}	Transceiver PCS power supply (right side)	0.82	0.85	0.88	V

(114) 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.

(118) This 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.

(119) This supply must be connected to 3.0 V if the CMU PLL, receiver CDR, or both, are configured at a base data rate > 6.5 Gbps. Up to 6.5 Gbps, you can connect this supply to either 3.0 V or 2.5 V.

(120) When using ATX PLLs, the supply must be 3.0 V.

I/O Standard	V_{CCIO} (V)			V_{REF} (V)			V_{TT} (V)		
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max
SSTL-135 Class I, II	1.283	1.35	1.418	0.49 × V_{CCIO}	0.5 × V_{CCIO}	0.51 × V_{CCIO}	0.49 × V_{CCIO}	0.5 × V_{CCIO}	0.51 × V_{CCIO}
SSTL-125 Class I, II	1.19	1.25	1.26	0.49 × V_{CCIO}	0.5 × V_{CCIO}	0.51 × V_{CCIO}	0.49 × V_{CCIO}	0.5 × VCCIO	0.51 × V_{CCIO}
SSTL-12 Class I, II	1.14	1.20	1.26	0.49 × V_{CCIO}	0.5 × V_{CCIO}	0.51 × V_{CCIO}	0.49 × V_{CCIO}	0.5 × VCCIO	0.51 × V_{CCIO}
HSTL-18 Class I, II	1.71	1.8	1.89	0.85	0.9	0.95	—	V_{CCIO}/2	—
HSTL-15 Class I, II	1.425	1.5	1.575	0.68	0.75	0.9	—	V_{CCIO}/2	—
HSTL-12 Class I, II	1.14	1.2	1.26	0.47 × V_{CCIO}	0.5 × V_{CCIO}	0.53 × V_{CCIO}	—	V_{CCIO}/2	—
HSUL-12	1.14	1.2	1.3	0.49 × V_{CCIO}	0.5 × V_{CCIO}	0.51 × V_{CCIO}	—	—	—

Table 2-18: Single-Ended SSTL, HSTL, and HSUL I/O Standards Signal Specifications for Arria V GZ Devices

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} (mA)	I_{oh} (mA)
	Min	Max	Min	Max	Max	Min	Max	Min		
SSTL-2 Class I	–0.3	V_{REF} – 0.15	V_{REF} + 0.15	V_{CCIO} + 0.3	V_{REF} – 0.31	V_{REF} + 0.31	V_{TT} – 0.608	V_{TT} + 0.608	8.1	–8.1
SSTL-2 Class II	–0.3	V_{REF} – 0.15	V_{REF} + 0.15	V_{CCIO} + 0.3	V_{REF} – 0.31	V_{REF} + 0.31	V_{TT} – 0.81	V_{TT} + 0.81	16.2	–16.2
SSTL-18 Class I	–0.3	V_{REF} – 0.125	V_{REF} + 0.125	V_{CCIO} + 0.3	V_{REF} – 0.25	V_{REF} + 0.25	V_{TT} – 0.603	V_{TT} + 0.603	6.7	–6.7

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.

Clock Network	ATX PLL			CMU PLL [161]			fPLL		
	Non-bonded Mode (Gbps)	Bonded Mode (Gbps)	Channel Span	Non-bonded Mode (Gbps)	Bonded Mode (Gbps)	Channel Span	Non-bonded Mode (Gbps)	Bonded Mode (Gbps)	Channel Span
xN (PCIe)	—	8.0	8	—	5.0	8	—	—	—
xN (Native PHY IP)	8.0	8.0	Up to 13 channels above and below PLL	7.99	7.99	Up to 13 channels above and below PLL	3.125	3.125	Up to 13 channels above and below PLL
	—	8.01 to 9.8304	Up to 7 channels above and below PLL						

Standard PCS Data Rate

Table 2-30: Standard PCS Approximate Maximum Date Rate (Gbps) for Arria V GZ Devices

The maximum data rate is also constrained by the transceiver speed grade. Refer to the "Commercial and Industrial Speed Grade Offering for Arria V GZ Devices" table for the transceiver speed grade.

Mode [164]	Transceiver Speed Grade	PMA Width	20	20	16	16	10	10	8	8
		PCS/Core Width	40	20	32	16	20	10	16	8
FIFO	2	C3, I3L core speed grade	9.9	9	7.84	7.2	5.3	4.7	4.24	3.76
	3	C4, I4 core speed grade	8.8	8.2	7.2	6.56	4.8	4.3	3.84	3.44

[161] ATX PLL is recommended at 8 Gbps and above data rates for improved jitter performance.

[164] The Phase Compensation FIFO can be configured in FIFO mode or register mode. In the FIFO mode, the pointers are not fixed, and the latency can vary. In the register mode the pointers are fixed for low latency.

Symbol	Conditions	C3, I3L			C4, I4			Unit
		Min	Typ	Max	Min	Typ	Max	
True Differential I/O Standards - f_{HSDR} (data rate)	SERDES factor J = 3 to 10 (182), (183)	(184)	—	1250	(184)	—	1050	Mbps
	SERDES factor J ≥ 4 LVDS TX with DPA (185), (186), (187), (188)	(184)	—	1600	(184)	—	1250	Mbps
	SERDES factor J = 2, uses DDR Registers	(184)	—	(189)	(184)	—	(189)	Mbps
	SERDES factor J = 1, uses SDR Register	(184)	—	(189)	(184)	—	(189)	Mbps
Emulated Differential I/O Standards with Three External Output Resistor Networks - f_{HSDR} (data rate) (190)	SERDES factor J = 4 to 10 (191)	(184)	—	840	(184)	—	840	Mbps

(182) If the receiver with DPA enabled and transmitter are using shared PLLs, the minimum data rate is 150 Mbps.
(183) The F_{MAX} specification is based on the fast clock used for serial data. The interface F_{MAX} is also dependent on the parallel clock domain which is design dependent and requires timing analysis.
(184) The minimum specification depends on the clock source (for example, the PLL and clock pin) and the clock routing resource (global, regional, or local) that you use. The I/O differential buffer and input register do not have a minimum toggle rate.
(185) Arria V GZ RX LVDS will need DPA. For Arria V GZ TX LVDS, the receiver side component must have DPA.
(186) Requires package skew compensation with PCB trace length.
(187) Do not mix single-ended I/O buffer within LVDS I/O bank.
(188) Chip-to-chip communication only with a maximum load of 5 pF.
(189) The maximum ideal data rate is the SERDES factor (J) x the PLL maximum output frequency (fOUT) provided you can close the design timing and the signal integrity simulation is clean.
(190) You must calculate the leftover timing margin in the receiver by performing link timing closure analysis. You must consider the board skew margin, transmitter channel-to-channel skew, and receiver sampling margin to determine leftover timing margin.
(191) When using True LVDS RX channels for emulated LVDS TX channel, only serialization factors 1 and 2 are supported.

JTAG Configuration Specifications

Table 2-54: JTAG Timing Parameters and Values for Arria V GZ Devices

Symbol	Description	Min	Max	Unit
t_{JCP}	TCK clock period	30	—	ns
t_{JCP}	TCK clock period	167 (203)	—	ns
t_{JCH}	TCK clock high time	14	—	ns
t_{JCL}	TCK clock low time	14	—	ns
$t_{JPSU\ (TDI)}$	TDI JTAG port setup time	2	—	ns
$t_{JPSU\ (TMS)}$	TMS JTAG port setup time	3	—	ns
t_{JPH}	JTAG port hold time	5	—	ns
t_{JPCO}	JTAG port clock to output	—	11 (204)	ns
t_{JPZX}	JTAG port high impedance to valid output	—	14 (204)	ns
t_{JPXZ}	JTAG port valid output to high impedance	—	14 (204)	ns

Fast Passive Parallel (FPP) Configuration Timing

DCLK-to-DATA[] Ratio (r) for FPP Configuration

FPP configuration requires a different DCLK-to-DATA[] ratio when you turn on encryption or the compression feature.

(203) The minimum TCK clock period is 167 ns if VCCBAT is within the range 1.2V-1.5V when you perform the volatile key programming.

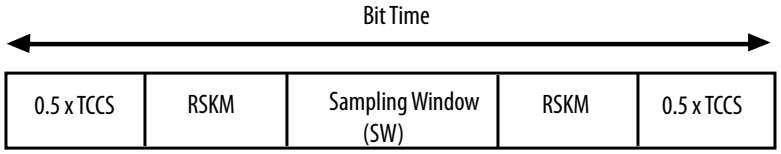
(204) A 1-ns adder is required for each V_{CCIO} voltage step down from 3.0 V. For example, t_{JPCO} = 12 ns if V_{CCIO} of the TDO I/O bank = 2.5 V, or 13 ns if it equals 1.8 V.

Symbol	Parameter	Minimum	Maximum	Unit
t_{CD2CU}	CONF_DONE high to CLKUSR enabled	4 × maximum DCLK period	—	—
t_{CD2UMC}	CONF_DONE high to user mode with CLKUSR option on	t_{CD2CU} + (8576 × CLKUSR period) (215)	—	—

Related Information

- **DCLK-to-DATA[] Ratio (r) for FPP Configuration** on page 2-57
- **Configuration, Design Security, and Remote System Upgrades in Arria V Devices**

(215) To enable the CLKUSR pin as the initialization clock source and to obtain the maximum frequency specification on these pins, refer to the "Initialization" section of the *Configuration, Design Security, and Remote System Upgrades in Arria V Devices* chapter.

Term	Definition
R_L	Receiver differential input discrete resistor (external to the Arria V GZ device).
SW (sampling window)	Timing Diagram—the period of time during which the data must be valid in order to capture it correctly. The setup and hold times determine the ideal strobe position within the sampling window, as shown: 
Single-ended voltage referenced I/O standard	The JEDEC standard for SSTL and HSTL I/O defines both the AC and DC input signal values. The AC values indicate the voltage levels at which the receiver must meet its timing specifications. The DC values indicate the voltage levels at which the final logic state of the receiver is unambiguously defined. After the receiver input has crossed the AC value, the receiver changes to the new logic state. The new logic state is then maintained as long as the input stays beyond the DC threshold. This approach is intended to provide predictable receiver timing in the presence of input waveform ringing: Single-Ended Voltage Referenced I/O Standard