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Applications of Embedded - FPGAs

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

Details	
Product Status	Active
Number of LABs/CLBs	147780
Number of Logic Elements/Cells	2586150
Total RAM Bits	391168000
Number of I/O	676
Number of Gates	-
Voltage - Supply	0.873V ~ 0.927V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 100°C (TJ)
Package / Case	2104-BBGA, FCBGA
Supplier Device Package	2104-FCBGA (47.5x47.5)
Purchase URL	https://www.e-xfl.com/product-detail/xilinx/xcvu9p-3fsgd2104e

Table 1: **Absolute Maximum Ratings(1) *(Cont'd)***

Symbol	Description	Min	Max	Units
I_{RMS}	Available RMS output current at the pad.	–20	20	mA
GTY Transceivers				
$V_{MGTAVCC}$	Analog supply voltage for transceiver circuits.	–0.500	1.000	V
$V_{MGTAVTT}$	Analog supply voltage for transceiver termination circuits.	–0.500	1.300	V
$V_{MGTVCCAUX}$	Auxiliary analog Quad PLL (QPLL) voltage supply for transceivers.	–0.500	1.900	V
$V_{MGTREFCLK}$	Transceiver reference clock absolute input voltage.	–0.500	1.300	V
$V_{MGTAVTTRCAL}$	Analog supply voltage for the resistor calibration circuit of the transceiver column.	–0.500	1.300	V
V_{IN}	Receiver (RXP/RXN) and transmitter (TXP/TXN) absolute input voltage.	–0.500	1.200	V
$I_{DCIN-FLOAT}$	DC input current for receiver input pins DC coupled RX termination = floating.(7)	–	10	mA
$I_{DCIN-MGTAVTT}$	DC input current for receiver input pins DC coupled RX termination = $V_{MGTAVTT}$.	–	10	mA
$I_{DCIN-GND}$	DC input current for receiver input pins DC coupled RX termination = GND.(8)	–	0	mA
$I_{DCIN-PROG}$	DC input current for receiver input pins DC coupled RX termination = programmable.(9)	–	0	mA
$I_{DCOUT-FLOAT}$	DC output current for transmitter pins DC coupled RX termination = floating.	–	6	mA
$I_{DCOUT-MGTAVTT}$	DC output current for transmitter pins DC coupled RX termination = $V_{MGTAVTT}$.	–	6	mA
System Monitor				
V_{CCADC}	System Monitor supply relative to GNDADC.	0.500	2.000	V
V_{REFP}	System Monitor reference input relative to GNDADC.	0.500	2.000	V
Temperature				
T_{STG}	Storage temperature (ambient).	–65	150	°C
T_{SOL}	Maximum soldering temperature.(11)	–	260	°C
T_j	Maximum junction temperature.(11)	–	125	°C

Notes:

1. Stresses beyond those listed under Absolute Maximum Ratings might cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those listed under Operating Conditions is not implied. Exposure to Absolute Maximum Ratings conditions for extended periods of time might affect device reliability.
2. V_{CCINT_IO} must be connected to V_{CCBRAM}.
3. V_{CCAUX_IO} must be connected to V_{CCAUX}.
4. The lower absolute voltage specification always applies.
5. For I/O operation, see the *UltraScale Architecture SelectIO Resources User Guide* (UG571).
6. When operating outside of the recommended operating conditions, refer to Table 4 for maximum overshoot and undershoot specifications.
7. AC coupled operation is not supported for RX termination = floating.
8. For GTY transceivers, DC coupled operation is not supported for RX termination = GND.
9. DC coupled operation is not supported for RX termination = programmable.
10. For more information on supported GTY transceiver terminations see the or *UltraScale Architecture GTY Transceiver User Guide* (UG578)
11. For soldering guidelines and thermal considerations, see the *UltraScale and UltraScale+ FPGA Packaging and Pinout Specifications* (UG575).

Table 2: **Recommended Operating Conditions(1)(2) *(Cont'd)***

Symbol	Description	Min	Typ	Max	Units
SYSMON					
V_{CCADC}	SYSMON supply relative to GNDADC.	1.746	1.800	1.854	V
V_{REFP}	SYSMON externally supplied reference voltage relative to GNDADC.	1.200	1.250	1.300	V
Temperature					
T_j(11)	Junction temperature operating range for extended (E) temperature devices.(12)	0	–	100	°C
	Junction temperature operating range for industrial (I) temperature devices.	–40	–	100	°C
	Junction temperature operating range for eFUSE programming.(13)	–40	–	125	°C

Notes:

1. All voltages are relative to GND.
2. For the design of the power distribution system consult *UltraScale Architecture PCB Design Guide* (UG583).
3. V_{CCINT_IO} must be connected to V_{CCBRAM}.
4. For V_{CCO_0}, the minimum recommended operating voltage for power on and during configuration is 1.425V. After configuration, data is retained even if V_{CCO} drops to 0V.
5. Includes V_{CCO} of 1.0V, 1.2V, 1.35V, 1.5V, and 1.8V.
6. V_{CCAUX_IO} must be connected to V_{CCAUX}.
7. The lower absolute voltage specification always applies.
8. A total of 200 mA per bank should not be exceeded.
9. If battery is not used, connect V_{BATT} to either GND or V_{CCAUX}.
10. Each voltage listed requires filtering as described in the *UltraScale Architecture GTY Transceiver User Guide* (UG578).
11. Xilinx recommends measuring the Tj of a device using the system monitor as described in the *UltraScale Architecture System Monitor User Guide* (UG580). The SYSMON temperature measurement errors (that are described in Table 58) must be accounted for in your design. For example, by using an external reference of 1.25V, when SYSMON reports 97°C, there is a measurement error ±3°C. A reading of 97°C is considered the maximum adjusted Tj (100°C – 3°C = 97°C).
12. Devices labeled with the speed/temperature grade of -2LE can operate for a limited time at a junction temperature of 110°C. Timing parameters adhere to the same speed file at 110°C as they do below 110°C, regardless of operating voltage (nominal voltage of 0.85V or a low-voltage of 0.72V). Operation at Tj = 110°C is limited to 1% of the device lifetime and can occur sequentially or at regular intervals as long as the total time does not exceed 1% of the device lifetime.
13. Do not program eFUSE during device configuration (e.g., during configuration, during configuration readback, or when readback CRC is active).

DC Characteristics Over Recommended Operating Conditions

Table 3: **DC Characteristics Over Recommended Operating Conditions**

Symbol	Description	Min	Typ(1)	Max	Units
V_{DRINT}	Data retention V_{CCINT} voltage (below which configuration data might be lost).	0.68	–	–	V
V_{DRAUX}	Data retention V_{CCAUX} voltage (below which configuration data might be lost).	1.5	–	–	V
I_{REF}	V_{REF} leakage current per pin.	–	–	15	µA
I_L	Input or output leakage current per pin (sample-tested).(2)	–	–	15	µA
C_{IN}(3)	Die input capacitance at the pad.	–	–	3.1	pF
I_{RPU}	Pad pull-up (when selected) at V_{IN} = 0V, V_{CCO} = 3.3V.	75	–	190	µA
	Pad pull-up (when selected) at V_{IN} = 0V, V_{CCO} = 2.5V.	50	–	169	µA
	Pad pull-up (when selected) at V_{IN} = 0V, V_{CCO} = 1.8V.	60	–	120	µA
	Pad pull-up (when selected) at V_{IN} = 0V, V_{CCO} = 1.5V.	30	–	120	µA
	Pad pull-up (when selected) at V_{IN} = 0V, V_{CCO} = 1.2V.	10	–	100	µA
I_{RPD}	Pad pull-down (when selected) at V_{IN} = 3.3V.	60	–	200	µA
	Pad pull-down (when selected) at V_{IN} = 1.8V.	29	–	120	µA
$I_{CCADCON}$	Analog supply current for the SYSMON circuits in the power-up state.	–	–	8	mA
$I_{CCADCOFF}$	Analog supply current for the SYSMON circuits in the power-down state.	–	–	1.5	mA
I_{BATT}(4)(5)	Battery supply current at V_{BATT} = 1.89V.	–	–	650	nA
	Battery supply current at V_{BATT} = 1.20V.	–	–	150	nA
I_{PFS}(6)	V_{CCAUX} additional supply current during eFUSE programming.	–	–	115	mA
Calibrated programmable on-die termination (DCI) in I/O banks(8) (measured per JEDEC specification)					
R(9)	Thevenin equivalent resistance of programmable input termination to V_{CCO}/2 where ODT = RTT_40.	–10%(8)	40	+10%(8)	Ω
	Thevenin equivalent resistance of programmable input termination to V_{CCO}/2 where ODT = RTT_48.	–10%(8)	48	+10%(8)	Ω
	Thevenin equivalent resistance of programmable input termination to V_{CCO}/2 where ODT = RTT_60.	–10%(8)	60	+10%(8)	Ω
	Programmable input termination to V_{CCO} where ODT = RTT_40.	–10%(8)	40	+10%(8)	Ω
	Programmable input termination to V_{CCO} where ODT = RTT_48.	–10%(8)	48	+10%(8)	Ω
	Programmable input termination to V_{CCO} where ODT = RTT_60.	–10%(8)	60	+10%(8)	Ω
	Programmable input termination to V_{CCO} where ODT = RTT_120.	–10%(8)	120	+10%(8)	Ω
	Programmable input termination to V_{CCO} where ODT = RTT_240.	–10%(8)	240	+10%(8)	Ω

Table 5: **Typical Quiescent Supply Current(1)(2)(3) *(Cont'd)***

Symbol	Description	Device	Speed Grade and V_{CCINT} Operating Voltages				Units
			0.90V	0.85V		0.72V	
			-3	-2	-1	-2	
I_{CCAUX_IOQ}	Quiescent V_{CCAUX_IO} supply current.	XCVU3P	62	62	62	62	mA
		XCVU5P	124	124	124	124	mA
		XCVU7P	124	124	124	124	mA
		XCVU9P	187	187	187	187	mA
		XCVU11P	79	79	79	79	mA
		XCVU13P	105	105	105	105	mA
$I_{CCBRAMQ}$	Quiescent V_{CCBRAM} supply current.	XCVU3P	45	43	43	43	mA
		XCVU5P	90	85	85	85	mA
		XCVU7P	90	85	85	85	mA
		XCVU9P	134	128	128	128	mA
		XCVU11P	130	124	124	124	mA
		XCVU13P	174	165	165	165	mA

Notes:

1. Typical values are specified at nominal voltage, 85°C junction temperatures (T_j) with single-ended SelectIO™ resources.
2. Typical values are for blank configured devices with no output current loads, no active input pull-up resistors, all I/O pins are 3-state and floating.
3. Use the Xilinx Power Estimator (XPE) spreadsheet tool (download at www.xilinx.com/power) to estimate static power consumption for conditions other than those specified.

Power-On/Off Power Supply Sequencing

The recommended power-on sequence is V_{CCINT}, V_{CCINT_IO}/V_{CCBRAM}, V_{CCAUX}/V_{CCAUX_IO}, and V_{CCO} to achieve minimum current draw and ensure that the I/Os are 3-stated at power-on. The recommended power-off sequence is the reverse of the power-on sequence. If V_{CCINT} and V_{CCINT_IO}/V_{CCBRAM} have the same recommended voltage levels, they can be powered by the same supply and ramped simultaneously. V_{CCINT_IO} must be connected to V_{CCBRAM}. If V_{CCAUX}/V_{CCAUX_IO} and V_{CCO} have the same recommended voltage levels, they can be powered by the same supply and ramped simultaneously. V_{CCAUX} and V_{CCAUX_IO} must be connected together. V_{CCADC} and V_{REF} can be powered at any time and have no power-up sequencing requirements.

The recommended power-on sequence to achieve minimum current draw for the GTY transceivers are V_{CCINT}, $V_{MGTAVCC}$, $V_{MGTAVTT}$ OR $V_{MGTAVCC}$, V_{CCINT}, $V_{MGTAVTT}$. There is no recommended sequencing for $V_{MGTVCCAUX}$. Both $V_{MGTAVCC}$ and V_{CCINT} can be ramped simultaneously. The recommended power-off sequence is the reverse of the power-on sequence to achieve minimum current draw.

If these recommended sequences are not met, current drawn from $V_{MGTAVTT}$ can be higher than specifications during power-up and power-down.

Table 10: **Differential SelectIO DC Input and Output Levels**

I/O Standard	V_{ICM} (V)(1)			V_{ID}(V)(2)			V_{ILHS}(3)	V_{IHHS}(3)	V_{OCM}(V)(4)			V_{OD}(V)(5)		
	Min	Typ	Max	Min	Typ	Max	Min	Max	Min	Typ	Max	Min	Typ	Max
SUB_LVDS	0.500	0.900	1.300	0.070	–	–	–	–	0.700	0.900	1.100	0.100	0.150	0.200
SLVS_400_18	0.070	0.200	0.330	0.140	–	0.450	–	–	–	–	–	–	–	–
MIPI_DPHY_DCI_HS(7)	0.070	–	0.330	0.070	–	–	–0.040	0.460	0.150	0.200	0.250	0.140	0.200	0.270

Notes:

1. V_{ICM} is the input common mode voltage.
2. V_{ID} is the input differential voltage (Q – $\overline{Q}$).
3. V_{IHHS} and V_{ILHS} are the single-ended input high and low voltages, respectively.
4. V_{OCM} is the output common mode voltage.
5. V_{OD} is the output differential voltage (Q – $\overline{Q}$).
6. LVDS is specified in Table 15.
7. High-speed option for MIPI_DPHY_DCI. The V_{ID} maximum is aligned with the standard's specification. A higher V_{ID} is acceptable as long as the V_{IN} specification is also met.

Table 11: **Complementary Differential SelectIO DC Input and Output Levels for the I/O Banks(1)**

I/O Standard	V_{ICM} (V)(2)			V_{ID} (V)(3)		V_{OL} (V)(4)	V_{OH} (V)(5)	I_{OL}	I_{OH}
	Min	Typ	Max	Min	Max	Max	Min	mA	mA
DIFF_HSTL_I	0.680	V_{CCO}/2	(V_{CCO}/2) + 0.150	0.100	–	0.400	V_{CCO} – 0.400	5.8	–5.8
DIFF_HSTL_I_12	0.400 x V_{CCO}	V_{CCO}/2	0.600 x V_{CCO}	0.100	–	0.250 x V_{CCO}	0.750 x V_{CCO}	4.1	–4.1
DIFF_HSTL_I_18	(V_{CCO}/2) – 0.175	V_{CCO}/2	(V_{CCO}/2) + 0.175	0.100	–	0.400	V_{CCO} – 0.400	6.2	–6.2
DIFF_HSUL_12	(V_{CCO}/2) – 0.120	V_{CCO}/2	(V_{CCO}/2) + 0.120	0.100	–	20% V_{CCO}	80% V_{CCO}	0.1	–0.1
DIFF_SSTL12	(V_{CCO}/2) – 0.150	V_{CCO}/2	(V_{CCO}/2) + 0.150	0.100	–	(V_{CCO}/2) – 0.150	(V_{CCO}/2) + 0.150	8.0	–8.0
DIFF_SSTL135	(V_{CCO}/2) – 0.150	V_{CCO}/2	(V_{CCO}/2) + 0.150	0.100	–	(V_{CCO}/2) – 0.150	(V_{CCO}/2) + 0.150	9.0	–9.0
DIFF_SSTL15	(V_{CCO}/2) – 0.175	V_{CCO}/2	(V_{CCO}/2) + 0.175	0.100	–	(V_{CCO}/2) – 0.175	(V_{CCO}/2) + 0.175	10.0	–10.0
DIFF_SSTL18_I	(V_{CCO}/2) – 0.175	V_{CCO}/2	(V_{CCO}/2) + 0.175	0.100	–	(V_{CCO}/2) – 0.470	(V_{CCO}/2) + 0.470	7.0	–7.0

Notes:

1. DIFF_POD10 and DIFF_POD12 HP I/O bank specifications are shown in Table 12, Table 13, and Table 14.
2. V_{ICM} is the input common mode voltage.
3. V_{ID} is the input differential voltage.
4. V_{OL} is the single-ended low-output voltage.
5. V_{OH} is the single-ended high-output voltage.

Table 12: **DC Input Levels for Differential POD10 and POD12 I/O Standards(1)(2)**

I/O Standard	V_{ICM} (V)			V_{ID} (V)	
	Min	Typ	Max	Min	Max
DIFF_POD10	0.63	0.70	0.77	0.14	–
DIFF_POD12	0.76	0.84	0.92	0.16	–

Notes:

1. Tested according to relevant specifications.
2. Standards specified using the default I/O standard configuration. For details, see the *UltraScale Architecture SelectIO Resources User Guide* (UG571).

FPGA Logic Performance Characteristics

This section provides the performance characteristics of some common functions and designs implemented in Virtex UltraScale+ FPGAs. These values are subject to the same guidelines as the AC Switching Characteristics, page 13.

Table 19: **LVDS Component Mode Performance**

Description	Speed Grade and V_{CCINT} Operating Voltages								Units
	0.90V		0.85V				0.72V		
	-3		-2		-1		-2		
	Min	Max	Min	Max	Min	Max	Min	Max	
LVDS TX DDR (OSERDES 4:1, 8:1)	0	1250	0	1250	0	1250	0	1250	Mb/s
LVDS TX SDR (OSERDES 2:1, 4:1)	0	625	0	625	0	625	0	625	Mb/s
LVDS RX DDR (ISERDES 1:4, 1:8)(1)	0	1250	0	1250	0	1250	0	1250	Mb/s
LVDS RX SDR (ISERDES 1:2, 1:4)(1)	0	625	0	625	0	625	0	625	Mb/s

Notes:

1. LVDS receivers are typically bounded with certain applications to achieve maximum performance. Package skews are not included and should be removed through PCB routing.

Table 20: **LVDS Native Mode Performance(1)(2)**

Description	DATA_WIDTH	Speed Grade and V_{CCINT} Operating Voltages								Units
		0.90V		0.85V				0.72V		
		-3		-2		-1		-2		
		Min	Max	Min	Max	Min	Max	Min	Max	
LVDS TX DDR (TX_BITSLICE)	4	375	1600	375	1600	375	1260	375	1400	Mb/s
	8	375	1600	375	1600	375	1260	375	1600	Mb/s
LVDS TX SDR (TX_BITSLICE)	4	187.5	800	187.5	800	187.5	630	187.5	700	Mb/s
	8	187.5	800	187.5	800	187.5	630	187.5	800	Mb/s
LVDS RX DDR (RX_BITSLICE)(3)	4	375	1600	375	1600	375	1260	375	1400	Mb/s
	8	375	1600	375	1600	375	1260	375	1600	Mb/s
LVDS RX SDR (RX_BITSLICE)(3)	4	187.5	800	187.5	800	187.5	630	187.5	700	Mb/s
	8	187.5	800	187.5	800	187.5	630	187.5	800	Mb/s

Notes:

1. Native mode is supported through the High-Speed SelectIO Interface Wizard available with the Vivado Design Suite.
2. PLL settings can restrict the minimum allowable data rate. For example, when using the PLL with CLKOUTPHY_MODE = VCO_HALF the minimum frequency is PLL_FVCOMIN/2.
3. LVDS receivers are typically bounded with certain applications to achieve maximum performance. Package skews are not included and should be removed through PCB routing.

Table 21: **MIPI D-PHY Performance**

Description	Speed Grade and V_{CCINT} Operating Voltages				Units
	0.90V	0.85V		0.72V	
	-3	-2	-1	-2	
MIPI D-PHY transmitter or receiver.	1500	1500	1260	1260	Mb/s

Table 22: **LVDS Native-Mode 1000BASE-X Support(1)**

Description	Speed Grade and V_{CCINT} Operating Voltages			
	0.90V	0.85V		0.72V
	-3	-2	-1	-2
1000BASE-X	Yes			

Notes:
1. 1000BASE-X support is based on the *IEEE Standard for CSMA/CD Access Method and Physical Layer Specifications* (IEEE Std 802.3-2008).

Table 23 provides the maximum data rates for applicable memory standards using the Virtex UltraScale+ FPGA memory PHY. Refer to Memory Interfaces for the complete list of memory interface standards supported and detailed specifications. The final performance of the memory interface is determined through a complete design implemented in the Vivado Design Suite, following guidelines in the *UltraScale Architecture PCB Design Guide* (UG583), electrical analysis, and characterization of the system.

Table 23: **Maximum Physical Interface (PHY) Rate for Memory Interfaces**

Memory Standard	DRAM Type	Speed Grade and V_{CCINT} Operating Voltages				Units
		0.90V	0.85V		0.72V	
		-3	-2	-1	-2	
DDR4	Single rank component	2666	2666	2400	2400	Mb/s
	1 rank DIMM(1)(2)	2400	2400	2133	2133	Mb/s
	2 rank DIMM(1)(3)	2133	2133	1866	1866	Mb/s
	4 rank DIMM(1)(4)	1600	1600	1333	1333	Mb/s
DDR3	Single rank component	2133	2133	2133	2133	Mb/s
	1 rank DIMM(1)(2)	1866	1866	1866	1866	Mb/s
	2 rank DIMM(1)(3)	1600	1600	1600	1600	Mb/s
	4 rank DIMM(1)(4)	1066	1066	1066	1066	Mb/s
DDR3L	Single rank component	1866	1866	1866	1866	Mb/s
	1 rank DIMM(1)(2)	1600	1600	1600	1600	Mb/s
	2 rank DIMM(1)(3)	1333	1333	1333	1333	Mb/s
	4 rank DIMM(1)(4)	800	800	800	800	Mb/s
QDR II+	Single rank component(5)	633	633	600	600	MHz
RLDRAM 3	Single rank component	1200	1200	1066	1066	MHz
QDR IV XP	Single rank component	1066	1066	1066	933	MHz
LPDDR3	Single rank component	1600	1600	1600	1600	Mb/s

Notes:
1. Dual in-line memory module (DIMM) includes RDIMM, SODIMM, UDIMM, and LRDIMM.
2. Includes: 1 rank 1 slot, DDP 2 rank, LRDIMM 2 or 4 rank 1 slot.
3. Includes: 2 rank 1 slot, 1 rank 2 slot, LRDIMM 2 rank 2 slot.
4. Includes: 2 rank 2 slot, 4 rank 1 slot.
5. The QDRII+ performance specifications are for burst-length 4 (BL = 4) implementations.

Table 24: **IOB High Performance (HP) Switching Characteristics *(Cont'd)***

I/O Standards	$T_{INBUF\_DELAY\_PAD\_I}$				$T_{OUTBUF\_DELAY\_O\_PAD}$				$T_{OUTBUF\_DELAY\_TD\_PAD}$				Units
	0.90V	0.85V		0.72V	0.90V	0.85V		0.72V	0.90V	0.85V		0.72V	
	-3	-2	-1	-2	-3	-2	-1	-2	-3	-2	-1	-2	
DIFF_POD10_DCI_F	0.411	0.411	0.430	0.411	0.425	0.425	0.444	0.425	0.555	0.555	0.584	0.555	ns
DIFF_POD10_DCI_M	0.411	0.411	0.430	0.411	0.542	0.542	0.571	0.542	0.640	0.640	0.681	0.640	ns
DIFF_POD10_DCI_S	0.411	0.411	0.430	0.411	0.754	0.754	0.815	0.754	0.850	0.850	0.917	0.850	ns
DIFF_POD10_F	0.411	0.411	0.433	0.411	0.438	0.438	0.459	0.438	0.569	0.569	0.601	0.569	ns
DIFF_POD10_M	0.411	0.411	0.433	0.411	0.538	0.538	0.568	0.538	0.630	0.630	0.667	0.630	ns
DIFF_POD10_S	0.411	0.411	0.433	0.411	0.766	0.766	0.821	0.766	0.836	0.836	0.894	0.836	ns
DIFF_POD12_DCI_F	0.407	0.407	0.432	0.407	0.425	0.425	0.443	0.425	0.558	0.558	0.586	0.558	ns
DIFF_POD12_DCI_M	0.407	0.407	0.432	0.407	0.543	0.543	0.572	0.543	0.638	0.638	0.678	0.638	ns
DIFF_POD12_DCI_S	0.407	0.407	0.432	0.407	0.772	0.772	0.822	0.772	0.862	0.862	0.929	0.862	ns
DIFF_POD12_F	0.409	0.409	0.430	0.409	0.455	0.455	0.476	0.455	0.595	0.595	0.626	0.595	ns
DIFF_POD12_M	0.409	0.409	0.430	0.409	0.551	0.551	0.582	0.551	0.641	0.641	0.679	0.641	ns
DIFF_POD12_S	0.409	0.409	0.430	0.409	0.767	0.767	0.817	0.767	0.832	0.832	0.889	0.832	ns
DIFF_SSTL12_DCI_F	0.381	0.381	0.400	0.381	0.425	0.425	0.443	0.425	0.558	0.558	0.586	0.558	ns
DIFF_SSTL12_DCI_M	0.381	0.381	0.400	0.381	0.557	0.557	0.587	0.557	0.654	0.654	0.694	0.654	ns
DIFF_SSTL12_DCI_S	0.381	0.381	0.400	0.381	0.754	0.754	0.803	0.754	0.842	0.842	0.908	0.842	ns
DIFF_SSTL12_F	0.394	0.394	0.402	0.394	0.412	0.412	0.430	0.412	0.538	0.538	0.566	0.538	ns
DIFF_SSTL12_M	0.394	0.394	0.402	0.394	0.553	0.553	0.584	0.553	0.641	0.641	0.676	0.641	ns
DIFF_SSTL12_S	0.394	0.394	0.402	0.394	0.758	0.758	0.808	0.758	0.823	0.823	0.879	0.823	ns
DIFF_SSTL135_DCI_F	0.371	0.371	0.402	0.371	0.411	0.411	0.428	0.411	0.537	0.537	0.565	0.537	ns
DIFF_SSTL135_DCI_M	0.371	0.371	0.402	0.371	0.551	0.551	0.582	0.551	0.645	0.645	0.685	0.645	ns
DIFF_SSTL135_DCI_S	0.371	0.371	0.402	0.371	0.746	0.746	0.799	0.746	0.829	0.829	0.893	0.829	ns
DIFF_SSTL135_F	0.375	0.375	0.402	0.375	0.408	0.408	0.428	0.408	0.528	0.528	0.561	0.528	ns
DIFF_SSTL135_M	0.375	0.375	0.402	0.375	0.555	0.555	0.585	0.555	0.641	0.641	0.679	0.641	ns
DIFF_SSTL135_S	0.375	0.375	0.402	0.375	0.772	0.772	0.823	0.772	0.827	0.827	0.878	0.827	ns
DIFF_SSTL15_DCI_F	0.397	0.397	0.417	0.397	0.412	0.412	0.429	0.412	0.531	0.531	0.563	0.531	ns
DIFF_SSTL15_DCI_M	0.397	0.397	0.417	0.397	0.553	0.553	0.583	0.553	0.645	0.645	0.685	0.645	ns
DIFF_SSTL15_DCI_S	0.397	0.397	0.417	0.397	0.768	0.768	0.822	0.768	0.847	0.847	0.912	0.847	ns
DIFF_SSTL15_F	0.404	0.404	0.417	0.404	0.424	0.424	0.445	0.424	0.551	0.551	0.577	0.551	ns
DIFF_SSTL15_M	0.404	0.404	0.417	0.404	0.554	0.554	0.585	0.554	0.639	0.639	0.677	0.639	ns
DIFF_SSTL15_S	0.404	0.404	0.417	0.404	0.767	0.767	0.817	0.767	0.813	0.813	0.867	0.813	ns
DIFF_SSTL18_I_DCI_F	0.320	0.320	0.336	0.320	0.445	0.445	0.461	0.445	0.566	0.566	0.595	0.566	ns
DIFF_SSTL18_I_DCI_M	0.320	0.320	0.336	0.320	0.554	0.554	0.585	0.554	0.644	0.644	0.683	0.644	ns
DIFF_SSTL18_I_DCI_S	0.320	0.320	0.336	0.320	0.762	0.762	0.818	0.762	0.837	0.837	0.899	0.837	ns
DIFF_SSTL18_I_F	0.316	0.316	0.336	0.316	0.454	0.454	0.476	0.454	0.578	0.578	0.608	0.578	ns
DIFF_SSTL18_I_M	0.316	0.316	0.336	0.316	0.571	0.571	0.603	0.571	0.652	0.652	0.692	0.652	ns
DIFF_SSTL18_I_S	0.316	0.316	0.336	0.316	0.782	0.782	0.835	0.782	0.816	0.816	0.870	0.816	ns
HSLVDCI_15_F	0.393	0.393	0.415	0.393	0.425	0.425	0.443	0.425	0.548	0.548	0.579	0.548	ns
HSLVDCI_15_M	0.393	0.393	0.415	0.393	0.552	0.552	0.581	0.552	0.644	0.644	0.684	0.644	ns
HSLVDCI_15_S	0.393	0.393	0.415	0.393	0.748	0.748	0.802	0.748	0.827	0.827	0.890	0.827	ns
HSLVDCI_18_F	0.424	0.424	0.447	0.424	0.445	0.445	0.461	0.445	0.566	0.566	0.595	0.566	ns
HSLVDCI_18_M	0.424	0.424	0.447	0.424	0.567	0.567	0.598	0.567	0.658	0.658	0.699	0.658	ns

Table 24: **IOB High Performance (HP) Switching Characteristics *(Cont'd)***

I/O Standards	$T_{INBUF\_DELAY\_PAD\_I}$				$T_{OUTBUF\_DELAY\_O\_PAD}$				$T_{OUTBUF\_DELAY\_TD\_PAD}$				Units
	0.90V	0.85V		0.72V	0.90V	0.85V		0.72V	0.90V	0.85V		0.72V	
	-3	-2	-1	-2	-3	-2	-1	-2	-3	-2	-1	-2	
LVCMOS15_F_8	0.414	0.414	0.445	0.414	0.518	0.518	0.538	0.518	0.686	0.686	0.703	0.686	ns
LVCMOS15_M_12	0.414	0.414	0.445	0.414	0.607	0.607	0.644	0.607	0.637	0.637	0.676	0.637	ns
LVCMOS15_M_2	0.414	0.414	0.445	0.414	0.741	0.741	0.770	0.741	0.938	0.938	0.962	0.938	ns
LVCMOS15_M_4	0.414	0.414	0.445	0.414	0.625	0.625	0.651	0.625	0.754	0.754	0.786	0.754	ns
LVCMOS15_M_6	0.414	0.414	0.445	0.414	0.576	0.576	0.604	0.576	0.674	0.674	0.710	0.674	ns
LVCMOS15_M_8	0.414	0.414	0.445	0.414	0.568	0.568	0.601	0.568	0.639	0.639	0.681	0.639	ns
LVCMOS15_S_12	0.414	0.414	0.445	0.414	0.788	0.788	0.855	0.788	0.695	0.695	0.733	0.695	ns
LVCMOS15_S_2	0.414	0.414	0.445	0.414	0.829	0.829	0.864	0.829	1.039	1.039	1.079	1.039	ns
LVCMOS15_S_4	0.414	0.414	0.445	0.414	0.687	0.687	0.725	0.687	0.813	0.813	0.851	0.813	ns
LVCMOS15_S_6	0.414	0.414	0.445	0.414	0.671	0.671	0.710	0.671	0.726	0.726	0.763	0.726	ns
LVCMOS15_S_8	0.414	0.414	0.445	0.414	0.704	0.704	0.755	0.704	0.721	0.721	0.758	0.721	ns
LVCMOS18_F_12	0.418	0.418	0.445	0.418	0.573	0.573	0.601	0.573	0.731	0.731	0.769	0.731	ns
LVCMOS18_F_2	0.418	0.418	0.445	0.418	0.739	0.739	0.760	0.739	0.945	0.945	0.971	0.945	ns
LVCMOS18_F_4	0.418	0.418	0.445	0.418	0.609	0.609	0.630	0.609	0.778	0.778	0.802	0.778	ns
LVCMOS18_F_6	0.418	0.418	0.445	0.418	0.603	0.603	0.633	0.603	0.781	0.781	0.808	0.781	ns
LVCMOS18_F_8	0.418	0.418	0.445	0.418	0.573	0.573	0.600	0.573	0.733	0.733	0.767	0.733	ns
LVCMOS18_M_12	0.418	0.418	0.445	0.418	0.640	0.640	0.678	0.640	0.670	0.670	0.709	0.670	ns
LVCMOS18_M_2	0.418	0.418	0.445	0.418	0.798	0.798	0.822	0.798	0.991	0.991	1.016	0.991	ns
LVCMOS18_M_4	0.418	0.418	0.445	0.418	0.664	0.664	0.693	0.664	0.798	0.798	0.836	0.798	ns
LVCMOS18_M_6	0.418	0.418	0.445	0.418	0.629	0.629	0.663	0.629	0.735	0.735	0.775	0.735	ns
LVCMOS18_M_8	0.418	0.418	0.445	0.418	0.626	0.626	0.661	0.626	0.705	0.705	0.746	0.705	ns
LVCMOS18_S_12	0.418	0.418	0.445	0.418	0.795	0.795	0.861	0.795	0.683	0.683	0.721	0.683	ns
LVCMOS18_S_2	0.418	0.418	0.445	0.418	0.862	0.862	0.897	0.862	1.076	1.076	1.098	1.076	ns
LVCMOS18_S_4	0.418	0.418	0.445	0.418	0.716	0.716	0.758	0.716	0.829	0.829	0.872	0.829	ns
LVCMOS18_S_6	0.418	0.418	0.445	0.418	0.682	0.682	0.724	0.682	0.724	0.724	0.762	0.724	ns
LVCMOS18_S_8	0.418	0.418	0.445	0.418	0.707	0.707	0.760	0.707	0.709	0.709	0.745	0.709	ns
LVDCI_15_F	0.425	0.425	0.462	0.425	0.426	0.426	0.443	0.426	0.548	0.548	0.581	0.548	ns
LVDCI_15_M	0.425	0.425	0.462	0.425	0.553	0.553	0.582	0.553	0.645	0.645	0.685	0.645	ns
LVDCI_15_S	0.425	0.425	0.462	0.425	0.749	0.749	0.803	0.749	0.821	0.821	0.890	0.821	ns
LVDCI_18_F	0.414	0.414	0.447	0.414	0.441	0.441	0.459	0.441	0.560	0.560	0.589	0.560	ns
LVDCI_18_M	0.414	0.414	0.447	0.414	0.554	0.554	0.585	0.554	0.644	0.644	0.683	0.644	ns
LVDCI_18_S	0.414	0.414	0.447	0.414	0.760	0.760	0.818	0.760	0.837	0.837	0.899	0.837	ns
LVDS	0.539	0.539	0.620	0.539	0.626	0.626	0.662	0.626	960.447	960.447	960.447	960.447	ns
MIPI_DPHY_DCI_HS	0.386	0.386	0.415	0.386	0.502	0.502	0.522	0.502	N/A	N/A	N/A	N/A	ns
MIPI_DPHY_DCI_LP	8.438	8.438	8.792	8.438	0.914	0.914	0.937	0.914	N/A	N/A	N/A	N/A	ns
POD10_DCI_F	0.408	0.408	0.430	0.408	0.425	0.425	0.444	0.425	0.555	0.555	0.584	0.555	ns
POD10_DCI_M	0.408	0.408	0.430	0.408	0.542	0.542	0.571	0.542	0.640	0.640	0.681	0.640	ns
POD10_DCI_S	0.408	0.408	0.430	0.408	0.754	0.754	0.815	0.754	0.850	0.850	0.917	0.850	ns
POD10_F	0.407	0.407	0.430	0.407	0.438	0.438	0.459	0.438	0.569	0.569	0.601	0.569	ns
POD10_M	0.407	0.407	0.430	0.407	0.538	0.538	0.568	0.538	0.630	0.630	0.667	0.630	ns
POD10_S	0.407	0.407	0.430	0.407	0.766	0.766	0.821	0.766	0.836	0.836	0.894	0.836	ns

Input/Output Delay Switching Characteristics

Table 30: **Input/Output Delay Switching Characteristics**

Symbol	Description	Speed Grade and V_{CCINT} Operating Voltages				Units
		0.90V	0.85V		0.72V	
		-3	-2	-1	-2	
F_{REFCLK}	REFCLK frequency for IDELAYCTRL (component mode).	300 to 800				MHz
	REFCLK frequency for BITSLICE_CONTROL (native mode).(1)	300 to 2666.67	300 to 2666.67	300 to 2400	300 to 2400	MHz
T_{MINPER_CLK}	Minimum period for IODELAY clock.	3.195	3.195	3.195	3.195	ns
T_{MINPER_RST}	Minimum reset pulse width.	52.00				ns
$T_{IDELAY\_RESOLUTION}$/ $T_{ODELAY\_RESOLUTION}$	IDELAY/ODELAY chain resolution.	2.1 to 12				ps

Notes:

1. PLL settings could restrict the minimum allowable data rate. For example, when using a PLL with CLKOUTPHY_MODE = VCO_HALF, the minimum frequency is PLL_FVCOMIN/2.

DSP48 Slice Switching Characteristics

Table 31: **DSP48 Slice Switching Characteristics**

Symbol	Description	Speed Grade and V_{CCINT} Operating Voltages				Units
		0.90V	0.85V		0.72V	
		-3	-2	-1	-2	
Maximum Frequency						
F_{MAX}	With all registers used.	891	775	645	644	MHz
F_{MAX_PATDET}	With pattern detector.	794	687	571	562	MHz
$F_{MAX\_MULT\_NOMREG}$	Two register multiply without MREG.	635	544	456	440	MHz
$F_{MAX\_MULT\_NOMREG\_PATDET}$	Two register multiply without MREG with pattern detect.	577	492	410	395	MHz
$F_{MAX\_PREADD\_NOADREG}$	Without ADREG.	655	565	468	453	MHz
$F_{MAX\_NOPIPELINEREG}$	Without pipeline registers (MREG, ADREG).	483	410	338	323	MHz
$F_{MAX\_NOPIPELINEREG\_PATDET}$	Without pipeline registers (MREG, ADREG) with pattern detect.	448	379	314	299	MHz

MMCM Switching Characteristics

Table 33: **MMCM Specification**

Symbol	Description	Speed Grade and V_{CCINT} Operating Voltages				Units
		0.90V	0.85V		0.72V	
		-3	-2	-1	-2	
MMCM_F_{INMAX}	Maximum input clock frequency.	1066	933	800	933	MHz
MMCM_F_{INMIN}	Minimum input clock frequency.	10	10	10	10	MHz
MMCM_$F_{INJITTER}$	Maximum input clock period jitter.	< 20% of clock input period or 1 ns Max				
MMCM_F_{INDUTY}	Input duty cycle range: 10–49 MHz.	25–75				%
	Input duty cycle range: 50–199 MHz.	30–70				%
	Input duty cycle range: 200–399 MHz.	35–65				%
	Input duty cycle range: 400–499 MHz.	40–60				%
	Input duty cycle range: >500 MHz.	45–55				%
MMCM_F_{MIN_PSCLK}	Minimum dynamic phase shift clock frequency.	0.01	0.01	0.01	0.01	MHz
MMCM_F_{MAX_PSCLK}	Maximum dynamic phase shift clock frequency.	550	500	450	500	MHz
MMCM_F_{VCOMIN}	Minimum MMCM VCO frequency.	800	800	800	800	MHz
MMCM_F_{VCOMAX}	Maximum MMCM VCO frequency.	1600	1600	1600	1600	MHz
MMCM_$F_{BANDWIDTH}$	Low MMCM bandwidth at typical.(1)	1.00	1.00	1.00	1.00	MHz
	High MMCM bandwidth at typical.(1)	4.00	4.00	4.00	4.00	MHz
MMCM_$T_{STATPHAOFFSET}$	Static phase offset of the MMCM outputs.(2)	0.12	0.12	0.12	0.12	ns
MMCM_$T_{OUTJITTER}$	MMCM output jitter.	Note 3				
MMCM_$T_{OUTDUTY}$	MMCM output clock duty cycle precision.(4)	0.165	0.20	0.20	0.20	ns
MMCM_$T_{LOCKMAX}$	MMCM maximum lock time for MMCM_F_{PFDMIN}.	100	100	100	100	µs
MMCM_F_{OUTMAX}	MMCM maximum output frequency.	891	775	667	725	MHz
MMCM_F_{OUTMIN}	MMCM minimum output frequency.(4)(5)	6.25	6.25	6.25	6.25	MHz
MMCM_$T_{EXTFDVAR}$	External clock feedback variation.	< 20% of clock input period or 1 ns Max				
MMCM_$RST_{MINPULSE}$	Minimum reset pulse width.	5.00	5.00	5.00	5.00	ns
MMCM_F_{PFDMAX}	Maximum frequency at the phase frequency detector.	550	500	450	500	MHz
MMCM_F_{PFDMIN}	Minimum frequency at the phase frequency detector.	10	10	10	10	MHz
MMCM_$T_{FBDELAY}$	Maximum delay in the feedback path.	5 ns Max or one clock cycle				
MMCM_F_{DPRCLK_MAX}	Maximum DRP clock frequency	250	250	250	250	MHz

Notes:

1. The MMCM does not filter typical spread-spectrum input clocks because they are usually far below the bandwidth filter frequencies.
2. The static offset is measured between any MMCM outputs with identical phase.
3. Values for this parameter are available in the Clocking Wizard.
4. Includes global clock buffer.
5. Calculated as F_{VCO}/128 assuming output duty cycle is 50%.

Device Pin-to-Pin Output Parameter Guidelines

The pin-to-pin numbers in Table 35 through Table 37 are based on the clock root placement in the center of the device. The actual pin-to-pin values will vary if the root placement selected is different. Consult the Vivado Design Suite timing report for the actual pin-to-pin values.

Table 35: **Global Clock Input to Output Delay Without MMCM (Near Clock Region)**

Symbol	Description	Device	Speed Grade and V_{CCINT} Operating Voltages				Units
			0.90V	0.85V		0.72V	
			-3	-2	-1	-2	
SSTL15 Global Clock Input to Output Delay using Output Flip-Flop, Fast Slew Rate, *without* MMCM.							
T_{ICKOF}	Global clock input and output flip-flop *without* MMCM (near clock region).	XCVU3P	4.08	4.77	5.09	5.28	ns
		XCVU5P	4.08	4.77	5.09	5.28	ns
		XCVU7P	4.08	4.77	5.09	5.28	ns
		XCVU9P	4.08	4.77	5.09	5.28	ns
		XCVU11P	3.93	4.59	4.90	5.07	ns
		XCVU13P	3.93	4.59	4.90	5.07	ns

Notes:

1. This table lists representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible I/O and CLB flip-flops are clocked by the global clock net in a single SLR.

Table 36: **Global Clock Input to Output Delay Without MMCM (Far Clock Region)**

Symbol	Description	Device	Speed Grade and V_{CCINT} Operating Voltages				Units
			0.90V	0.85V		0.72V	
			-3	-2	-1	-2	
SSTL15 Global Clock Input to Output Delay using Output Flip-Flop, Fast Slew Rate, *without* MMCM.							
T_{ICKOF_FAR}	Global clock input and output flip-flop *without* MMCM (far clock region).	XCVU3P	4.53	5.33	5.69	5.92	ns
		XCVU5P	4.53	5.33	5.69	5.92	ns
		XCVU7P	4.53	5.33	5.69	5.92	ns
		XCVU9P	4.53	5.33	5.69	5.92	ns
		XCVU11P	4.10	4.79	5.11	5.28	ns
		XCVU13P	4.10	4.79	5.11	5.28	ns

Notes:

1. This table lists representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible I/O and CLB flip-flops are clocked by the global clock net in a single SLR.

Table 37: **Global Clock Input to Output Delay With MMCM**

Symbol	Description	Device	Speed Grade and V_{CCINT} Operating Voltages				Units
			0.90V	0.85V		0.72V	
			-3	-2	-1	-2	
SSTL15 Global Clock Input to Output Delay using Output Flip-Flop, Fast Slew Rate, with MMCM.							
$T_{ICKOFMMCMCC}$	Global clock input and output flip-flop *with* MMCM.	XCVU3P	1.80	1.80	1.94	2.34	ns
		XCVU5P	1.80	1.80	1.94	2.34	ns
		XCVU7P	1.80	1.80	1.94	2.34	ns
		XCVU9P	1.80	1.80	1.94	2.34	ns
		XCVU11P	1.56	1.56	1.68	2.07	ns
		XCVU13P	1.56	1.56	1.68	2.07	ns

Notes:

1. This table lists representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible I/O and CLB flip-flops are clocked by the global clock net in a single SLR.
2. MMCM output jitter is already included in the timing calculation.

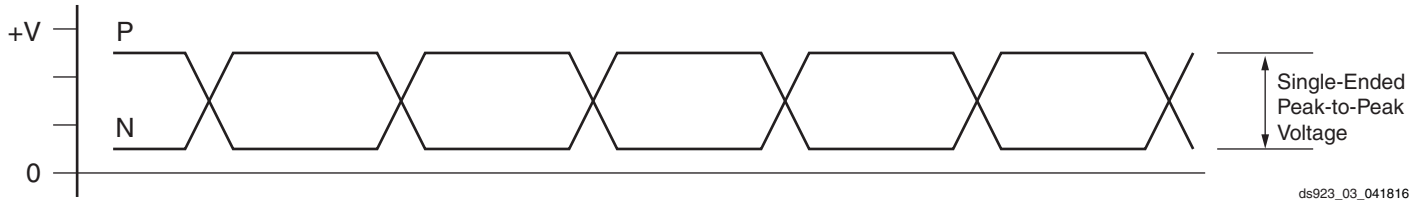

Figure 3: **Single-Ended Peak-to-Peak Voltage**

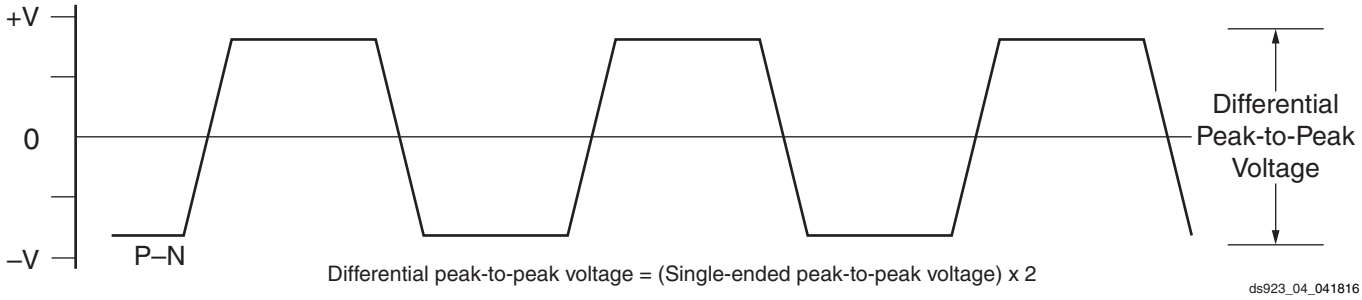

Figure 4: **Differential Peak-to-Peak Voltage**

Table 42 and Table 43 summarize the DC specifications of the clock input of the GTY transceivers in Virtex UltraScale+ FPGAs. Consult www.xilinx.com/products/technology/high-speed-serial for further details.

Table 42: **GTY Transceiver Clock DC Input Level Specification**

Symbol	DC Parameter	Min	Typ	Max	Units
V_{IDIFF}	Differential peak-to-peak input voltage	250	–	2000	mV
R_{IN}	Differential input resistance	–	100	–	Ω
C_{EXT}	Required external AC coupling capacitor	–	10	–	nF

Table 43: **GTY Transceiver Clock Output Level Specification**

Symbol	Description	Conditions	Min	Typ	Max	Units
V_{OL}	Output high voltage for P and N	R_T = 100Ω across P and N signals	100	–	330	mV
V_{OH}	Output low voltage for P and N	R_T = 100Ω across P and N signals	500	–	700	mV
V_{DDOUT}	Differential output voltage (P–N), P = High (N–P), N = High	R_T = 100Ω across P and N signals	300	–	430	mV
V_{CMOUT}	Common mode voltage	R_T = 100Ω across P and N signals	300	–	500	mV

Table 49: **GTY Transceiver User Clock Switching Characteristics(1) *(Cont'd)***

Symbol	Description	Data Width Conditions (Bit)		Speed Grade and V_{CCINT} Operating Voltages				Units
				0.90V	0.85V		0.72V	
		Internal Logic	Interconnect Logic	-3	-2	-1	-2	
F_{TXIN2}	TXUSRCLK2(2) maximum frequency	16	16	511.719	511.719	390.625	390.625	MHz
		16	32	255.859	255.859	195.313	195.313	MHz
		32	32	511.719	511.719	390.625	390.625	MHz
		32	64	255.859	255.859	195.313	195.313	MHz
		64	64	511.719	440.781	402.832	402.832	MHz
		64	128	255.859	220.391	201.416	201.416	MHz
		20	20	409.375	409.375	312.500	312.500	MHz
		20	40	204.688	204.688	156.250	156.250	MHz
		40	40	409.375	409.375	312.500	350.000	MHz
		40	80	204.688	204.688	156.250	175.000	MHz
		80	80	409.375	352.625	322.266	352.625	MHz
		80	160	204.688	176.313	161.133	176.313	MHz
F_{RXIN2}	RXUSRCLK2(2) maximum frequency	16	16	511.719	511.719	390.625	390.625	MHz
		16	32	255.859	255.859	195.313	195.313	MHz
		32	32	511.719	511.719	390.625	390.625	MHz
		32	64	255.859	255.859	195.313	195.313	MHz
		64	64	511.719	440.781	402.832	402.832	MHz
		64	128	255.859	220.391	201.416	201.416	MHz
		20	20	409.375	409.375	312.500	312.500	MHz
		20	40	204.688	204.688	156.250	156.250	MHz
		40	40	409.375	409.375	312.500	350.000	MHz
		40	80	204.688	204.688	156.250	175.000	MHz
		80	80	409.375	352.625	322.266	352.625	MHz
		80	160	204.688	176.313	161.133	176.313	MHz

Notes:

1. Clocking must be implemented as described in the *UltraScale Architecture GTY Transceiver User Guide* (UG578).
2. When the gearbox is used, these maximums refer to the XCLK. For more information, see the *Valid Data Width Combinations for TX Asynchronous Gearbox* table in the *UltraScale Architecture GTY Transceiver User Guide* (UG578).

Table 52: **GTY Transceiver Protocol List *(Cont'd)***

Protocol	Specification	Serial Rate (Gb/s)	Electrical Compliance
Serial RapidIO	RapidIO specification 3.1	1.25–10.3125	Compliant
DisplayPort (source only)	DP 1.2B CTS	1.62–5.4	Compliant(3)
Fibre channel	FC-PI-4	1.0625–14.025	Compliant
SATA Gen1, 2, 3	Serial ATA revision 3.0 specification	1.5, 3.0, and 6.0	Compliant
SAS Gen1, 2, 3	T10/BSR INCITS 519	3.0, 6.0, and 12.0	Compliant
SFI-5	OIF-SFI5-01.0	0.625 - 12.5	Compliant
Aurora	CEI-6G, CEI-11G-LR	All rates	Compliant

Notes:

1. 25 dB loss at Nyquist without FEC.
2. The transition time of the transmitter is faster than the IEEE Std 802.3-2012 specification.
3. This protocol requires external circuitry to achieve compliance.

Table 54: **Maximum Performance for Interlaken 6 x 25.78125 Gb/s and 6 x 28.21 Gb/s Protocol and Lane Logic Mode Designs**

Symbol	Description	Speed Grade and V_{CCINT} Operating Voltages										Units
		0.90V		0.85V				0.72V				
		-3(1)		-2(1)		-1		-2		-1		
$F_{RX\_SERDES\_CLK}$	Receive serializer/ deserializer clock	440.79		440.79		N/A		402.84		N/A		MHz
$F_{TX\_SERDES\_CLK}$	Transmit serializer/ deserializer clock	440.79		440.79		N/A		402.84		N/A		MHz
F_{DRP_CLK}	Dynamic reconfiguration port clock	250.00		250.00		N/A		250.00		N/A		MHz
		Min(2)	Max	Min(2)	Max	Min	Max	Min(2)	Max	Min	Max	
F_{CORE_CLK}	Interlaken core clock	412.50(3)	479.20	412.50(3)	479.20	N/A		412.50	429.69	N/A		MHz
F_{LBUS_CLK}	Interlaken local bus clock	300.00(4)	349.52	300.00(4)	349.52	N/A		300.00	349.52	N/A		MHz

Notes:

1. 6 x 28.21 mode is only supported in the -2 (V_{CCINT}=0.85V) and -3 (V_{CCINT}=0.90V) speed grades.
2. These are the minimum clock frequencies at the maximum lane performance.
3. The minimum value for CORE_CLK is 451.36 MHz for the 6 x 28.21 Gb/s protocol.
4. The minimum value for LBUS_CLK is 330.00 MHz for the 6 x 28.21 Gb/s protocol.

Table 55: **Maximum Performance for Interlaken 12 x 25.78125 Gb/s Lane Logic Only Mode Designs**

Symbol	Description	Speed Grade and V_{CCINT} Operating Voltages					Units
		0.90V	0.85V		0.72V		
		-3	-2	-1	-2	-1	
$F_{RX\_SERDES\_CLK}$	Receive serializer/ deserializer clock	402.84	402.84	N/A	N/A	N/A	MHz
$F_{TX\_SERDES\_CLK}$	Transmit serializer/ deserializer clock	402.84	402.84	N/A	N/A	N/A	MHz
F_{DRP_CLK}	Dynamic reconfiguration port clock	250.00	250.00	N/A	N/A	N/A	MHz
F_{CORE_CLK}	Interlaken core clock	412.50	412.50	N/A	N/A	N/A	MHz
F_{LBUS_CLK}	Interlaken local bus clock	349.52	349.52	N/A	N/A	N/A	MHz

SYSMON I2C/PMBus Interfaces

Table 59: **SYSMON I2C Fast Mode Interface Switching Characteristics(1)**

Symbol	Description	Min	Max	Units
T_{SMFCKL}	SCL Low time	1.3	–	µs
T_{SMFCKH}	SCL High time	0.6	–	µs
T_{SMFCKO}	SDAO clock-to-out delay	–	900	ns
T_{SMFDCK}	SDAI setup time	100	–	ns
F_{SMFCLK}	SCL clock frequency	–	400	kHz

Notes:

1. The test conditions are configured to the LVCMOS 1.8V I/O standard.

Table 60: **SYSMON I2C Standard Mode Interface Switching Characteristics(1)**

Symbol	Description	Min	Max	Units
T_{SMSCKL}	SCL Low time	4.7	–	µs
T_{SMSCKH}	SCL High time	4.0	–	µs
T_{SMSCKO}	SDAO clock-to-out delay	–	3450	ns
T_{SMSDCK}	SDAI setup time	250	–	ns
F_{SMSCLK}	SCL clock frequency	–	100	kHz

Notes:

1. The test conditions are configured to the LVCMOS 1.8V I/O standard.

Configuration Switching Characteristics

Table 61: **Configuration Switching Characteristics**

Symbol	Description		Speed Grade and V_{CCINT} Operating Voltages				Units
			0.90V	0.85V		0.72V	
			-3	-2	-1	-2	
Power-up Timing Characteristics							
T_{PL}	Program latency.		8.5	8.5	8.5	8.5	ms, Max
T_{POR}	Power-on reset (40 ms maximum ramp rate).		65	65	65	65	ms, Max
			0	0	0	0	ms, Min
	Power-on reset with POR override (2 ms maximum ramp rate).		15	15	15	15	ms, Max
			5	5	5	5	ms, Min
$T_{PROGRAM}$	Program pulse width.		250	250	250	250	ns, Min
CCLK Output (Master Mode)							
T_{ICCK}	Master CCLK output delay from INIT_B.		150	150	150	150	ns, Min
T_{MCCKL} (1)	Master CCLK clock Low time duty cycle.		40/60	40/60	40/60	40/60	%, Min/Max
T_{MCCKH}	Master CCLK clock High time duty cycle.		40/60	40/60	40/60	40/60	%, Min/Max
F_{MCCK}	Master SPI/BPI CCLK frequency.		125	125	125	100	MHz, Max
F_{MCCK_START}	Master CCLK frequency at start of configuration.		2.70	2.70	2.70	2.70	MHz, Typ
$F_{MCCKTOL}$	Frequency tolerance, master mode with respect to nominal CCLK.		±15	±15	±15	±15	%, Max
CCLK Input (Slave Mode)							
T_{SCCKL}	Slave CCLK clock minimum Low time.		2.5	2.5	2.5	2.5	ns, Min
T_{SCCKH}	Slave CCLK clock minimum High time.		2.5	2.5	2.5	2.5	ns, Min
F_{SCCK}	Slave serial SelectMap CCLK frequency.	XCVU3P, XCVU5P, XCVU7P, XCVU9P	125	125	125	100	MHz, Max
		XCVU11P, XCVU13P	125	125	125	66	MHz, Max
EMCCLK Input (Master Mode)							
T_{EMCCKL}	External master CCLK Low time.		2.5	2.5	2.5	2.5	ns, Min
T_{EMCCKH}	External master CCLK High time.		2.5	2.5	2.5	2.5	ns, Min
F_{EMCCK}	External master CCLK frequency.		125	125	125	100	MHz, Max
Internal Configuration Access Port							
F_{ICAPCK}	Internal configuration access port (ICAPE3).	XCVU3P	200	200	200	150	MHz, Max
	Master SLR ICAPE3 accessing entire device.	XCVU5P, XCVU7P, XCVU9P, XCVU11P, XCVU13P	125	125	125	100	MHz, Max
	SLR ICAPE3 accessing local SLR.	XCVU5P, XCVU7P, XCVU9P, XCVU11P, XCVU13P	200	200	200	150	MHz, Max
Slave Serial Mode Programming Switching							
T_{DCCK}/T_{CCKD}	D_{IN} setup/hold.		3.0/0	3.0/0	3.0/0	4.0/0	ns, Min
T_{CCO}	D_{OUT} clock to out.		8.0	8.0	8.0	9.0	ns, Max

Revision History

The following table shows the revision history for this document.

Date	Version	Description of Revisions
04/19/2017	1.1	Updated the Summary description. In Table 1, updated Note 6, added data, and added Note 7, Note 8, and Note 9. Updated and added data to Table 2 though Table 6. Removed the -1LI speed grade. Updated Table 16, Table 17, and Table 18 to production release in Vivado Design Suite 2017.1 for the XCVU3P: -2E, -2I, -1E, -1I. Updated Table 15. Added Note 1 to Table 17. Updated Table 19, Table 20, Table 24, Table 25, Table 26, Table 28, Table 29, and Table 30. Added Table 21. Added MMCM_F_{DPRCLK_MAX} to Table 33 and PLL_F_{DPRCLK_MAX} to Table 34. Updated to Vivado Design Suite 2017.1 Table 35, Table 36, Table 37, and Table 38. Added data to Table 39 and Table 40. Updated the GTY Transceiver Specifications section. Revised the Integrated Interface Block for Interlaken section. Updated the System Monitor Specifications section adding notes to the tables. Updated the Configuration Switching Characteristics section. Removed the *eFUSE Programming Conditions* table and added the specifications to Table 2 and Table 3. Updated the Automotive Applications Disclaimer.
04/20/2016	1.0	Initial Xilinx release.

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