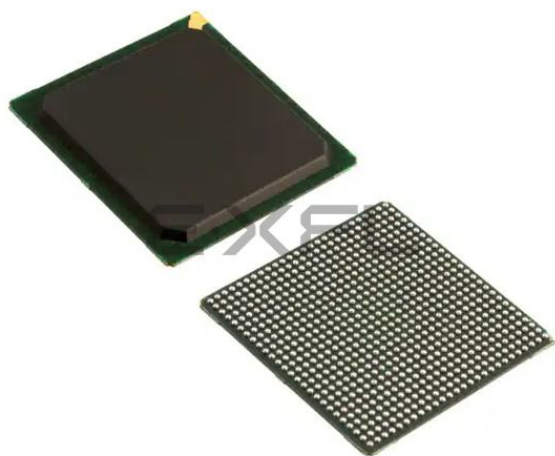




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### Understanding [Embedded - FPGAs \(Field Programmable Gate Array\)](#)

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                 | Active                                                                                                                                      |
| Number of LABs/CLBs            | 5831                                                                                                                                        |
| Number of Logic Elements/Cells | 74637                                                                                                                                       |
| Total RAM Bits                 | 3170304                                                                                                                                     |
| Number of I/O                  | 348                                                                                                                                         |
| Number of Gates                | -                                                                                                                                           |
| Voltage - Supply               | 1.14V ~ 1.26V                                                                                                                               |
| Mounting Type                  | Surface Mount                                                                                                                               |
| Operating Temperature          | -40°C ~ 100°C (TJ)                                                                                                                          |
| Package / Case                 | 676-BGA                                                                                                                                     |
| Supplier Device Package        | 676-FBGA (27x27)                                                                                                                            |
| Purchase URL                   | <a href="https://www.e-xfl.com/product-detail/xilinx/xc6slx75t-2fgg676i">https://www.e-xfl.com/product-detail/xilinx/xc6slx75t-2fgg676i</a> |

## eFUSE Read Endurance

Table 11 lists the minimum guaranteed number of read cycle operations for Device DNA and for the AES eFUSE key. For more information, see [UG380: Spartan-6 FPGA Configuration User Guide](#).

Table 11: eFUSE Read Endurance

| Symbol     | Description                                                                                                 | Speed Grade |     |    |     | Units (Min) |
|------------|-------------------------------------------------------------------------------------------------------------|-------------|-----|----|-----|-------------|
|            |                                                                                                             | -3          | -3N | -2 | -1L |             |
| DNA_CYCLES | Number of DNA_PORT READ operations or JTAG ISC_DNA read command operations. Unaffected by SHIFT operations. | 30,000,000  |     |    |     | Read Cycles |
| AES_CYCLES | Number of JTAG FUSE_KEY or FUSE_CNTL read command operations. Unaffected by SHIFT operations.               | 30,000,000  |     |    |     | Read Cycles |

## GTP Transceiver Specifications

GTP transceivers are available in the Spartan-6 LXT devices. See [DS160: Spartan-6 Family Overview](#) for more information.

### GTP Transceiver DC Characteristics

Table 12: Absolute Maximum Ratings for GTP Transceivers<sup>(1)</sup>

| Symbol                 | Description                                                                                            | Min  | Max  | Units |
|------------------------|--------------------------------------------------------------------------------------------------------|------|------|-------|
| MGTAVCC                | Analog supply voltage for the GTP transmitter and receiver circuits relative to GND                    | -0.5 | 1.32 | V     |
| MGTAVTTTX              | Analog supply voltage for the GTP transmitter termination circuit relative to GND                      | -0.5 | 1.32 | V     |
| MGTAVTTRX              | Analog supply voltage for the GTP receiver termination circuit relative to GND                         | -0.5 | 1.32 | V     |
| MGTAVCCPLL             | Analog supply voltage for the GTP transmitter and receiver PLL circuits relative to GND                | -0.5 | 1.32 | V     |
| MGTAVTTRCAL            | Analog supply voltage for the resistor calibration circuit of the GTP transceiver bank (top or bottom) | -0.5 | 1.32 | V     |
| V <sub>IN</sub>        | Receiver (RXP/RXN) and Transmitter (TXP/TXN) absolute input voltage                                    | -0.5 | 1.32 | V     |
| V <sub>MGTREFCLK</sub> | Reference clock absolute input voltage                                                                 | -0.5 | 1.32 | V     |

#### Notes:

- 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.

Table 13: Recommended Operating Conditions for GTP Transceivers<sup>(1)(2)(3)</sup>

| Symbol      | Description                                                                                            | Min  | Typ  | Max  | Units |
|-------------|--------------------------------------------------------------------------------------------------------|------|------|------|-------|
| MGTAVCC     | Analog supply voltage for the GTP transmitter and receiver circuits relative to GND                    | 1.14 | 1.20 | 1.26 | V     |
| MGTAVTTTX   | Analog supply voltage for the GTP transmitter termination circuit relative to GND                      | 1.14 | 1.20 | 1.26 | V     |
| MGTAVTTRX   | Analog supply voltage for the GTP receiver termination circuit relative to GND                         | 1.14 | 1.20 | 1.26 | V     |
| MGTAVCCPLL  | Analog supply voltage for the GTP transmitter and receiver PLL circuits relative to GND                | 1.14 | 1.20 | 1.26 | V     |
| MGTAVTTRCAL | Analog supply voltage for the resistor calibration circuit of the GTP transceiver bank (top or bottom) | 1.14 | 1.20 | 1.26 | V     |

#### Notes:

- Each voltage listed requires the filter circuit described in [UG386: Spartan-6 FPGA GTP Transceivers User Guide](#).
- Voltages are specified for the temperature range of T<sub>j</sub> = -40°C to +125°C.
- The voltage level of MGTAVCCPLL must not exceed the voltage level of MGTAVCC +10mV. The voltage level of MGTAVCC must not exceed the voltage level of MGTAVCCPLL.

## GTP Transceiver DC Input and Output Levels

Table 16 summarizes the DC output specifications of the GTP transceivers in Spartan-6 FPGAs. Figure 1 shows the single-ended output voltage swing. Figure 2 shows the peak-to-peak differential output voltage.

Consult [UG386: Spartan-6 FPGA GTP Transceivers User Guide](#) for further details.

Table 16: GTP Transceiver DC Specifications

| Symbol               | DC Parameter                                              | Conditions                                         | Min                               | Typ              | Max       | Units |
|----------------------|-----------------------------------------------------------|----------------------------------------------------|-----------------------------------|------------------|-----------|-------|
| DV <sub>PPIN</sub>   | Differential peak-to-peak input voltage                   | External AC coupled                                | 140                               | –                | 2000      | mV    |
| V <sub>IN</sub>      | Absolute input voltage                                    | DC coupled<br>MGTAVTTRX = 1.2V                     | –400                              | –                | MGTAVTTRX | mV    |
| V <sub>CMIN</sub>    | Common mode input voltage                                 | DC coupled<br>MGTAVTTRX = 1.2V                     | –                                 | 3/4<br>MGTAVTTRX | –         | mV    |
| DV <sub>PPOUT</sub>  | Differential peak-to-peak output voltage <sup>(1)</sup>   | Transmitter output swing is set to maximum setting | –                                 | –                | 1000      | mV    |
| V <sub>SEOUT</sub>   | Single-ended output voltage swing <sup>(1)</sup>          |                                                    | –                                 | –                | 500       | mV    |
| V <sub>CMOUTDC</sub> | Common mode output voltage                                | Equation based                                     | MGTAVTTTX – V <sub>SEOUT</sub> /2 |                  |           | mV    |
| R <sub>IN</sub>      | Differential input resistance                             |                                                    | 80                                | 100              | 130       | Ω     |
| R <sub>OUT</sub>     | Differential output resistance                            |                                                    | 80                                | 100              | 130       | Ω     |
| T <sub>OSKEW</sub>   | Transmitter output skew                                   |                                                    | –                                 | –                | 15        | ps    |
| C <sub>EXT</sub>     | Recommended external AC coupling capacitor <sup>(2)</sup> |                                                    | 75                                | 100              | 200       | nF    |

### Notes:

- The output swing and preemphasis levels are programmable using the attributes discussed in [UG386: Spartan-6 FPGA GTP Transceivers User Guide](#) and can result in values lower than reported in this table.
- Other values can be used as appropriate to conform to specific protocols and standards.

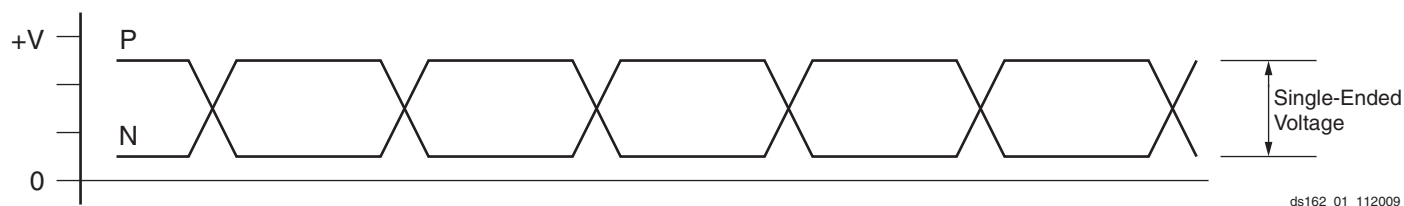


Figure 1: Single-Ended Peak-to-Peak Voltage

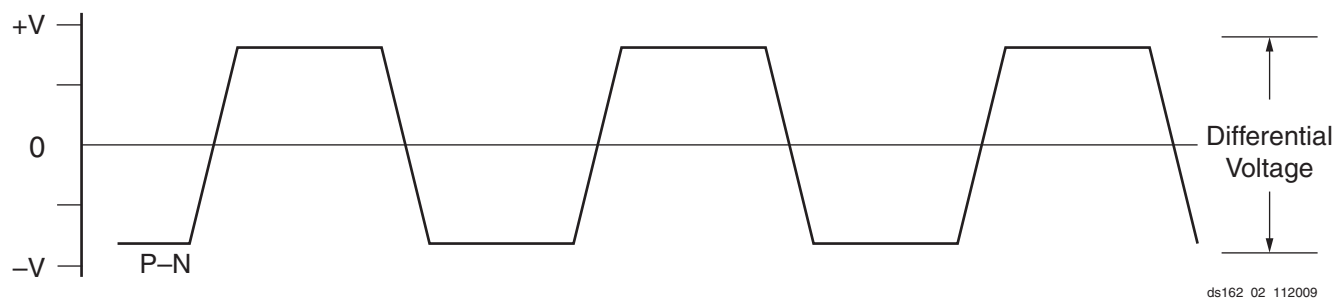


Figure 2: Differential Peak-to-Peak Voltage

Table 17 summarizes the DC specifications of the clock input of the GTP transceiver. Consult [UG386: Spartan-6 FPGA GTP Transceivers User Guide](#) for further details.

Table 17: GTP Transceiver Clock DC Input Level Specification

| Symbol      | DC Parameter                            | Min | Typ | Max  | Units    |
|-------------|-----------------------------------------|-----|-----|------|----------|
| $V_{IDIFF}$ | Differential peak-to-peak input voltage | 200 | 800 | 2000 | mV       |
| $R_{IN}$    | Differential input resistance           | 80  | 100 | 120  | $\Omega$ |
| $C_{EXT}$   | Required external AC coupling capacitor | –   | 100 | –    | nF       |

## GTP Transceiver Switching Characteristics

Consult [UG386](#): *Spartan-6 FPGA GTP Transceivers User Guide* for further information.

Table 18: GTP Transceiver Performance

| Symbol          | Description                                               | Speed Grade  |              |              |     | Units |
|-----------------|-----------------------------------------------------------|--------------|--------------|--------------|-----|-------|
|                 |                                                           | -3           | -3N          | -2           | -1L |       |
| $F_{GTPMAX}$    | Maximum GTP transceiver data rate                         | 3.2          | 3.2          | 2.7          | N/A | Gb/s  |
| $F_{GTPRANGE1}$ | GTP transceiver data rate range when PLL_TXDIVSEL_OUT = 1 | 1.88 to 3.2  | 1.88 to 3.2  | 1.88 to 2.7  | N/A | Gb/s  |
| $F_{GTPRANGE2}$ | GTP transceiver data rate range when PLL_TXDIVSEL_OUT = 2 | 0.94 to 1.62 | 0.94 to 1.62 | 0.94 to 1.62 | N/A | Gb/s  |
| $F_{GTPRANGE3}$ | GTP transceiver data rate range when PLL_TXDIVSEL_OUT = 4 | 0.6 to 0.81  | 0.6 to 0.81  | 0.6 to 0.81  | N/A | Gb/s  |
| $F_{GPLLMAX}$   | Maximum PLL frequency                                     | 1.62         | 1.62         | 1.62         | N/A | GHz   |
| $F_{GPLLMIN}$   | Minimum PLL frequency                                     | 0.94         | 0.94         | 0.94         | N/A | GHz   |

Table 19: GTP Transceiver Dynamic Reconfiguration Port (DRP) Switching Characteristics

| Symbol         | Description                                        | Speed Grade |     |     |     | Units |
|----------------|----------------------------------------------------|-------------|-----|-----|-----|-------|
|                |                                                    | -3          | -3N | -2  | -1L |       |
| $F_{GTPDRCLK}$ | GTP transceiver DCLK (DRP clock) maximum frequency | 125         | 125 | 100 | N/A | MHz   |

Table 20: GTP Transceiver Reference Clock Switching Characteristics

| Symbol      | Description                               | Conditions                                               | All LXT Speed Grades |     |     | Units   |
|-------------|-------------------------------------------|----------------------------------------------------------|----------------------|-----|-----|---------|
|             |                                           |                                                          | Min                  | Typ | Max |         |
| $F_{GCLK}$  | Reference clock frequency range           |                                                          | 60                   | –   | 160 | MHz     |
| $T_{RCLK}$  | Reference clock rise time                 | 20% – 80%                                                | –                    | 200 | –   | ps      |
| $T_{FCLK}$  | Reference clock fall time                 | 80% – 20%                                                | –                    | 200 | –   | ps      |
| $T_{DCREF}$ | Reference clock duty cycle                | Transceiver PLL only                                     | 45                   | 50  | 55  | %       |
| $T_{LOCK}$  | Clock recovery frequency acquisition time | Initial PLL lock                                         | –                    | –   | 1   | ms      |
| $T_{PHASE}$ | Clock recovery phase acquisition time     | Lock to data after PLL has locked to the reference clock | –                    | –   | 200 | $\mu$ s |

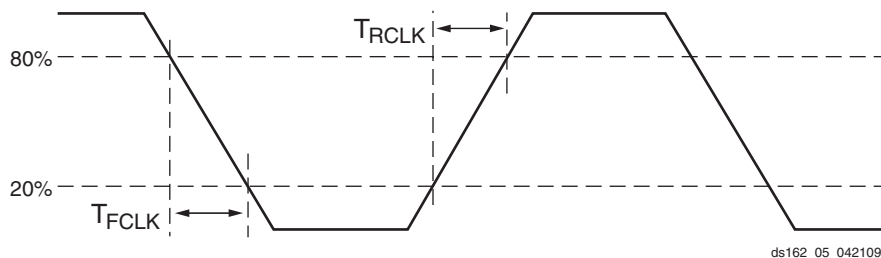


Figure 3: Reference Clock Timing Parameters

Table 21: GTP Transceiver User Clock Switching Characteristics<sup>(1)</sup>

| Symbol             | Description                 | Conditions       | Speed Grade |        |      |     | Units |
|--------------------|-----------------------------|------------------|-------------|--------|------|-----|-------|
|                    |                             |                  | -3          | -3N    | -2   | -1L |       |
| F <sub>TXOUT</sub> | TXOUTCLK maximum frequency  |                  | 320         | 320    | 270  | N/A | MHz   |
| F <sub>RXREC</sub> | RXRECCLK maximum frequency  |                  | 320         | 320    | 270  | N/A | MHz   |
| T <sub>RX</sub>    | RXUSRCLK maximum frequency  |                  | 320         | 320    | 270  | N/A | MHz   |
| T <sub>RX2</sub>   | RXUSRCLK2 maximum frequency | 1 byte interface | 156.25      | 156.25 | 125  | N/A | MHz   |
|                    |                             | 2 byte interface | 160         | 160    | 125  | N/A | MHz   |
|                    |                             | 4 byte interface | 80          | 80     | 67.5 | N/A | MHz   |
| T <sub>TX</sub>    | TXUSRCLK maximum frequency  |                  | 320         | 320    | 270  | N/A | MHz   |
| T <sub>TX2</sub>   | TXUSRCLK2 maximum frequency | 1 byte interface | 156.25      | 156.25 | 125  | N/A | MHz   |
|                    |                             | 2 byte interface | 160         | 160    | 125  | N/A | MHz   |
|                    |                             | 4 byte interface | 80          | 80     | 67.5 | N/A | MHz   |

**Notes:**

1. Clocking must be implemented as described in [UG386: Spartan-6 FPGA GTP Transceivers User Guide](#).

Table 22: GTP Transceiver Transmitter Switching Characteristics

| Symbol                       | Description                         | Condition  | Min | Typ | Max  | Units |
|------------------------------|-------------------------------------|------------|-----|-----|------|-------|
| T <sub>RTX</sub>             | TX Rise time                        | 20%–80%    | –   | 140 | –    | ps    |
| T <sub>FTX</sub>             | TX Fall time                        | 80%–20%    | –   | 120 | –    | ps    |
| T <sub>LLSKEW</sub>          | TX lane-to-lane skew <sup>(1)</sup> |            | –   | –   | 400  | ps    |
| V <sub>TXOOBVDPP</sub>       | Electrical idle amplitude           |            | –   | –   | 20   | mV    |
| T <sub>TXOOBTRANSITION</sub> | Electrical idle transition time     |            | –   | –   | 50   | ns    |
| T <sub>J3.125</sub>          | Total Jitter <sup>(2)</sup>         | 3.125 Gb/s | –   | –   | 0.35 | UI    |
| D <sub>J3.125</sub>          | Deterministic Jitter <sup>(2)</sup> |            | –   | –   | 0.15 | UI    |
| T <sub>J2.5</sub>            | Total Jitter <sup>(2)</sup>         | 2.5 Gb/s   | –   | –   | 0.33 | UI    |
| D <sub>J2.5</sub>            | Deterministic Jitter <sup>(2)</sup> |            | –   | –   | 0.15 | UI    |
| T <sub>J1.62</sub>           | Total Jitter <sup>(2)</sup>         | 1.62 Gb/s  | –   | –   | 0.20 | UI    |
| D <sub>J1.62</sub>           | Deterministic Jitter <sup>(2)</sup> |            | –   | –   | 0.10 | UI    |
| T <sub>J1.25</sub>           | Total Jitter <sup>(2)</sup>         | 1.25 Gb/s  | –   | –   | 0.20 | UI    |
| D <sub>J1.25</sub>           | Deterministic Jitter <sup>(2)</sup> |            | –   | –   | 0.10 | UI    |
| T <sub>J614</sub>            | Total Jitter <sup>(2)</sup>         | 614 Mb/s   | –   | –   | 0.10 | UI    |
| D <sub>J614</sub>            | Deterministic Jitter <sup>(2)</sup> |            | –   | –   | 0.05 | UI    |

**Notes:**

1. Using same REFCLK input with TXENPMAPHASEALIGN enabled for up to four consecutive GTP transceiver sites.
2. Using PLL\_DIVSEL\_FB = 2, INTDATAWIDTH = 1. These values are NOT intended for protocol specific compliance determinations.

Table 23: GTP Transceiver Receiver Switching Characteristics

| Symbol                                                  | Description                                                   |                                          | Min                  | Typ   | Max | Units |     |
|---------------------------------------------------------|---------------------------------------------------------------|------------------------------------------|----------------------|-------|-----|-------|-----|
| T <sub>RXELECIDLE</sub>                                 | Time for RXELECIDLE to respond to loss or restoration of data |                                          | –                    | 75    | –   | ns    |     |
| R <sub>XOVBVDPP</sub>                                   | OOB detect threshold peak-to-peak                             |                                          | 60                   | –     | 150 | mV    |     |
| R <sub>XSST</sub>                                       | Receiver spread-spectrum tracking <sup>(1)</sup>              | Modulated @ 33 KHz                       | –5000                | –     | 0   | ppm   |     |
| R <sub>XRL</sub>                                        | Run length (CID)                                              | Internal AC capacitor bypassed           | –                    | –     | 150 | UI    |     |
| R <sub>XPMTOL</sub>                                     | Data/REFCLK PPM offset tolerance                              | CDR 2 <sup>nd</sup> -order loop disabled | –200                 | –     | 200 | ppm   |     |
|                                                         |                                                               | CDR 2 <sup>nd</sup> -order loop enabled  | PLL_RXDIVSEL_OUT = 1 | –2000 | –   | 2000  | ppm |
|                                                         |                                                               |                                          | PLL_RXDIVSEL_OUT = 2 | –2000 | –   | 2000  | ppm |
|                                                         |                                                               |                                          | PLL_RXDIVSEL_OUT = 4 | –1000 | –   | 1000  | ppm |
| SJ Jitter Tolerance <sup>(2)</sup>                      |                                                               |                                          |                      |       |     |       |     |
| JT_SJ <sub>3.125</sub>                                  | Sinusoidal Jitter <sup>(3)</sup>                              | 3.125 Gb/s                               | 0.4                  | –     | –   | UI    |     |
| JT_SJ <sub>2.5</sub>                                    | Sinusoidal Jitter <sup>(3)</sup>                              | 2.5 Gb/s                                 | 0.4                  | –     | –   | UI    |     |
| JT_SJ <sub>1.62</sub>                                   | Sinusoidal Jitter <sup>(3)</sup>                              | 1.62 Gb/s                                | 0.5                  | –     | –   | UI    |     |
| JT_SJ <sub>1.25</sub>                                   | Sinusoidal Jitter <sup>(3)</sup>                              | 1.25 Gb/s                                | 0.5                  | –     | –   | UI    |     |
| JT_SJ <sub>614</sub>                                    | Sinusoidal Jitter <sup>(3)</sup>                              | 614 Mb/s                                 | 0.5                  | –     | –   | UI    |     |
| SJ Jitter Tolerance with Stressed Eye <sup>(2)(5)</sup> |                                                               |                                          |                      |       |     |       |     |
| JT_TJSE <sub>3.125</sub>                                | Total Jitter with stressed eye <sup>(4)</sup>                 | 3.125 Gb/s                               | 0.65                 | –     | –   | UI    |     |
| JT_SJSE <sub>3.125</sub>                                | Sinusoidal Jitter with stressed eye                           | 3.125 Gb/s                               | 0.1                  | –     | –   | UI    |     |
| JT_TJSE <sub>2.7</sub>                                  | Total Jitter with stressed eye <sup>(4)</sup>                 | 2.7 Gb/s                                 | 0.65                 | –     | –   | UI    |     |
| JT_SJSE <sub>2.7</sub>                                  | Sinusoidal Jitter with stressed eye                           | 2.7 Gb/s                                 | 0.1                  | –     | –   | UI    |     |

**Notes:**

- Using PLL\_RXDIVSEL\_OUT = 1, 2, and 4.
- All jitter values are based on a Bit Error Ratio of 1e<sup>-12</sup>.
- Using 80 MHz sinusoidal jitter only in the absence of deterministic and random jitter.
- Composed of 0.37 UI DJ in the form of ISI and 0.18 UI RJ.
- Measured using PRBS7 data pattern.

## Endpoint Block for PCI Express Designs Switching Characteristics

The Endpoint block for PCI Express is available in the Spartan-6 LXT devices. Consult the [Spartan-6 FPGA Integrated Endpoint Block for PCI Express](#) for further information.

Table 24: Maximum Performance for PCI Express Designs

| Symbol                | Description                  | Speed Grade |      |      |     | Units |
|-----------------------|------------------------------|-------------|------|------|-----|-------|
|                       |                              | -3          | -3N  | -2   | -1L |       |
| F <sub>PCIEUSER</sub> | User clock maximum frequency | 62.5        | 62.5 | 62.5 | N/A | MHz   |

## Switching Characteristics

All values represented in this data sheet are based on these speed specifications: v1.20 for -3, -3N, and -2; and v1.08 for -1L. Switching characteristics are specified on a per-speed-grade basis and can be designated as Advance, Preliminary, or Production. Each designation is defined as follows:

### Advance

These specifications are based on simulations only and are typically available soon after device design specifications are frozen. Although speed grades with this designation are considered relatively stable and conservative, some under-reporting might still occur.

### Preliminary

These specifications are based on complete ES (engineering sample) silicon characterization. Devices and speed grades with this designation are intended to give a better indication of the expected performance of production silicon. The probability of under-reporting delays is greatly reduced as compared to Advance data.

### Production

These specifications are released once enough production silicon of a particular device family member has been characterized to provide full correlation between specifications and devices over numerous production lots. There is no under-reporting of delays, and customers receive formal notification of any subsequent changes. Typically, the slowest speed grades transition to Production before faster speed grades.

All specifications are always representative of worst-case supply voltage and junction temperature conditions.

Since individual family members are produced at different times, the migration from one category to another depends completely on the status of the fabrication process for each device.

The -1L speed grade refers to the lower-power Spartan-6 devices. The -3N speed grade refers to the Spartan-6 devices that do not support MCB functionality.

[Table 26](#) correlates the current status of each Spartan-6 device on a per speed grade basis.

## Testing of Switching Characteristics

All devices are 100% functionally tested. Internal timing parameters are derived from measuring internal test patterns. Listed below are representative values.

For more specific, more precise, and worst-case guaranteed data, use the values reported by the static timing analyzer and back-annotate to the simulation net list. Unless otherwise noted, values apply to all Spartan-6 devices.

**Table 26: Spartan-6 Device Speed Grade Designations**

| Device                 | Speed Grade Designations |             |                  |
|------------------------|--------------------------|-------------|------------------|
|                        | Advance                  | Preliminary | Production       |
| XC6SLX4 <sup>(1)</sup> |                          |             | -3, -2, -1L      |
| XC6SLX9                |                          |             | -3, -3N, -2, -1L |
| XC6SLX16               |                          |             | -3, -3N, -2, -1L |
| XC6SLX25               |                          |             | -3, -3N, -2, -1L |
| XC6SLX25T              |                          |             | -3, -3N, -2      |
| XC6SLX45               |                          |             | -3, -3N, -2, -1L |
| XC6SLX45T              |                          |             | -3, -3N, -2      |
| XC6SLX75               |                          |             | -3, -3N, -2, -1L |
| XC6SLX75T              |                          |             | -3, -3N, -2      |
| XC6SLX100              |                          |             | -3, -3N, -2, -1L |
| XC6SLX100T             |                          |             | -3, -3N, -2      |
| XC6SLX150              |                          |             | -3, -3N, -2, -1L |
| XC6SLX150T             |                          |             | -3, -3N, -2      |
| XA6SLX4                |                          |             | -3, -2           |
| XA6SLX9                |                          |             | -3, -2           |
| XA6SLX16               |                          |             | -3, -2           |
| XA6SLX25               |                          |             | -3, -2           |
| XA6SLX25T              |                          |             | -3, -2           |
| XA6SLX45               |                          |             | -3, -2           |
| XA6SLX45T              |                          |             | -3, -2           |
| XA6SLX75               |                          |             | -3, -2           |
| XA6SLX75T              |                          |             | -3, -2           |
| XA6SLX100              |                          |             | -2               |
| XQ6SLX75               |                          |             | -2, -1L          |
| XQ6SLX75T              |                          |             | -3, -2           |
| XQ6SLX150              |                          |             | -2, -1L          |
| XQ6SLX150T             |                          |             | -3, -2           |

#### Notes:

1. The XC6SLX4 is not available in the -3N speed grade.

Table 28: IOB Switching Characteristics for the Commercial (XC) Spartan-6 Devices (Cont'd)

| I/O Standard     | T <sub>IOPI</sub> |      |      |                     | T <sub>IOOP</sub> |       |       |                     | T <sub>IOTP</sub> |       |       |                     | Units |
|------------------|-------------------|------|------|---------------------|-------------------|-------|-------|---------------------|-------------------|-------|-------|---------------------|-------|
|                  | Speed Grade       |      |      |                     | Speed Grade       |       |       |                     | Speed Grade       |       |       |                     |       |
|                  | -3                | -3N  | -2   | -1L <sup>(1)</sup>  | -3                | -3N   | -2    | -1L <sup>(1)</sup>  | -3                | -3N   | -2    | -1L <sup>(1)</sup>  |       |
| PPDS_33          | 1.17              | 1.29 | 1.42 | 1.68                | 1.57              | 1.71  | 1.91  | 2.43                | 3000              | 3000  | 3000  | 3000                | ns    |
| PPDS_25          | 1.01              | 1.13 | 1.26 | 1.56                | 1.68              | 1.82  | 2.02  | 2.47                | 3000              | 3000  | 3000  | 3000                | ns    |
| PCI33_3          | 1.07              | 1.19 | 1.32 | 1.57 <sup>(2)</sup> | 3.51              | 3.65  | 3.85  | 4.38 <sup>(2)</sup> | 3.51              | 3.65  | 3.85  | 4.38 <sup>(1)</sup> | ns    |
| PCI66_3          | 1.07              | 1.19 | 1.32 | 1.57 <sup>(2)</sup> | 3.53              | 3.67  | 3.87  | 4.39 <sup>(2)</sup> | 3.53              | 3.67  | 3.87  | 4.39 <sup>(1)</sup> | ns    |
| DISPLAY_PORT     | 1.02              | 1.14 | 1.27 | 1.56                | 3.15              | 3.29  | 3.49  | 4.08                | 3.15              | 3.29  | 3.49  | 4.08                | ns    |
| I2C              | 1.33              | 1.45 | 1.58 | 1.82                | 11.56             | 11.70 | 11.90 | 12.52               | 11.56             | 11.70 | 11.90 | 12.52               | ns    |
| SMBUS            | 1.33              | 1.45 | 1.58 | 1.82                | 11.56             | 11.70 | 11.90 | 12.52               | 11.56             | 11.70 | 11.90 | 12.52               | ns    |
| SDIO             | 1.36              | 1.48 | 1.61 | 1.84                | 2.64              | 2.78  | 2.98  | 3.60                | 2.64              | 2.78  | 2.98  | 3.60                | ns    |
| MOBILE_DDR       | 0.94              | 1.06 | 1.19 | 1.43                | 2.35              | 2.49  | 2.69  | 3.31                | 2.35              | 2.49  | 2.69  | 3.31                | ns    |
| HSTL_I           | 0.90              | 1.02 | 1.15 | 1.39                | 1.66              | 1.80  | 2.00  | 2.62                | 1.66              | 1.80  | 2.00  | 2.62                | ns    |
| HSTL_II          | 0.91              | 1.03 | 1.16 | 1.40                | 1.72              | 1.86  | 2.06  | 2.68                | 1.72              | 1.86  | 2.06  | 2.68                | ns    |
| HSTL_III         | 0.95              | 1.07 | 1.20 | 1.44                | 1.67              | 1.81  | 2.01  | 2.61                | 1.67              | 1.81  | 2.01  | 2.61                | ns    |
| HSTL_I_18        | 0.94              | 1.06 | 1.19 | 1.43                | 1.77              | 1.91  | 2.11  | 2.73                | 1.77              | 1.91  | 2.11  | 2.73                | ns    |
| HSTL_II_18       | 0.94              | 1.06 | 1.19 | 1.43                | 1.85              | 1.99  | 2.19  | 2.81                | 1.85              | 1.99  | 2.19  | 2.81                | ns    |
| HSTL_III_18      | 0.99              | 1.11 | 1.24 | 1.47                | 1.79              | 1.93  | 2.13  | 2.72                | 1.79              | 1.93  | 2.13  | 2.72                | ns    |
| SSTL3_I          | 1.58              | 1.70 | 1.83 | 2.16                | 1.83              | 1.97  | 2.17  | 2.72                | 1.83              | 1.97  | 2.17  | 2.72                | ns    |
| SSTL3_II         | 1.58              | 1.70 | 1.83 | 2.16                | 2.01              | 2.15  | 2.35  | 2.94                | 2.01              | 2.15  | 2.35  | 2.94                | ns    |
| SSTL2_I          | 1.30              | 1.42 | 1.55 | 1.87                | 1.77              | 1.91  | 2.11  | 2.69                | 1.77              | 1.91  | 2.11  | 2.69                | ns    |
| SSTL2_II         | 1.30              | 1.42 | 1.55 | 1.88                | 1.86              | 2.00  | 2.20  | 2.82                | 1.86              | 2.00  | 2.20  | 2.82                | ns    |
| SSTL18_I         | 0.92              | 1.04 | 1.17 | 1.41                | 1.63              | 1.77  | 1.97  | 2.59                | 1.63              | 1.77  | 1.97  | 2.59                | ns    |
| SSTL18_II        | 0.92              | 1.04 | 1.17 | 1.41                | 1.66              | 1.80  | 2.00  | 2.62                | 1.66              | 1.80  | 2.00  | 2.62                | ns    |
| SSTL15_II        | 0.92              | 1.04 | 1.17 | 1.41                | 1.67              | 1.81  | 2.01  | 2.63                | 1.67              | 1.81  | 2.01  | 2.63                | ns    |
| DIFF_HSTL_I      | 0.94              | 1.06 | 1.19 | 1.46                | 1.77              | 1.91  | 2.11  | 2.62                | 1.77              | 1.91  | 2.11  | 2.62                | ns    |
| DIFF_HSTL_II     | 0.93              | 1.05 | 1.18 | 1.45                | 1.72              | 1.86  | 2.06  | 2.54                | 1.72              | 1.86  | 2.06  | 2.54                | ns    |
| DIFF_HSTL_III    | 0.93              | 1.05 | 1.18 | 1.46                | 1.69              | 1.83  | 2.03  | 2.53                | 1.69              | 1.83  | 2.03  | 2.53                | ns    |
| DIFF_HSTL_I_18   | 0.97              | 1.09 | 1.22 | 1.50                | 1.79              | 1.93  | 2.13  | 2.63                | 1.79              | 1.93  | 2.13  | 2.63                | ns    |
| DIFF_HSTL_II_18  | 0.97              | 1.09 | 1.22 | 1.49                | 1.69              | 1.83  | 2.03  | 2.51                | 1.69              | 1.83  | 2.03  | 2.51                | ns    |
| DIFF_HSTL_III_18 | 0.97              | 1.09 | 1.22 | 1.50                | 1.69              | 1.83  | 2.03  | 2.53                | 1.69              | 1.83  | 2.03  | 2.53                | ns    |
| DIFF_SSTL3_I     | 1.18              | 1.30 | 1.43 | 1.68                | 1.81              | 1.95  | 2.15  | 2.64                | 1.81              | 1.95  | 2.15  | 2.64                | ns    |
| DIFF_SSTL3_II    | 1.19              | 1.31 | 1.44 | 1.68                | 1.80              | 1.94  | 2.14  | 2.63                | 1.80              | 1.94  | 2.14  | 2.63                | ns    |
| DIFF_SSTL2_I     | 1.02              | 1.14 | 1.27 | 1.57                | 1.80              | 1.94  | 2.14  | 2.62                | 1.80              | 1.94  | 2.14  | 2.62                | ns    |
| DIFF_SSTL2_II    | 1.02              | 1.14 | 1.27 | 1.57                | 1.76              | 1.90  | 2.10  | 2.57                | 1.76              | 1.90  | 2.10  | 2.57                | ns    |
| DIFF_SSTL18_I    | 0.97              | 1.09 | 1.22 | 1.51                | 1.72              | 1.86  | 2.06  | 2.56                | 1.72              | 1.86  | 2.06  | 2.56                | ns    |
| DIFF_SSTL18_II   | 0.98              | 1.10 | 1.23 | 1.50                | 1.68              | 1.82  | 2.02  | 2.52                | 1.68              | 1.82  | 2.02  | 2.52                | ns    |
| DIFF_SSTL15_II   | 0.94              | 1.06 | 1.19 | 1.46                | 1.67              | 1.81  | 2.01  | 2.50                | 1.67              | 1.81  | 2.01  | 2.50                | ns    |
| DIFF_MOBILE_DDR  | 0.97              | 1.09 | 1.22 | 1.51                | 1.75              | 1.89  | 2.09  | 2.57                | 1.75              | 1.89  | 2.09  | 2.57                | ns    |

Table 29: IOB Switching Characteristics for the Automotive XA Spartan-6 and the Spartan-6Q Devices<sup>(1)</sup>

| I/O Standard             | T <sub>IOPI</sub> |      | T <sub>IOOP</sub> |       | T <sub>IOTP</sub> |       | Units |
|--------------------------|-------------------|------|-------------------|-------|-------------------|-------|-------|
|                          | Speed Grade       |      | Speed Grade       |       | Speed Grade       |       |       |
|                          | -3                | -2   | -3                | -2    | -3                | -2    |       |
| LVDS_33                  | 1.24              | 1.42 | 1.69              | 1.89  | 3000              | 3000  | ns    |
| LVDS_25                  | 1.08              | 1.26 | 1.79              | 1.99  | 3000              | 3000  | ns    |
| BLVDS_25                 | 1.09              | 1.27 | 1.86              | 2.06  | 1.86              | 2.06  | ns    |
| MINI_LVDS_33             | 1.25              | 1.43 | 1.71              | 1.91  | 3000              | 3000  | ns    |
| MINI_LVDS_25             | 1.08              | 1.26 | 1.79              | 1.99  | 3000              | 3000  | ns    |
| LVPECL_33                | 1.25              | 1.43 | N/A               | N/A   | N/A               | N/A   | ns    |
| LVPECL_25                | 1.09              | 1.27 | N/A               | N/A   | N/A               | N/A   | ns    |
| RSDS_33 (point to point) | 1.24              | 1.42 | 1.71              | 1.91  | 3000              | 3000  | ns    |
| RSDS_25 (point to point) | 1.08              | 1.26 | 1.79              | 1.99  | 3000              | 3000  | ns    |
| TMDS_33                  | 1.29              | 1.47 | 1.68              | 1.88  | 3000              | 3000  | ns    |
| PPDS_33                  | 1.25              | 1.43 | 1.71              | 1.91  | 3000              | 3000  | ns    |
| PPDS_25                  | 1.08              | 1.26 | 1.82              | 2.02  | 3000              | 3000  | ns    |
| PCI33_3                  | 1.14              | 1.32 | 3.81              | 4.01  | 3.81              | 4.01  | ns    |
| PCI66_3                  | 1.14              | 1.32 | 3.81              | 4.01  | 3.81              | 4.01  | ns    |
| DISPLAY_PORT             | 1.09              | 1.27 | 3.29              | 3.49  | 3.29              | 3.49  | ns    |
| I2C                      | 1.40              | 1.58 | 11.70             | 11.90 | 11.70             | 11.90 | ns    |
| SMBUS                    | 1.40              | 1.58 | 11.70             | 11.90 | 11.70             | 11.90 | ns    |
| SDIO                     | 1.43              | 1.61 | 2.78              | 2.98  | 2.78              | 2.98  | ns    |
| MOBILE_DDR               | 1.01              | 1.19 | 2.50              | 2.70  | 2.50              | 2.70  | ns    |
| HSTL_I                   | 1.01              | 1.19 | 1.80              | 2.00  | 1.80              | 2.00  | ns    |
| HSTL_II                  | 1.01              | 1.19 | 1.86              | 2.06  | 1.86              | 2.06  | ns    |
| HSTL_III                 | 1.07              | 1.25 | 1.81              | 2.01  | 1.81              | 2.01  | ns    |
| HSTL_I_18                | 1.05              | 1.23 | 1.91              | 2.11  | 1.91              | 2.11  | ns    |
| HSTL_II_18               | 1.05              | 1.23 | 1.99              | 2.19  | 1.99              | 2.19  | ns    |
| HSTL_III_18              | 1.13              | 1.31 | 1.93              | 2.13  | 1.93              | 2.13  | ns    |
| SSTL3_I                  | 1.65              | 1.83 | 1.97              | 2.17  | 1.97              | 2.17  | ns    |
| SSTL3_II                 | 1.65              | 1.83 | 2.15              | 2.35  | 2.15              | 2.35  | ns    |
| SSTL2_I                  | 1.37              | 1.55 | 1.91              | 2.11  | 1.91              | 2.11  | ns    |
| SSTL2_II                 | 1.37              | 1.55 | 2.00              | 2.20  | 2.00              | 2.20  | ns    |
| SSTL18_I                 | 0.99              | 1.17 | 1.77              | 1.97  | 1.77              | 1.97  | ns    |
| SSTL18_II                | 1.00              | 1.18 | 1.80              | 2.00  | 1.80              | 2.00  | ns    |
| SSTL15_II                | 1.00              | 1.18 | 1.81              | 2.01  | 1.81              | 2.01  | ns    |
| DIFF_HSTL_I              | 1.01              | 1.19 | 1.91              | 2.11  | 1.91              | 2.11  | ns    |
| DIFF_HSTL_II             | 1.00              | 1.18 | 1.86              | 2.06  | 1.86              | 2.06  | ns    |
| DIFF_HSTL_III            | 1.00              | 1.18 | 1.83              | 2.03  | 1.83              | 2.03  | ns    |
| DIFF_HSTL_I_18           | 1.04              | 1.22 | 1.93              | 2.13  | 1.93              | 2.13  | ns    |
| DIFF_HSTL_II_18          | 1.04              | 1.22 | 1.83              | 2.03  | 1.83              | 2.03  | ns    |
| DIFF_HSTL_III_18         | 1.04              | 1.22 | 1.83              | 2.03  | 1.83              | 2.03  | ns    |

Table 32: Output Delay Measurement Methodology (Cont'd)

| Description                                              | I/O Standard Attribute     | $R_{REF}$ ( $\Omega$ ) | $C_{REF}^{(1)}$ (pF) | $V_{MEAS}$ (V)   | $V_{REF}$ (V) |
|----------------------------------------------------------|----------------------------|------------------------|----------------------|------------------|---------------|
| SSTL, Class II, 2.5V                                     | SSTL2_II                   | 25                     | 0                    | $V_{REF}$        | 1.25          |
| SSTL, Class II, 1.5V                                     | SSTL15_II                  | 25                     | 0                    | $V_{REF}$        | 0.75          |
| LVDS (Low-Voltage Differential Signaling), 2.5V & 3.3V   | LVDS_25, LVDS_33           | 100                    | 0                    | 0 <sup>(3)</sup> | —             |
| BLVDS (Bus LVDS), 2.5V                                   | BLVDS_25                   | Note 4                 | 0                    | 0 <sup>(3)</sup> | —             |
| Mini-LVDS, 2.5V & 3.3V                                   | MINI_LVDS_25, MINI_LVDS_33 | 100                    | 0                    | 0 <sup>(3)</sup> | —             |
| RSDS (Reduced Swing Differential Signaling), 2.5V & 3.3V | RSDS_25, RSDS_33           | 100                    | 0                    | 0 <sup>(3)</sup> | —             |
| TMDS (Transition Minimized Differential Signaling), 3.3V | TMDS_33                    | Note 5                 | 0                    | 0 <sup>(3)</sup> | —             |
| PPDS (Point-to-Point Differential Signaling, 2.5V & 3.3V | PPDS_25, PPDS_33           | 100                    | 0                    | 0 <sup>(3)</sup> | —             |

**Notes:**

1.  $C_{REF}$  is the capacitance of the probe, nominally 0 pF.
2. Per PCI specifications.
3. The value given is the differential output voltage.
4. See the *BLVDS Output Termination* section in [UG381](#), *Spartan-6 FPGA SelectIO Resources User Guide*.
5. See the *TMDS\_33 Termination* section in [UG381](#), *Spartan-6 FPGA SelectIO Resources User Guide*.

## Simultaneously Switching Outputs

Due to package electrical parasitics, a given package supports a limited number of simultaneous switching outputs (SSOs) when using fast, high-drive outputs. [Table 33](#) and [Table 34](#) provide guidelines for the recommended maximum allowable number of SSOs. These guidelines describe the maximum number of user I/O pins of an output signal standard that should simultaneously switch in the same direction, while maintaining a safe level of switching noise for that particular signal standard. Meeting these guidelines for the stated test conditions ensures that the FPGA operates free from the adverse effects of GND and power bounce.

For each device/package combination, [Table 33](#) provides the number of equivalent  $V_{CCO}$ /GND pairs per bank. For each output signal standard and drive strength, [Table 34](#) recommends the maximum number of SSOs, switching in the same direction, allowed per  $V_{CCO}$ /GND pair within an I/O bank. The guidelines are categorized by package style, slew rate, and output drive current. The number of SSOs are also specified by I/O bank. Multiply the appropriate numbers from each table to calculate the maximum number of SSOs allowed within an I/O bank. The guidelines assume that all pins within a bank use the same I/O standard. Exceeding these SSO guidelines can result in increased power or GND bounce, degraded signal integrity, or increased system jitter. For a given I/O standard, if the SSO limit per pair in [Table 34](#) is greater than the maximum I/O per pair in [Table 33](#), then there is no SSO limit for the exclusive use of that I/O standard.

The recommended maximum SSO values assume that the FPGA is soldered on a printed circuit board and that the board uses sound design practices. Due to the additional inductance introduced by the socket, the SSO values do not apply for FPGAs mounted in sockets. The SSO values assume that the  $V_{CCAUX}$  is powered at 3.3V. Setting  $V_{CCAUX}$  to 2.5V provides better SSO characteristics. For more detail, see [UG381](#): *Spartan-6 FPGA SelectIO Resources User Guide*.

## CLB Distributed RAM Switching Characteristics (SLICEM Only)

Table 41: CLB Distributed RAM Switching Characteristics (SLICEM Only)

| Symbol                                      | Description                                      | Speed Grade    |                |                |                | Units   |
|---------------------------------------------|--------------------------------------------------|----------------|----------------|----------------|----------------|---------|
|                                             |                                                  | -3             | -3N            | -2             | -1L            |         |
| Sequential Delays                           |                                                  |                |                |                |                |         |
| T <sub>SHCKO</sub>                          | Clock to A – D outputs                           | 1.26           | 1.55           | 1.55           | 2.35           | ns, Max |
|                                             | Clock to A – D outputs (direct output path)      | 0.96           | 1.20           | 1.20           | 1.87           | ns, Max |
| Setup and Hold Times Before/After Clock CLK |                                                  |                |                |                |                |         |
| T <sub>DS</sub> /T <sub>DH</sub>            | AX – DX or AI – DI inputs to CLK                 | 0.59/<br>0.17  | 0.73/<br>0.22  | 0.73/<br>0.22  | 1.17/<br>0.33  | ns, Min |
| T <sub>AS</sub> /T <sub>AH</sub>            | Address An inputs to clock for XC devices        | 0.28/<br>0.35  | 0.32/<br>0.42  | 0.32/<br>0.42  | 0.26/<br>0.71  | ns, Min |
|                                             | Address An inputs to clock for XA and XQ devices | 0.28/<br>0.51  | N/A            | 0.32/<br>0.51  | 0.26/<br>0.71  | ns, Min |
| T <sub>WS</sub> /T <sub>WH</sub>            | WE input to clock                                | 0.31/<br>–0.08 | 0.37/<br>–0.08 | 0.37/<br>–0.08 | 0.59/<br>–0.27 | ns, Min |
| T <sub>CECK</sub> /T <sub>CKCE</sub>        | CE input to CLK                                  | 0.31/<br>–0.08 | 0.37/<br>–0.08 | 0.37/<br>–0.08 | 0.59/<br>–0.27 | ns, Min |

## CLB Shift Register Switching Characteristics (SLICEM Only)

Table 42: CLB Shift Register Switching Characteristics

| Symbol                                      | Description                                 | Speed Grade    |                |                |                | Units   |
|---------------------------------------------|---------------------------------------------|----------------|----------------|----------------|----------------|---------|
|                                             |                                             | -3             | -3N            | -2             | -1L            |         |
| Sequential Delays                           |                                             |                |                |                |                |         |
| T <sub>REG</sub>                            | Clock to A – D outputs                      | 1.35           | 1.78           | 1.78           | 2.74           | ns, Max |
|                                             | Clock to A – D outputs (direct output path) | 1.24           | 1.65           | 1.65           | 2.48           | ns, Max |
| Setup and Hold Times Before/After Clock CLK |                                             |                |                |                |                |         |
| T <sub>WS</sub> /T <sub>WH</sub>            | WE input to CLK                             | 0.20/<br>–0.07 | 0.24/<br>–0.07 | 0.24/<br>–0.07 | 0.29/<br>–0.27 | ns, Min |
| T <sub>CECK</sub> /T <sub>CKCE</sub>        | CE input to CLK for XC devices              | 0.30/<br>0.30  | 0.30/<br>0.38  | 0.30/<br>0.38  | 0.82/<br>–0.41 | ns, Min |
|                                             | CE input to CLK for XA and XQ devices       | 0.32/<br>0.30  | N/A            | 0.40/<br>0.38  | 0.82/<br>–0.41 | ns, Min |
| T <sub>DS</sub> /T <sub>DH</sub>            | AX – DX or AI – DI inputs to CLK            | 0.07/<br>0.11  | 0.09/<br>0.14  | 0.09/<br>0.14  | 0.11/<br>0.23  | ns, Min |

Table 52: PLL Specification (Cont'd)

| Symbol                             | Description                                          | Device <sup>(1)</sup> | Speed Grade                         |       |       |       | Units |
|------------------------------------|------------------------------------------------------|-----------------------|-------------------------------------|-------|-------|-------|-------|
|                                    |                                                      |                       | -3                                  | -3N   | -2    | -1L   |       |
| F <sub>INMIN</sub>                 | Minimum Input Clock Frequency                        | LX devices            | 19                                  | 19    | 19    | 19    | MHz   |
|                                    |                                                      | LXT devices           | 19                                  | 19    | 19    | N/A   | MHz   |
| F <sub>INJITTER</sub>              | Maximum Input Clock Period Jitter: 19–200 MHz        | All                   | 1 ns Maximum                        |       |       |       |       |
|                                    | Maximum Input Clock Period Jitter: > 200 MHz         | All                   | <20% of clock input period Maximum  |       |       |       |       |
| F <sub>INDUTY</sub>                | Allowable Input Duty Cycle: 19—199 MHz               | All                   | 25/75                               |       |       |       | %     |
|                                    | Allowable Input Duty Cycle: 200—299 MHz              | All                   | 35/65                               |       |       |       | %     |
|                                    | Allowable Input Duty Cycle: > 300 MHz                | All                   | 45/55                               |       |       |       | %     |
| F <sub>VCOMIN</sub>                | Minimum PLL VCO Frequency                            | LX devices            | 400                                 | 400   | 400   | 400   | MHz   |
|                                    |                                                      | LXT devices           | 400                                 | 400   | 400   | N/A   | MHz   |
| F <sub>VCOMAX</sub>                | Maximum PLL VCO Frequency                            | LX devices            | 1080                                | 1050  | 1000  | 1000  | MHz   |
|                                    |                                                      | LXT devices           | 1080                                | 1050  | 1000  | N/A   | MHz   |
| F <sub>BANDWIDTH</sub>             | Low PLL Bandwidth at Typical <sup>(3)</sup>          | All                   | 1                                   | 1     | 1     | 1     | MHz   |
|                                    | High PLL Bandwidth at Typical <sup>(3)</sup>         | All                   | 4                                   | 4     | 4     | 4     | MHz   |
| T <sub>STAPHAOFFSET</sub>          | Static Phase Offset of the PLL Outputs               | All                   | 0.12                                | 0.12  | 0.12  | 0.15  | ns    |
| T <sub>OUTJITTER</sub>             | PLL Output Jitter <sup>(3)</sup>                     | All                   | Note 2                              |       |       |       |       |
| T <sub>OUTDUTY</sub>               | PLL Output Clock Duty Cycle Precision <sup>(4)</sup> | All                   | 0.15                                | 0.15  | 0.20  | 0.25  | ns    |
| T <sub>LOCKMAX</sub>               | PLL Maximum Lock Time                                | All                   | 100                                 | 100   | 100   | 100   | μs    |
| F <sub>OUTMAX</sub>                | PLL Maximum Output Frequency for BUFGMUX             | LX devices            | 400                                 | 400   | 375   | 250   | MHz   |
|                                    |                                                      | LXT devices           | 400                                 | 400   | 375   | N/A   | MHz   |
|                                    | PLL Maximum Output Frequency for BUFPLL              | LX devices            | 1080                                | 1050  | 950   | 500   | MHz   |
|                                    |                                                      | LXT devices           | 1080                                | 1050  | 950   | N/A   | MHz   |
| F <sub>OUTMIN</sub>                | PLL Minimum Output Frequency <sup>(5)</sup>          | All                   | 3.125                               | 3.125 | 3.125 | 3.125 | MHz   |
| T <sub>EXTFDVAR</sub>              | External Clock Feedback Variation: 19–200 MHz        | All                   | 1 ns Maximum                        |       |       |       |       |
|                                    | External Clock Feedback Variation: > 200 MHz         | All                   | < 20% of clock input period Maximum |       |       |       |       |
| RST <sub>MINPULSE</sub>            | Minimum Reset Pulse Width                            | All                   | 5                                   | 5     | 5     | 5     | ns    |
| F <sub>PFDMAX</sub> <sup>(5)</sup> | Maximum Frequency at the Phase Frequency Detector    | LX devices            | 500                                 | 500   | 400   | 300   | MHz   |
|                                    |                                                      | LXT devices           | 500                                 | 500   | 400   | N/A   | MHz   |
| F <sub>PFDMIN</sub>                | Minimum Frequency at the Phase Frequency Detector    | LX devices            | 19                                  | 19    | 19    | 19    | MHz   |
|                                    |                                                      | LXT devices           | 19                                  | 19    | 19    | N/A   | MHz   |
| T <sub>FBDELAY</sub>               | Maximum Delay in the Feedback Path                   | All                   | 3 ns Max or one CLKIN cycle         |       |       |       |       |

**Notes:**

1. LXT devices are not available with a -1L speed grade.
2. Values for this parameter are available in the Clocking Wizard.
3. The PLL does not filter typical spread spectrum input clocks because they are usually far below the bandwidth filter frequencies.
4. Includes global clock buffer.
5. Calculated as  $F_{VCO}/128$  assuming output duty cycle is 50%.
6. When using CLK\_FEEDBACK = CLKOUT0 with BUFIO2 feedback, the feedback frequency will be higher than the phase frequency detector frequency.  $F_{PFDMAX} = F_{CLKFB} / CLKFBOUT\_MULT$

Table 64: Global Clock Input to Output Delay With DCM in System-Synchronous Mode

| Symbol                                                                                                                                | Description                            | Device     | Speed Grade |      |      |      | Units |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------|-------------|------|------|------|-------|
|                                                                                                                                       |                                        |            | -3          | -3N  | -2   | -1L  |       |
| LVCMOS25 Global Clock Input to Output Delay using Output Flip-Flop, 12mA, Fast Slew Rate, <i>with</i> DCM in System-Synchronous Mode. |                                        |            |             |      |      |      |       |
| T <sub>ICKOFDCM</sub>                                                                                                                 | Global Clock and OUTFF <i>with</i> DCM | XC6SLX4    | 4.23        | N/A  | 6.11 | 6.60 | ns    |
|                                                                                                                                       |                                        | XC6SLX9    | 4.23        | 5.17 | 6.11 | 6.60 | ns    |
|                                                                                                                                       |                                        | XC6SLX16   | 4.28        | 4.57 | 5.34 | 6.36 | ns    |
|                                                                                                                                       |                                        | XC6SLX25   | 3.95        | 4.18 | 4.59 | 6.91 | ns    |
|                                                                                                                                       |                                        | XC6SLX25T  | 3.95        | 4.18 | 4.59 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX45   | 4.37        | 4.70 | 5.50 | 6.85 | ns    |
|                                                                                                                                       |                                        | XC6SLX45T  | 4.37        | 4.70 | 5.50 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX75   | 3.90        | 4.23 | 4.77 | 6.31 | ns    |
|                                                                                                                                       |                                        | XC6SLX75T  | 3.90        | 4.23 | 4.77 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX100  | 3.86        | 4.16 | 4.66 | 7.25 | ns    |
|                                                                                                                                       |                                        | XC6SLX100T | 3.90        | 4.16 | 4.66 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX150  | 4.03        | 4.33 | 4.83 | 6.63 | ns    |
|                                                                                                                                       |                                        | XC6SLX150T | 4.03        | 4.33 | 4.83 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX4    | 4.55        | N/A  | 6.11 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX9    | 4.55        | N/A  | 6.11 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX16   | 4.62        | N/A  | 5.33 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX25   | 4.27        | N/A  | 4.59 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX25T  | 4.27        | N/A  | 4.69 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX45   | 4.69        | N/A  | 5.50 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX45T  | 4.69        | N/A  | 5.50 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX75   | 4.22        | N/A  | 4.77 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX75T  | 4.22        | N/A  | 4.77 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX100  | N/A         | N/A  | 5.34 | N/A  | ns    |
|                                                                                                                                       |                                        | XQ6SLX75   | N/A         | N/A  | 4.77 | 6.31 | ns    |
|                                                                                                                                       |                                        | XQ6SLX75T  | 4.22        | N/A  | 4.77 | N/A  | ns    |
|                                                                                                                                       |                                        | XQ6SLX150  | N/A         | N/A  | 4.96 | 6.63 | ns    |
|                                                                                                                                       |                                        | XQ6SLX150T | 4.62        | N/A  | 4.96 | N/A  | ns    |

**Notes:**

- Listed above are representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible IOB and CLB flip-flops are clocked by the global clock net.
- DCM output jitter is already included in the timing calculation.

Table 65: Global Clock Input to Output Delay With DCM in Source-Synchronous Mode

| Symbol                                                                                                                                | Description                            | Device     | Speed Grade |      |      |      | Units |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------|-------------|------|------|------|-------|
|                                                                                                                                       |                                        |            | -3          | -3N  | -2   | -1L  |       |
| LVCMOS25 Global Clock Input to Output Delay using Output Flip-Flop, 12mA, Fast Slew Rate, <i>with</i> DCM in Source-Synchronous Mode. |                                        |            |             |      |      |      |       |
| T <sub>ICKOFDCM_0</sub>                                                                                                               | Global Clock and OUTFF <i>with</i> DCM | XC6SLX4    | 5.03        | N/A  | 7.21 | 8.05 | ns    |
|                                                                                                                                       |                                        | XC6SLX9    | 5.03        | 6.13 | 7.21 | 8.05 | ns    |
|                                                                                                                                       |                                        | XC6SLX16   | 5.08        | 5.51 | 6.44 | 7.96 | ns    |
|                                                                                                                                       |                                        | XC6SLX25   | 4.81        | 5.13 | 5.69 | 7.94 | ns    |
|                                                                                                                                       |                                        | XC6SLX25T  | 4.81        | 5.13 | 5.69 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX45   | 5.26        | 5.69 | 6.63 | 7.92 | ns    |
|                                                                                                                                       |                                        | XC6SLX45T  | 5.26        | 5.69 | 6.63 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX75   | 4.77        | 5.18 | 5.88 | 7.95 | ns    |
|                                                                                                                                       |                                        | XC6SLX75T  | 4.77        | 5.18 | 5.88 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX100  | 4.72        | 5.11 | 5.76 | 8.59 | ns    |
|                                                                                                                                       |                                        | XC6SLX100T | 4.76        | 5.11 | 5.76 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX150  | 4.90        | 5.30 | 5.93 | 7.93 | ns    |
|                                                                                                                                       |                                        | XC6SLX150T | 4.90        | 5.30 | 5.93 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX4    | 5.35        | N/A  | 7.21 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX9    | 5.35        | N/A  | 7.21 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX16   | 5.42        | N/A  | 6.44 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX25   | 5.13        | N/A  | 5.69 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX25T  | 5.13        | N/A  | 5.79 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX45   | 5.58        | N/A  | 6.63 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX45T  | 5.58        | N/A  | 6.63 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX75   | 5.09        | N/A  | 5.87 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX75T  | 5.09        | N/A  | 5.87 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX100  | N/A         | N/A  | 6.44 | N/A  | ns    |
|                                                                                                                                       |                                        | XQ6SLX75   | N/A         | N/A  | 5.87 | 7.95 | ns    |
|                                                                                                                                       |                                        | XQ6SLX75T  | 5.09        | N/A  | 5.87 | N/A  | ns    |
|                                                                                                                                       |                                        | XQ6SLX150  | N/A         | N/A  | 6.06 | 7.93 | ns    |
|                                                                                                                                       |                                        | XQ6SLX150T | 5.50        | N/A  | 6.06 | N/A  | ns    |

**Notes:**

- Listed above are representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible IOB and CLB flip-flops are clocked by the global clock net.
- DCM output jitter is already included in the timing calculation.

Table 67: Global Clock Input to Output Delay With PLL in Source-Synchronous Mode

| Symbol                                                                                                                                | Description                            | Device     | Speed Grade |      |      |      | Units |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------|-------------|------|------|------|-------|
|                                                                                                                                       |                                        |            | -3          | -3N  | -2   | -1L  |       |
| LVCMOS25 Global Clock Input to Output Delay using Output Flip-Flop, 12mA, Fast Slew Rate, <i>with</i> PLL in Source-Synchronous Mode. |                                        |            |             |      |      |      |       |
| T <sub>ICKOFFLL_0</sub>                                                                                                               | Global Clock and OUTFF <i>with</i> PLL | XC6SLX4    | 5.49        | N/A  | 7.44 | 8.55 | ns    |
|                                                                                                                                       |                                        | XC6SLX9    | 5.49        | 6.29 | 7.44 | 8.55 | ns    |
|                                                                                                                                       |                                        | XC6SLX16   | 5.23        | 5.77 | 6.79 | 8.21 | ns    |
|                                                                                                                                       |                                        | XC6SLX25   | 5.00        | 5.35 | 6.10 | 8.54 | ns    |
|                                                                                                                                       |                                        | XC6SLX25T  | 5.00        | 5.35 | 6.10 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX45   | 5.59        | 6.03 | 7.02 | 8.39 | ns    |
|                                                                                                                                       |                                        | XC6SLX45T  | 5.59        | 6.03 | 7.02 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX75   | 4.96        | 5.41 | 6.22 | 8.32 | ns    |
|                                                                                                                                       |                                        | XC6SLX75T  | 4.96        | 5.41 | 6.22 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX100  | 4.97        | 5.42 | 6.21 | 9.08 | ns    |
|                                                                                                                                       |                                        | XC6SLX100T | 5.01        | 5.42 | 6.21 | N/A  | ns    |
|                                                                                                                                       |                                        | XC6SLX150  | 4.59        | 5.06 | 5.86 | 8.13 | ns    |
|                                                                                                                                       |                                        | XC6SLX150T | 4.59        | 5.06 | 5.86 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX4    | 5.79        | N/A  | 7.32 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX9    | 5.79        | N/A  | 7.32 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX16   | 5.56        | N/A  | 6.66 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX25   | 5.40        | N/A  | 5.97 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX25T  | 5.40        | N/A  | 6.07 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX45   | 5.89        | N/A  | 6.90 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX45T  | 5.89        | N/A  | 6.90 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX75   | 5.27        | N/A  | 6.12 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX75T  | 5.27        | N/A  | 6.12 | N/A  | ns    |
|                                                                                                                                       |                                        | XA6SLX100  | N/A         | N/A  | 6.80 | N/A  | ns    |
|                                                                                                                                       |                                        | XQ6SLX75   | N/A         | N/A  | 6.12 | 8.32 | ns    |
|                                                                                                                                       |                                        | XQ6SLX75T  | 5.27        | N/A  | 6.12 | N/A  | ns    |
|                                                                                                                                       |                                        | XQ6SLX150  | N/A         | N/A  | 5.88 | 8.13 | ns    |
|                                                                                                                                       |                                        | XQ6SLX150T | 5.21        | N/A  | 5.88 | N/A  | ns    |

**Notes:**

1. Listed above are representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible IOB and CLB flip-flops are clocked by the global clock net.
2. PLL output jitter is included in the timing calculation.

Table 68: Global Clock Input to Output Delay With DCM and PLL in System-Synchronous Mode

| Symbol                                                                                                                                                        | Description                             | Device     | Speed Grade |      |      |      | Units |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------|-------------|------|------|------|-------|
|                                                                                                                                                               |                                         |            | -3          | -3N  | -2   | -1L  |       |
| LVCMOS25 Global Clock Input to Output Delay using Output Flip-Flop, 12mA, Fast Slew Rate, <i>with</i> DCM in System-Synchronous Mode and PLL in DCM2PLL Mode. |                                         |            |             |      |      |      |       |
| T <sub>ICKOFDCM_PLL</sub>                                                                                                                                     | Global Clock and OUTFF with DCM and PLL | XC6SLX4    | 4.78        | N/A  | 6.32 | 7.09 | ns    |
|                                                                                                                                                               |                                         | XC6SLX9    | 4.78        | 5.24 | 6.32 | 7.09 | ns    |
|                                                                                                                                                               |                                         | XC6SLX16   | 4.70        | 5.12 | 5.94 | 6.63 | ns    |
|                                                                                                                                                               |                                         | XC6SLX25   | 4.70        | 5.09 | 5.92 | 7.30 | ns    |
|                                                                                                                                                               |                                         | XC6SLX25T  | 4.70        | 5.09 | 5.92 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX45   | 4.63        | 4.98 | 5.83 | 7.26 | ns    |
|                                                                                                                                                               |                                         | XC6SLX45T  | 4.63        | 4.98 | 5.83 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX75   | 4.68        | 5.04 | 5.88 | 6.90 | ns    |
|                                                                                                                                                               |                                         | XC6SLX75T  | 4.68        | 5.04 | 5.88 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX100  | 4.72        | 5.07 | 5.92 | 7.77 | ns    |
|                                                                                                                                                               |                                         | XC6SLX100T | 4.76        | 5.07 | 5.92 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX150  | 4.44        | 4.73 | 5.31 | 6.96 | ns    |
|                                                                                                                                                               |                                         | XC6SLX150T | 4.44        | 4.73 | 5.31 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX4    | 5.07        | N/A  | 6.18 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX9    | 5.07        | N/A  | 6.18 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX16   | 5.22        | N/A  | 5.77 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX25   | 5.01        | N/A  | 5.80 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX25T  | 5.01        | N/A  | 5.90 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX45   | 4.93        | N/A  | 5.67 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX45T  | 4.93        | N/A  | 5.67 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX75   | 4.94        | N/A  | 5.70 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX75T  | 4.94        | N/A  | 5.70 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX100  | N/A         | N/A  | 5.77 | N/A  | ns    |
|                                                                                                                                                               |                                         | XQ6SLX75   | N/A         | N/A  | 5.70 | 6.90 | ns    |
|                                                                                                                                                               |                                         | XQ6SLX75T  | 4.94        | N/A  | 5.70 | N/A  | ns    |
|                                                                                                                                                               |                                         | XQ6SLX150  | N/A         | N/A  | 5.31 | 6.96 | ns    |
|                                                                                                                                                               |                                         | XQ6SLX150T | 5.02        | N/A  | 5.31 | N/A  | ns    |

**Notes:**

1. Listed above are representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible IOB and CLB flip-flops are clocked by the global clock net.
2. DCM and PLL output jitter are already included in the timing calculation.

Table 69: Global Clock Input to Output Delay With DCM and PLL in Source-Synchronous Mode

| Symbol                                                                                                                                                        | Description                             | Device     | Speed Grade |      |      |      | Units |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------|-------------|------|------|------|-------|
|                                                                                                                                                               |                                         |            | -3          | -3N  | -2   | -1L  |       |
| LVCMOS25 Global Clock Input to Output Delay using Output Flip-Flop, 12mA, Fast Slew Rate, <i>with</i> DCM in Source-Synchronous Mode and PLL in DCM2PLL Mode. |                                         |            |             |      |      |      |       |
| T <sub>ICKOFDCM0_PLL</sub>                                                                                                                                    | Global Clock and OUTFF with DCM and PLL | XC6SLX4    | 5.58        | N/A  | 7.42 | 8.54 | ns    |
|                                                                                                                                                               |                                         | XC6SLX9    | 5.58        | 6.19 | 7.42 | 8.54 | ns    |
|                                                                                                                                                               |                                         | XC6SLX16   | 5.50        | 6.06 | 7.05 | 8.24 | ns    |
|                                                                                                                                                               |                                         | XC6SLX25   | 5.57        | 6.04 | 7.02 | 8.33 | ns    |
|                                                                                                                                                               |                                         | XC6SLX25T  | 5.57        | 6.04 | 7.02 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX45   | 5.53        | 5.97 | 6.96 | 8.32 | ns    |
|                                                                                                                                                               |                                         | XC6SLX45T  | 5.53        | 5.97 | 6.96 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX75   | 5.55        | 6.00 | 6.99 | 8.54 | ns    |
|                                                                                                                                                               |                                         | XC6SLX75T  | 5.55        | 6.00 | 6.99 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX100  | 5.58        | 6.03 | 7.02 | 9.11 | ns    |
|                                                                                                                                                               |                                         | XC6SLX100T | 5.62        | 6.03 | 7.02 | N/A  | ns    |
|                                                                                                                                                               |                                         | XC6SLX150  | 5.32        | 5.70 | 6.41 | 8.26 | ns    |
|                                                                                                                                                               |                                         | XC6SLX150T | 5.32        | 5.70 | 6.41 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX4    | 5.87        | N/A  | 7.28 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX9    | 5.87        | N/A  | 7.28 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX16   | 6.02        | N/A  | 6.87 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX25   | 5.88        | N/A  | 6.90 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX25T  | 5.88        | N/A  | 7.00 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX45   | 5.82        | N/A  | 6.81 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX45T  | 5.82        | N/A  | 6.81 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX75   | 5.81        | N/A  | 6.80 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX75T  | 5.81        | N/A  | 6.80 | N/A  | ns    |
|                                                                                                                                                               |                                         | XA6SLX100  | N/A         | N/A  | 6.88 | N/A  | ns    |
|                                                                                                                                                               |                                         | XQ6SLX75   | N/A         | N/A  | 6.80 | 8.54 | ns    |
|                                                                                                                                                               |                                         | XQ6SLX75T  | 5.81        | N/A  | 6.80 | N/A  | ns    |
|                                                                                                                                                               |                                         | XQ6SLX150  | N/A         | N/A  | 6.41 | 8.26 | ns    |
|                                                                                                                                                               |                                         | XQ6SLX150T | 5.90        | N/A  | 6.41 | N/A  | ns    |

**Notes:**

1. Listed above are representative values where one global clock input drives one vertical clock line in each accessible column, and where all accessible IOB and CLB flip-flops are clocked by the global clock net.
2. DCM and PLL output jitter are already included in the timing calculation.

Table 72: Global Clock Setup and Hold With DCM in System-Synchronous Mode

| Symbol                                                                                                 | Description                                                                      | Device     | Speed Grade |            |            |           | Units |
|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------|-------------|------------|------------|-----------|-------|
|                                                                                                        |                                                                                  |            | -3          | -3N        | -2         | -1L       |       |
| Input Setup and Hold Time Relative to Global Clock Input Signal for LVC MOS25 Standard. <sup>(1)</sup> |                                                                                  |            |             |            |            |           |       |
| T <sub>PSDCM</sub> / T <sub>PHDCM</sub>                                                                | No Delay Global Clock and IFF <sup>(2)</sup> with DCM in System-Synchronous Mode | XC6SLX4    | 1.54/0.06   | N/A        | 1.75/0.12  | 2.84/0.27 | ns    |
|                                                                                                        |                                                                                  | XC6SLX9    | 1.54/0.06   | 1.63/0.12  | 1.75/0.12  | 2.84/0.27 | ns    |
|                                                                                                        |                                                                                  | XC6SLX16   | 1.72/−0.18  | 1.87/−0.17 | 2.13/−0.17 | 2.31/0.26 | ns    |
|                                                                                                        |                                                                                  | XC6SLX25   | 1.70/−0.03  | 1.78/−0.02 | 2.00/−0.02 | 2.88/0.20 | ns    |
|                                                                                                        |                                                                                  | XC6SLX25T  | 1.70/0.07   | 1.78/0.08  | 2.00/0.08  | N/A       | ns    |
|                                                                                                        |                                                                                  | XC6SLX45   | 1.74/−0.03  | 1.84/−0.02 | 2.02/−0.02 | 2.64/0.52 | ns    |
|                                                                                                        |                                                                                  | XC6SLX45T  | 1.74/−0.01  | 1.84/0.00  | 2.02/0.00  | N/A       | ns    |
|                                                                                                        |                                                                                  | XC6SLX75   | 1.86/0.11   | 1.98/0.12  | 2.20/0.12  | 2.96/0.58 | ns    |
|                                                                                                        |                                                                                  | XC6SLX75T  | 1.86/0.11   | 1.98/0.12  | 2.20/0.12  | N/A       | ns    |
|                                                                                                        |                                                                                  | XC6SLX100  | 1.64/0.07   | 1.72/0.08  | 1.97/0.08  | 2.70/0.99 | ns    |
|                                                                                                        |                                                                                  | XC6SLX100T | 1.64/0.09   | 1.72/0.10  | 1.97/0.10  | N/A       | ns    |
|                                                                                                        |                                                                                  | XC6SLX150  | 1.53/0.39   | 1.62/0.40  | 1.82/0.40  | 2.75/1.00 | ns    |
|                                                                                                        |                                                                                  | XC6SLX150T | 1.53/0.39   | 1.62/0.40  | 1.82/0.40  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX4    | 1.65/0.16   | N/A        | 1.75/0.26  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX9    | 1.65/0.16   | N/A        | 1.75/0.26  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX16   | 1.88/0.02   | N/A        | 2.13/0.03  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX25   | 1.80/0.16   | N/A        | 2.05/0.17  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX25T  | 1.80/0.16   | N/A        | 2.13/0.17  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX45   | 1.75/0.12   | N/A        | 2.02/0.13  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX45T  | 1.75/0.12   | N/A        | 2.02/0.13  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX75   | 1.87/0.11   | N/A        | 2.20/0.12  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX75T  | 1.87/0.11   | N/A        | 2.20/0.12  | N/A       | ns    |
|                                                                                                        |                                                                                  | XA6SLX100  | N/A         | N/A        | 2.46/0.24  | N/A       | ns    |
|                                                                                                        |                                                                                  | XQ6SLX75   | N/A         | N/A        | 2.20/0.12  | 2.96/0.58 | ns    |
|                                                                                                        |                                                                                  | XQ6SLX75T  | 1.87/0.11   | N/A        | 2.20/0.12  | N/A       | ns    |
|                                                                                                        |                                                                                  | XQ6SLX150  | N/A         | N/A        | 1.82/0.56  | 2.75/1.00 | ns    |
|                                                                                                        |                                                                                  | XQ6SLX150T | 1.65/0.55   | N/A        | 1.82/0.56  | N/A       | ns    |

**Notes:**

1. Setup and Hold times are measured over worst case conditions (process, voltage, temperature). Setup time is measured relative to the Global Clock input signal using the slowest process, highest temperature, and lowest voltage. Hold time is measured relative to the Global Clock input signal using the fastest process, lowest temperature, and highest voltage. These measurements include DCM CLK0 jitter.
2. IFF = Input Flip-Flop or Latch
3. Use IBIS to determine any duty-cycle distortion incurred using various standards.

Table 73: Global Clock Setup and Hold With DCM in Source-Synchronous Mode

| Symbol                                                                                                | Description                                                                      | Device     | Speed Grade |           |           |           | Units |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------|-------------|-----------|-----------|-----------|-------|
|                                                                                                       |                                                                                  |            | -3          | -3N       | -2        | -1L       |       |
| Input Setup and Hold Time Relative to Global Clock Input Signal for LVCMOS25 Standard. <sup>(1)</sup> |                                                                                  |            |             |           |           |           |       |
| T <sub>PSDCM0</sub> / T <sub>PHDCM0</sub>                                                             | No Delay Global Clock and IFF <sup>(2)</sup> with DCM in Source-Synchronous Mode | XC6SLX4    | 0.71/0.65   | N/A       | 0.72/1.22 | 1.58/1.18 | ns    |
|                                                                                                       |                                                                                  | XC6SLX9    | 0.71/0.69   | 0.71/1.19 | 0.72/1.36 | 1.58/1.18 | ns    |
|                                                                                                       |                                                                                  | XC6SLX16   | 0.86/0.52   | 0.92/0.57 | 1.04/0.60 | 1.02/1.06 | ns    |
|                                                                                                       |                                                                                  | XC6SLX25   | 0.84/0.58   | 0.90/0.59 | 1.01/0.59 | 1.58/1.07 | ns    |
|                                                                                                       |                                                                                  | XC6SLX25T  | 0.84/0.58   | 0.90/0.59 | 1.01/0.59 | N/A       | ns    |
|                                                                                                       |                                                                                  | XC6SLX45   | 0.85/0.70   | 0.90/0.76 | 0.98/0.79 | 1.34/1.34 | ns    |
|                                                                                                       |                                                                                  | XC6SLX45T  | 0.85/0.70   | 0.90/0.76 | 0.98/0.79 | N/A       | ns    |
|                                                                                                       |                                                                                  | XC6SLX75   | 1.00/0.62   | 1.06/0.63 | 1.15/0.63 | 1.65/1.46 | ns    |
|                                                                                                       |                                                                                  | XC6SLX75T  | 1.00/0.71   | 1.06/0.72 | 1.15/0.72 | N/A       | ns    |
|                                                                                                       |                                                                                  | XC6SLX100  | 0.81/0.68   | 0.81/0.69 | 0.94/0.69 | 1.42/2.07 | ns    |
|                                                                                                       |                                                                                  | XC6SLX100T | 0.81/0.68   | 0.81/0.69 | 0.94/0.69 | N/A       | ns    |
|                                                                                                       |                                                                                  | XC6SLX150  | 0.68/0.98   | 0.69/0.99 | 0.79/0.99 | 1.45/1.60 | ns    |
|                                                                                                       |                                                                                  | XC6SLX150T | 0.68/0.98   | 0.69/0.99 | 0.79/0.99 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX4    | 0.81/0.74   | N/A       | 0.72/1.36 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX9    | 0.81/0.74   | N/A       | 0.72/1.36 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX16   | 1.01/0.56   | N/A       | 1.04/0.60 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX25   | 0.94/0.76   | N/A       | 1.06/0.77 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX25T  | 0.94/0.76   | N/A       | 1.14/0.77 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX45   | 0.86/0.74   | N/A       | 0.98/0.78 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX45T  | 0.86/0.74   | N/A       | 0.98/0.78 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX75   | 1.02/0.71   | N/A       | 1.15/0.72 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX75T  | 1.02/0.71   | N/A       | 1.15/0.72 | N/A       | ns    |
|                                                                                                       |                                                                                  | XA6SLX100  | N/A         | N/A       | 1.37/0.75 | N/A       | ns    |
|                                                                                                       |                                                                                  | XQ6SLX75   | N/A         | N/A       | 1.15/0.72 | 1.65/1.46 | ns    |
|                                                                                                       |                                                                                  | XQ6SLX75T  | 1.02/0.71   | N/A       | 1.15/0.72 | N/A       | ns    |
|                                                                                                       |                                                                                  | XQ6SLX150  | N/A         | N/A       | 0.79/1.15 | 1.45/1.60 | ns    |
|                                                                                                       |                                                                                  | XQ6SLX150T | 0.73/1.15   | N/A       | 0.79/1.15 | N/A       | ns    |

**Notes:**

- Setup and Hold times are measured over worst case conditions (process, voltage, temperature). Setup time is measured relative to the Global Clock input signal using the slowest process, highest temperature, and lowest voltage. Hold time is measured relative to the Global Clock input signal using the fastest process, lowest temperature, and highest voltage. These measurements include DCM CLK0 jitter.
- IFF = Input Flip-Flop or Latch
- Use IBIS to determine any duty-cycle distortion incurred using various standards.

Table 74: Global Clock Setup and Hold With PLL in System-Synchronous Mode

| Symbol                                                                                     | Description                                                             | Device     | Speed Grade |            |            |           | Units |
|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------|-------------|------------|------------|-----------|-------|
|                                                                                            |                                                                         |            | -3          | -3N        | -2         | -1L       |       |
| Input Setup and Hold Time Relative to Global Clock Input Signal for LVC MOS25 Standard.(1) |                                                                         |            |             |            |            |           |       |
| T <sub>PSPLL</sub> / T <sub>PHPLL</sub>                                                    | No Delay Global Clock and IFF(2)<br>with PLL in System-Synchronous Mode | XC6SLX4    | 1.37/0.25   | N/A        | 1.52/0.41  | 2.07/0.69 | ns    |
|                                                                                            |                                                                         | XC6SLX9    | 1.37/0.21   | 1.48/0.21  | 1.52/0.26  | 2.07/0.69 | ns    |
|                                                                                            |                                                                         | XC6SLX16   | 1.33/−0.03  | 1.53/−0.02 | 1.60/−0.02 | 1.57/0.48 | ns    |
|                                                                                            |                                                                         | XC6SLX25   | 1.65/0.28   | 1.71/0.28  | 1.91/0.28  | 2.44/0.76 | ns    |
|                                                                                            |                                                                         | XC6SLX25T  | 1.65/0.28   | 1.71/0.28  | 1.91/0.28  | N/A       | ns    |
|                                                                                            |                                                                         | XC6SLX45   | 1.55/0.18   | 1.64/0.18  | 1.75/0.18  | 2.02/0.90 | ns    |
|                                                                                            |                                                                         | XC6SLX45T  | 1.55/0.18   | 1.64/0.18  | 1.75/0.18  | N/A       | ns    |
|                                                                                            |                                                                         | XC6SLX75   | 1.77/0.21   | 1.89/0.21  | 2.13/0.21  | 2.46/0.53 | ns    |
|                                                                                            |                                                                         | XC6SLX75T  | 1.77/0.21   | 1.89/0.21  | 2.13/0.21  | N/A       | ns    |
|                                                                                            |                                                                         | XC6SLX100  | 1.44/0.32   | 1.52/0.32  | 1.70/0.32  | 1.78/0.86 | ns    |
|                                                                                            |                                                                         | XC6SLX100T | 1.44/0.32   | 1.52/0.32  | 1.70/0.32  | N/A       | ns    |
|                                                                                            |                                                                         | XC6SLX150  | 1.39/0.49   | 1.48/0.49  | 1.67/0.49  | 1.94/0.94 | ns    |
|                                                                                            |                                                                         | XC6SLX150T | 1.39/0.49   | 1.48/0.49  | 1.67/0.49  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX4    | 1.61/0.10   | N/A        | 1.64/0.28  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX9    | 1.61/0.10   | N/A        | 1.64/0.28  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX16   | 1.89/−0.08  | N/A        | 1.72/−0.08 | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX25   | 1.85/0.16   | N/A        | 2.08/0.16  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX25T  | 1.85/0.16   | N/A        | 2.17/0.16  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX45   | 1.58/0.07   | N/A        | 1.87/0.03  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX45T  | 1.58/0.07   | N/A        | 1.87/0.03  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX75   | 1.80/0.06   | N/A        | 2.25/0.06  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX75T  | 1.80/0.06   | N/A        | 2.25/0.06  | N/A       | ns    |
|                                                                                            |                                                                         | XA6SLX100  | N/A         | N/A        | 2.34/0.14  | N/A       | ns    |
|                                                                                            |                                                                         | XQ6SLX75   | N/A         | N/A        | 2.25/0.06  | 2.46/0.53 | ns    |
|                                                                                            |                                                                         | XQ6SLX75T  | 1.80/0.06   | N/A        | 2.25/0.06  | N/A       | ns    |
|                                                                                            |                                                                         | XQ6SLX150  | N/A         | N/A        | 1.79/0.37  | 1.94/0.94 | ns    |
|                                                                                            |                                                                         | XQ6SLX150T | 1.43/0.37   | N/A        | 1.79/0.37  | N/A       | ns    |

**Notes:**

1. Setup and Hold times are measured over worst case conditions (process, voltage, temperature). Setup time is measured relative to the Global Clock input signal using the slowest process, highest temperature, and lowest voltage. Hold time is measured relative to the Global Clock input signal using the fastest process, lowest temperature, and highest voltage. These measurements include PLL CLKOUT0 jitter.
2. IFF = Input Flip-Flop or Latch
3. Use IBIS to determine any duty-cycle distortion incurred using various standards.

Table 79: Package Skew (Cont'd)

| Symbol               | Description                 | Device | Package <sup>(2)</sup> | Value | Units |
|----------------------|-----------------------------|--------|------------------------|-------|-------|
| T <sub>PKGSKEW</sub> | Package Skew <sup>(1)</sup> | LX45   | CSG324                 | 70    | ps    |
|                      |                             |        | CS(G)484               | 99    | ps    |
|                      |                             |        | FG(G)484               | 109   | ps    |
|                      |                             |        | FG(G)676               | 138   | ps    |
|                      |                             | LX45T  | CSG324                 | 75    | ps    |
|                      |                             |        | CS(G)484               | 100   | ps    |
|                      |                             |        | FG(G)484               | 95    | ps    |
|                      |                             | LX75   | CS(G)484               | 101   | ps    |
|                      |                             |        | FG(G)484               | 107   | ps    |
|                      |                             |        | FG(G)676               | 161   | ps    |
|                      |                             | LX75T  | CS(G)484               | 107   | ps    |
|                      |                             |        | FG(G)484               | 110   | ps    |
|                      |                             |        | FG(G)676               | 134   | ps    |
|                      |                             | LX100  | CS(G)484               | 95    | ps    |
|                      |                             |        | FG(G)484               | 155   | ps    |
|                      |                             |        | FG(G)676               | 144   | ps    |
|                      |                             | LX100T | CS(G)484               | 88    | ps    |
|                      |                             |        | FG(G)484               | 111   | ps    |
|                      |                             |        | FG(G)676               | 147   | ps    |
|                      |                             |        | FG(G)900               | 134   | ps    |
|                      |                             | LX150  | CS(G)484               | 84    | ps    |
|                      |                             |        | FG(G)484               | 103   | ps    |
|                      |                             |        | FG(G)676               | 115   | ps    |
|                      |                             |        | FG(G)900               | 121   | ps    |
|                      |                             | LX150T | CS(G)484               | 83    | ps    |
|                      |                             |        | FG(G)484               | 88    | ps    |
|                      |                             |        | FG(G)676               | 141   | ps    |
|                      |                             |        | FG(G)900               | 120   | ps    |

**Notes:**

- These values represent the worst-case skew between any two SelectIO resources in the package: shortest delay to longest delay from Pad to Ball.
- Some of the devices are available in both Pb and Pb-free (additional G) packages as standard ordering options. See [DS160: Spartan-6 Family Overview](#) for more information.

Table 80: Sample Window

| Symbol                   | Description                                                 | Device <sup>(1)</sup> | Speed Grade |     |     |     | Units |
|--------------------------|-------------------------------------------------------------|-----------------------|-------------|-----|-----|-----|-------|
|                          |                                                             |                       | -3          | -3N | -2  | -1L |       |
| T <sub>SAMP</sub>        | Sampling Error at Receiver Pins <sup>(2)</sup>              | All                   | 510         | 510 | 530 | 740 | ps    |
| T <sub>SAMP_BUFIO2</sub> | Sampling Error at Receiver Pins using BUFIO2 <sup>(3)</sup> | All                   | 430         | 430 | 450 | 590 | ps    |

**Notes:**

- LXT devices are not available with a -1L speed grade.
- This parameter indicates the total sampling error of Spartan-6 FPGA DDR input registers, measured across voltage, temperature, and process. The characterization methodology uses the DCM to capture the DDR input registers' edges of operation. These measurements include:
  - CLK0 DCM jitter
  - DCM accuracy (phase offset)
  - DCM phase shift resolution
 These measurements do not include package or clock tree skew.
- This parameter indicates the total sampling error of Spartan-6 FPGA DDR input registers, measured across voltage, temperature, and process. The characterization methodology uses the BUFIO2 clock network and IODELAY2 to capture the DDR input registers' edges of operation. These measurements do not include package or clock tree skew.