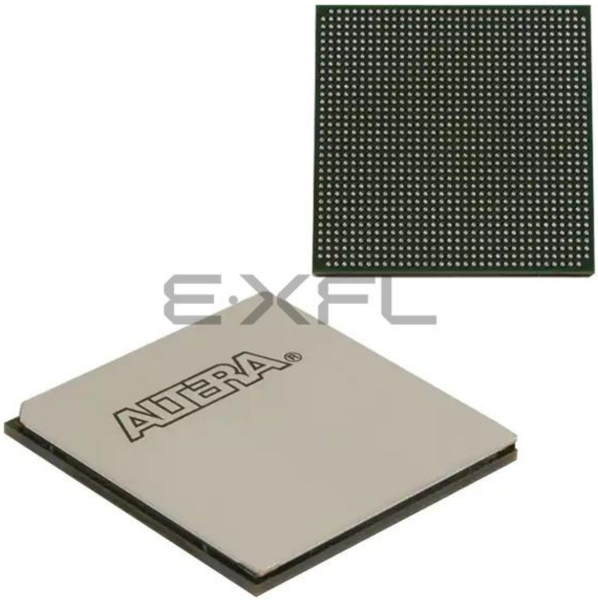
Intel - 5AGZME1H2F35C3N Datasheet



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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	10377
Number of Logic Elements/Cells	220000
Total RAM Bits	15282176
Number of I/O	414
Number of Gates	-
Voltage - Supply	0.82V ~ 0.88V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 85°C (TJ)
Package / Case	1152-BBGA, FCBGA
Supplier Device Package	1152-FBGA (35x35)
Purchase URL	https://www.e-xfl.com/product-detail/intel/5agzme1h2f35c3n

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

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-125	1.19	1.25	1.31	0.18	(15)	$V_{CCIO}/2 - 0.15$	$V_{CCIO}/2$	$V_{CCIO}/2 + 0.15$	$2(V_{IH(AC)} - V_{REF})$	$2(V_{IL(AC)} - V_{REF})$

Differential HSTL and HSUL I/O Standards

Table 1-18: Differential HSTL and HSUL I/O Standards for Arria V Devices

I/O Standard	V_{CCIO} (V)			$V_{DIF(DC)}$ (V)		$V_{X(AC)}$ (V)			$V_{CM(DC)}$ (V)			$V_{DIF(AC)}$ (V)	
	Min	Typ	Max	Min	Max	Min	Typ	Max	Min	Typ	Max	Min	Max
HSTL-18 Class I, II	1.71	1.8	1.89	0.2	—	0.78	—	1.12	0.78	—	1.12	0.4	—
HSTL-15 Class I, II	1.425	1.5	1.575	0.2	—	0.68	—	0.9	0.68	—	0.9	0.4	—
HSTL-12 Class I, II	1.14	1.2	1.26	0.16	$V_{CCIO} + 0.3$	—	$0.5 \times V_{CCIO}$	—	$0.4 \times V_{CCIO}$	$0.5 \times V_{CCIO}$	$0.6 \times V_{CCIO}$	0.3	$V_{CCIO} + 0.48$
HSUL-12	1.14	1.2	1.3	0.26	0.26	$0.5 \times V_{CCIO} - 0.12$	$0.5 \times V_{CCIO}$	$0.5 \times V_{CCIO} + 0.12$	$0.4 \times V_{CCIO}$	$0.5 \times V_{CCIO}$	$0.6 \times V_{CCIO}$	0.44	0.44

Differential I/O Standard Specifications

Table 1-19: Differential I/O Standard Specifications for Arria V Devices

Differential inputs are powered by V_{CCPD} which requires 2.5 V.

Table 1-21: Transceiver Clocks 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	
`fixedclk` clock frequency	PCIe Receiver Detect	—	125	—	—	125	—	MHz
Transceiver Reconfiguration Controller IP (`mgmt_clk_clk`) clock frequency	—	75	—	125	75	—	125	MHz

Table 1-22: Receiver 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	1.5 V PCML, 2.5 V PCML, LVPECL, and LVDS							
Data rate[28]	—	611	—	6553.6	611	—	3125	Mbps
Absolute V_{MAX} for a receiver pin[29]	—	—	—	1.2	—	—	1.2	V
Absolute V_{MIN} for a receiver pin	—	–0.4	—	—	–0.4	—	—	V
Maximum peak-to-peak differential input voltage V_{ID} (diff p-p) before device configuration	—	—	—	1.6	—	—	1.6	V
Maximum peak-to-peak differential input voltage V_{ID} (diff p-p) after device configuration	—	—	—	2.2	—	—	2.2	V

(28) To support data rates lower than the minimum specification through oversampling, use the CDR in LTR mode only.
(29) The device cannot tolerate prolonged operation at this absolute maximum.

Symbol/Description	Condition	Transceiver Speed Grade 3			Unit
		Min	Typ	Max	
Data rate (10-Gbps transceiver)(44)	—	0.611	—	10.3125	Gbps
Absolute V_{MAX} for a receiver pin(45)	—	—	—	1.2	V
Absolute V_{MIN} for a receiver pin	—	–0.4	—	—	V
Maximum peak-to-peak differential input voltage V_{ID} (diff p-p) before device configuration	—	—	—	1.6	V
Maximum peak-to-peak differential input voltage V_{ID} (diff p-p) after device configuration	—	—	—	2.2	V
Minimum differential eye opening at the receiver serial input pins(46)	—	100	—	—	mV
V_{ICM} (AC coupled)	—	—	750(47)/800	—	mV
V_{ICM} (DC coupled)	≤ 3.2Gbps(48)	670	700	730	mV
Differential on-chip termination resistors	85-Ω setting	85			Ω
	100-Ω setting	100			Ω
	120-Ω setting	120			Ω
	150-Ω setting	150			Ω
t_{LTR}(49)	—	—	—	10	µs
t_{LTD}(50)	—	4	—	—	µs

(45) The device cannot tolerate prolonged operation at this absolute maximum.

(46) The differential eye opening specification at the receiver input pins assumes that you have disabled the **Receiver Equalization** feature. If you enable the **Receiver Equalization** feature, the receiver circuitry can tolerate a lower minimum eye opening, depending on the equalization level.

(47) The AC coupled V_{ICM} is 750 mV for PCIe mode only.

(48) For standard protocol compliance, use AC coupling.

(49) t_{LTR} is the time required for the receive CDR to lock to the input reference clock frequency after coming out of reset.

(50) t_{LTD} is time required for the receiver CDR to start recovering valid data after the `rx_is_lockedtodata` signal goes high.

Typical TX V_{OD} Setting for Arria V Transceiver Channels with termination of 100 Ω

Table 1-32: Typical TX V_{OD} Setting for Arria V Transceiver Channels with termination of 100 Ω

Symbol	V_{OD} Setting[58]	V_{OD} Value (mV)	V_{OD} Setting[58]	V_{OD} Value (mV)
V_{OD} differential peak-to-peak typical	6[59]	120	34	680
	7[59]	140	35	700
	8[59]	160	36	720
	9	180	37	740
	10	200	38	760
	11	220	39	780
	12	240	40	800
	13	260	41	820
	14	280	42	840
	15	300	43	860
	16	320	44	880
	17	340	45	900
	18	360	46	920
	19	380	47	940
	20	400	48	960
	21	420	49	980
	22	440	50	1000
	23	460	51	1020
	24	480	52	1040

[58] Convert these values to their binary equivalent form if you are using the dynamic reconfiguration mode for PMA analog controls.
[59] Only valid for data rates ≤ 5 Gbps.

High-Speed I/O Specifications

Table 1-40: High-Speed I/O Specifications for Arria V Devices

When J = 3 to 10, use the serializer/deserializer (SERDES) block. When J = 1 or 2, bypass the SERDES block.

For LVDS applications, you must use the PLLs in integer PLL mode.

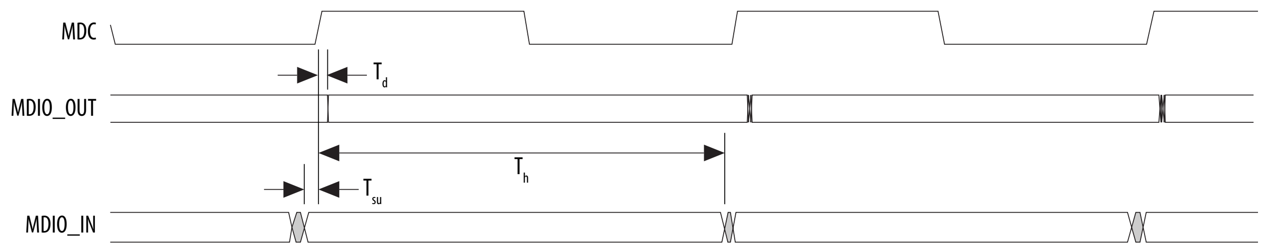
The Arria V devices support the following output standards using true LVDS output buffer types on all I/O banks.

- True RSDS output standard with data rates of up to 360 Mbps
- True mini-LVDS output standard with data rates of up to 400 Mbps

Symbol		Condition	–I3, –C4			–I5, –C5			–C6			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
f_{HSCLK_in} (input clock frequency) True Differential I/O Standards		Clock boost factor W = 1 to 40[(72)]	5	—	800	5	—	750	5	—	625	MHz
f_{HSCLK_in} (input clock frequency) Single-Ended I/O Standards[(73)]		Clock boost factor W = 1 to 40[(72)]	5	—	625	5	—	625	5	—	500	MHz
f_{HSCLK_in} (input clock frequency) Single-Ended I/O Standards[(74)]		Clock boost factor W = 1 to 40[(72)]	5	—	420	5	—	420	5	—	420	MHz
f_{HSCLK_OUT} (output clock frequency)		—	5	—	625[(75)]	5	—	625[(75)]	5	—	500[(75)]	MHz
Transmitter	True Differential I/O Standards - f_{HSDR} (data rate)	SERDES factor J =3 to 10[(76)]	[(77)]	—	1250	[(77)]	—	1250	[(77)]	—	1050	Mbps

(72) Clock boost factor (W) is the ratio between the input data rate and the input clock rate.
(73) This applies to DPA and soft-CDR modes only.
(74) This applies to non-DPA mode only.
(75) This is achieved by using the LVDS clock network.
(76) 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.
(77) 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.

Figure 1-15: MDIO Timing Diagram

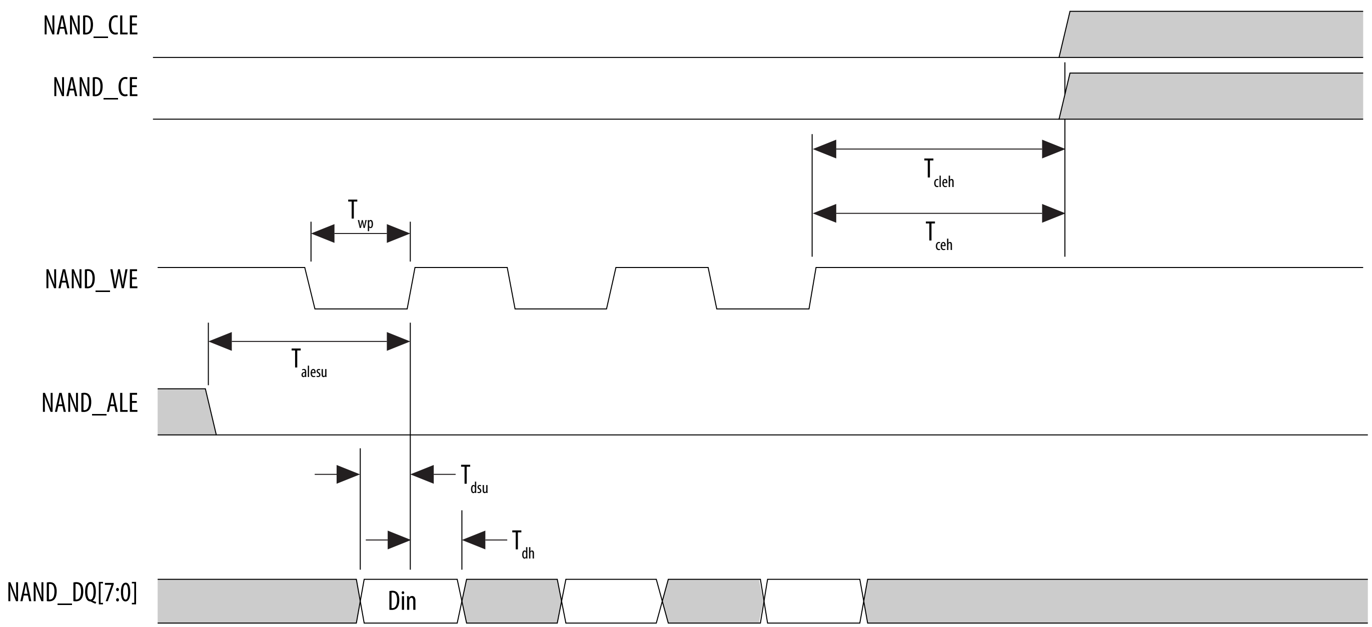


I^{2}C Timing Characteristics

Table 1-59: I^{2}C Timing Requirements for Arria V Devices

Symbol	Description	Standard Mode		Fast Mode		Unit
		Min	Max	Min	Max	
T_{clk}	Serial clock (SCL) clock period	10	—	2.5	—	μs
$T_{clkhigh}$	SCL high time	4.7	—	0.6	—	μs
T_{clklow}	SCL low time	4	—	1.3	—	μs
T_s	Setup time for serial data line (SDA) data to SCL	0.25	—	0.1	—	μs
T_h	Hold time for SCL to SDA data	0	3.45	0	0.9	μs
T_d	SCL to SDA output data delay	—	0.2	—	0.2	μs
T_{su_start}	Setup time for a repeated start condition	4.7	—	0.6	—	μs
T_{hd_start}	Hold time for a repeated start condition	4	—	0.6	—	μs
T_{su_stop}	Setup time for a stop condition	4	—	0.6	—	μs

Figure 1-19: NAND Data Write Timing Diagram



Initialization

Table 1-71: Initialization Clock Source Option and the Maximum Frequency for Arria V Devices

Initialization Clock Source	Configuration Scheme	Maximum Frequency (MHz)	Minimum Number of Clock Cycles
Internal Oscillator	AS, PS, and FPP	12.5	T_{init}
`CLKUSR`[107]	PS and FPP	125	
	AS	100	
`DCLK`	PS and FPP	125	

Configuration Files

Table 1-72: Uncompressed .rbf Sizes for Arria V Devices

Use this table to estimate the file size before design compilation. Different configuration file formats, such as a hexadecimal file (`.hex`) or tabular text file (`.ttf`) format, have different file sizes.

For the different types of configuration file and file sizes, refer to the Quartus Prime software. However, for a specific version of the Quartus Prime software, any design targeted for the same device has the same uncompressed configuration file size.

The IOCSR raw binary file (`.rbf`) size is specifically for the Configuration via Protocol (CvP) feature.

(107) To enable `CLKUSR` as the initialization clock source, turn on the **Enable user-supplied start-up clock (CLKUSR)** option in the Quartus Prime software from the **General** panel of the **Device and Pin Options** dialog box.

Variant	Member Code	Configuration .rbf Size (bits)	IOCSR .rbf Size (bits)
Arria V GX	A1	71,015,712	439,960
	A3	71,015,712	439,960
	A5	101,740,800	446,360
	A7	101,740,800	446,360
	B1	137,785,088	457,368
	B3	137,785,088	457,368
	B5	185,915,808	463,128
	B7	185,915,808	463,128
Arria V GT	C3	71,015,712	439,960
	C7	101,740,800	446,360
	D3	137,785,088	457,368
	D7	185,915,808	463,128
Arria V SX	B3	185,903,680	450,968
	B5	185,903,680	450,968
Arria V ST	D3	185,903,680	450,968
	D5	185,903,680	450,968

Minimum Configuration Time Estimation

Table 1-73: Minimum Configuration Time Estimation for Arria V Devices

The estimated values are based on the configuration `.rbf` sizes in Uncompressed .rbf Sizes for Arria V Devices table.

Term	Definition
t_{FALL}	Signal high-to-low transition time (80–20%)
t_{INCCJ}	Cycle-to-cycle jitter tolerance on the PLL clock input
t_{OUTPJ_IO}	Period jitter on the GPIO driven by a PLL
t_{OUTPJ_DC}	Period jitter on the dedicated clock output driven by a PLL
t_{RISE}	Signal low-to-high transition time (20–80%)
Timing Unit Interval (TUI)	The timing budget allowed for skew, propagation delays, and the data sampling window. (TUI = 1/(Receiver Input Clock Frequency Multiplication Factor) = t_C/w)
$V_{CM(DC)}$	DC common mode input voltage.
V_{ICM}	Input common mode voltage—The common mode of the differential signal at the receiver.
V_{ID}	Input differential voltage swing—The difference in voltage between the positive and complementary conductors of a differential transmission at the receiver.
$V_{DIF(AC)}$	AC differential input voltage—Minimum AC input differential voltage required for switching.
$V_{DIF(DC)}$	DC differential input voltage— Minimum DC input differential voltage required for switching.
V_{IH}	Voltage input high—The minimum positive voltage applied to the input which is accepted by the device as a logic high.
$V_{IH(AC)}$	High-level AC input voltage
$V_{IH(DC)}$	High-level DC input voltage
V_{IL}	Voltage input low—The maximum positive voltage applied to the input which is accepted by the device as a logic low.
$V_{IL(AC)}$	Low-level AC input voltage
$V_{IL(DC)}$	Low-level DC input voltage
V_{OCM}	Output common mode voltage—The common mode of the differential signal at the transmitter.
V_{OD}	Output differential voltage swing—The difference in voltage between the positive and complementary conductors of a differential transmission line at the transmitter.
V_{SWING}	Differential input voltage
V_X	Input differential cross point voltage

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.

Arria V GZ Device Datasheet

2

2017.02.10

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This document covers the electrical and switching characteristics for Arria V GZ devices. Electrical characteristics include operating conditions and power consumption. Switching characteristics include transceiver specifications, core, and periphery performance. This document also describes I/O timing, including programmable I/O element (IOE) delay and programmable output buffer delay.

Related Information

Arria V Device Overview

For information regarding the densities and packages of devices in the Arria V GZ family.

Electrical Characteristics

Operating Conditions

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

Arria V GZ devices are offered in commercial and industrial temperature grades.

Commercial devices are offered in –3 (fastest) and –4 core speed grades. Industrial devices are offered in –3L and –4 core speed grades. Arria V GZ devices are offered in –2 and –3 transceiver speed grades.

Table 2-1: Commercial and Industrial Speed Grade Offering for Arria V GZ Devices

C = Commercial temperature grade; I = Industrial temperature grade.

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Related Information

- **PowerPlay Early Power Estimator User Guide**
  For more information about the EPE tool.
- **PowerPlay Power Analysis**
  For more information about PowerPlay power analysis.

Power Consumption

Altera offers two ways to estimate power consumption for a design—the Excel-based Early Power Estimator and the Quartus II PowerPlay Power Analyzer feature.

Note: You typically use the interactive Excel-based Early Power Estimator before designing the FPGA to get a magnitude estimate of the device power. The Quartus II PowerPlay Power Analyzer provides better quality estimates based on the specifics of the design after you complete place-and-route. The PowerPlay Power Analyzer can apply a combination of user-entered, simulation-derived, and estimated signal activities that, when combined with detailed circuit models, yields very accurate power estimates.

Related Information

- **PowerPlay Early Power Estimator User Guide**
  For more information about the EPE tool.
- **PowerPlay Power Analysis**
  For more information about PowerPlay power analysis.

I/O Pin Leakage Current

Table 2-8: I/O Pin Leakage Current for Arria V GZ Devices

If $V_O = V_{CCIO}$ to $V_{CCIOMax}$, 100 µA of leakage current per I/O is expected.

Symbol	Description	Conditions	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

Core Performance Specifications

Clock Tree Specifications

Table 2-33: Clock Tree Performance for Arria V GZ Devices

Symbol	Performance		Unit
	C3, I3L	C4, I4	
Global and Regional Clock	650	580	MHz
Periphery Clock	500	500	MHz

PLL Specifications

Table 2-34: PLL Specifications for Arria V GZ Devices

Symbol	Parameter	Min	Typ	Max	Unit
f_{IN} (167)	Input clock frequency (C3, I3L speed grade)	5	—	800	MHz
	Input clock frequency (C4, I4 speed grade)	5	—	650	MHz
f_{INPFD}	Input frequency to the PFD	5	—	325	MHz
f_{FINPFD}	Fractional Input clock frequency to the PFD	50	—	160	MHz
f_{VCO} (168)	PLL VCO operating range (C3, I3L speed grade)	600	—	1600	MHz
	PLL VCO operating range (C4, I4 speed grade)	600	—	1300	MHz
$t_{EINDUTY}$	Input clock or external feedback clock input duty cycle	40	—	60	%

(167) This specification is limited in the Quartus II software by the I/O maximum frequency. The maximum I/O frequency is different for each I/O standard.

(168) The VCO frequency reported by the Quartus II software in the **PLL Usage Summary** section of the compilation report takes into consideration the VCO post-scale counter K value. Therefore, if the counter K has a value of 2, the frequency reported can be lower than the f_{VCO} specification.

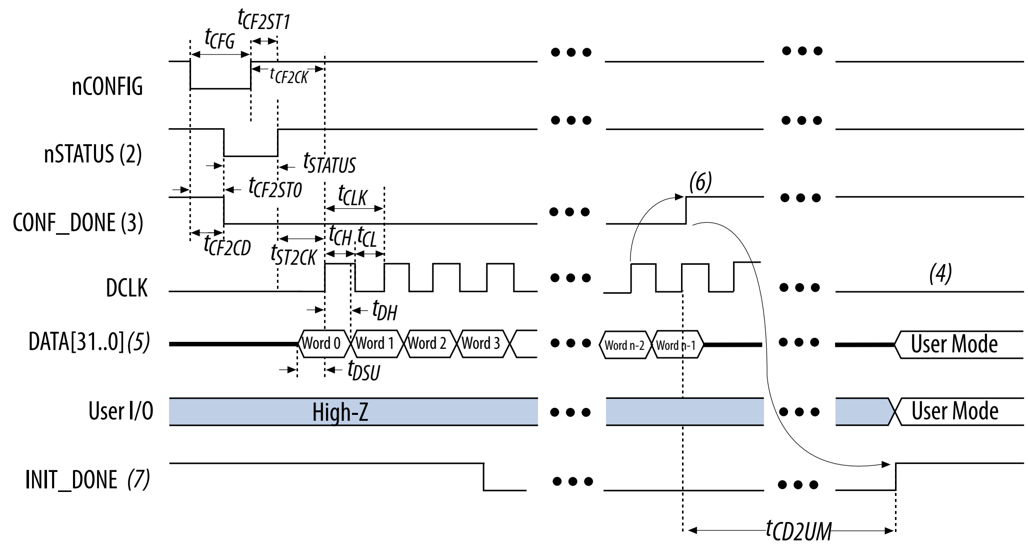
Symbol	Parameter	Min	Typ	Max	Unit
f_{OUT} [169]	Output frequency for an internal global or regional clock (C3, I3L speed grade)	—	—	650	MHz
	Output frequency for an internal global or regional clock (C4, I4 speed grade)	—	—	580	MHz
f_{OUT_EXT} [169]	Output frequency for an external clock output (C3, 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.

FPP Configuration Timing when DCLK to DATA[] = 1

Figure 2-7: FPP Configuration Timing Waveform When the DCLK-to-DATA[] Ratio is 1

Timing waveform for FPP configuration when using a MAX® II or MAX V device as an external host.



Notes:
1. The beginning of this waveform shows the device in user mode. In user mode, nCONFIG, nSTATUS, and CONF_DONE are at logic-high levels. When nCONFIG is pulled low, a reconfiguration cycle begins.
2. After power-up, the Arria V GZ device holds nSTATUS low for the time of the POR delay.
3. After power-up, before and during configuration, CONF_DONE is low.
4. Do not leave DCLK floating after configuration. DCLK is ignored after configuration is complete. It can toggle high or low if required.
5. For FPP ×16, use DATA[15..0]. For FPP ×8, use DATA[7..0]. DATA[31..0] are available as a user I/O pin after configuration. The state of this pin depends on the dual-purpose pin settings.
6. To ensure a successful configuration, send the entire configuration data to the Arria V GZ device. CONF_DONE is released high when the Arria V GZ device receives all the configuration data successfully. After CONF_DONE goes high, send two additional falling edges on DCLK to begin initialization and enter user mode.
7. After the option bit to enable the INIT_DONE pin is configured into the device, the INIT_DONE goes low.

Programmable IOE Delay

Table 2-66: IOE Programmable Delay for Arria V GZ Devices

Parameter (228)	Available Settings	Min Offset (229)	Fast Model		Slow Model				Unit
			Industrial	Commercial	C3	C4	I3L	I4	
D1	64	0	0.464	0.493	0.924	1.011	0.921	1.006	ns
D2	32	0	0.230	0.244	0.459	0.503	0.456	0.500	ns
D3	8	0	1.587	1.699	2.992	3.192	3.047	3.257	ns
D4	64	0	0.464	0.492	0.924	1.011	0.920	1.006	ns
D5	64	0	0.464	0.493	0.924	1.011	0.921	1.006	ns
D6	32	0	0.229	0.244	0.458	0.503	0.456	0.499	ns

Programmable Output Buffer Delay

Table 2-67: Programmable Output Buffer Delay for Arria V GZ Devices

You can set the programmable output buffer delay in the Quartus II software by setting the **Output Buffer Delay Control** assignment to either positive, negative, or both edges, with the specific values stated here (in ps) for the **Output Buffer Delay** assignment.

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

(228) You can set this value in the Quartus II software by selecting **D1**, **D2**, **D3**, **D4**, **D5**, and **D6** in the **Assignment Name** column of **Assignment Editor**.
(229) Minimum offset does not include the intrinsic delay.

Term	Definition
V_{OCM}	Output common mode voltage—The common mode of the differential signal at the transmitter.
V_{OD}	Output differential voltage swing—The difference in voltage between the positive and complementary conductors of a differential transmission at the transmitter.
V_{SWING}	Differential input voltage
V_X	Input differential cross point voltage
V_{OX}	Output differential cross point voltage
W	High-speed I/O block—clock boost factor

Document Revision History

Date	Version	Changes
February 2017	2017.02.10	• Changed the minimum value for t_{CD2UMC} in the “FPP Timing Parameters for Arria V GZ Devices When the DCLK-to-DATA[] Ratio is 1” table. • Changed the minimum value for t_{CD2UMC} in the "FPP Timing Parameters for Arria V GZ Devices When the DCLK-to-DATA[] Ratio is >1" table. • Changed the minimum value for t_{CD2UMC} in the "AS Timing Parameters for AS x1 and AS x4 Configurations in Arria V GZ Devices" table. • Changed the minimum value for t_{CD2UMC} in the "PS Timing Parameters for Arria V GZ Devices" table. • Changed the minimum number of clock cycles value in the "Initialization Clock Source Option and the Maximum Frequency for Arria V GZ Devices" table.