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Understanding [Embedded - CPLDs \(Complex Programmable Logic Devices\)](#)

Embedded - CPLDs, or Complex Programmable Logic Devices, are highly versatile digital logic devices used in electronic systems. These programmable components are designed to perform complex logical operations and can be customized for specific applications. Unlike fixed-function ICs, CPLDs offer the flexibility to reprogram their configuration, making them an ideal choice for various embedded systems. They consist of a set of logic gates and programmable interconnects, allowing designers to implement complex logic circuits without needing custom hardware.

Applications of Embedded - CPLDs

Details

| | |
|---------------------------------|---|
| Product Status | Active |
| Programmable Type | In System Programmable (min 1K program/erase cycles) |
| Delay Time tpd(1) Max | 9 ns |
| Voltage Supply - Internal | 2.7V ~ 3.6V |
| Number of Logic Elements/Blocks | 24 |
| Number of Macrocells | 384 |
| Number of Gates | 9000 |
| Number of I/O | 212 |
| Operating Temperature | -40°C ~ 85°C (TA) |
| Mounting Type | Surface Mount |
| Package / Case | 256-LBGA |
| Supplier Device Package | 256-FTBGA (17x17) |
| Purchase URL | https://www.e-xfl.com/product-detail/xilinx/xcr3384xl-10ft256i |

Features

- Low power 3.3V 384 macrocell CPLD
- 7.0 ns pin-to-pin logic delays
- System frequencies up to 135 MHz
- 384 macrocells with 9,000 usable gates
- Available in small footprint packages
 - 144-pin TQFP (118 user I/O)
 - 208-pin PQFP (172 user I/O)
 - 256-ball FBGA (212 user I/O)
 - 324-ball FBGA (220 user I/O)
- Optimized for 3.3V systems
 - Ultra low power operation
 - Typical Standby Current of 18 μ A at 25°C
 - 5V tolerant I/O pins with 3.3V core supply
 - Advanced 0.35 micron five layer metal EEPROM process
 - Fast Zero Power™ (FZP) CMOS design technology
 - 3.3V PCI electrical specification compatible outputs (no internal clamp diode on any input or I/O)
- Advanced system features
 - In-system programming
 - Input registers
 - Predictable timing model
 - Up to 23 clocks available per function block
 - Excellent pin retention during design changes
 - Full IEEE Standard 1149.1 boundary-scan (JTAG)
 - Four global clocks
 - Eight product term control terms per function block
- Fast ISP programming times
- Port Enable pin for additional I/O
- 2.7V to 3.6V supply voltage at industrial grade voltage range
- Programmable slew rate control per output
- Security bit prevents unauthorized access
- Refer to CoolRunner™ XPLA3 family data sheet ([DS012](#)) for architecture description

Description

The CoolRunner™ XPLA3 XCR3384XL device is a 3.3V, 384 macrocell CPLD targeted at power sensitive designs that require leading edge programmable logic solutions. A total of 24 function blocks provide 9,000 usable gates. Pin-to-pin propagation delays are as fast as 7.0 ns with a maximum system frequency of 135 MHz.

TotalCMOS Design Technique for Fast Zero Power

CoolRunner XPLA3 CPLDs offer a TotalCMOS™ solution, both in process technology and design technique. These CPLDs employ a cascade of CMOS gates to implement their sum of products, instead of the traditional sense amp approach. This CMOS gate implementation allows Xilinx to offer CPLDs that are both high performance and low power, breaking the paradigm that to have low power, you must have low performance. Refer to [Figure 1](#) and [Table 1](#) showing the I_{CC} vs. Frequency of our XCR3384XL TotalCMOS CPLD (data taken with 24 resettable up/down, 16-bit counters at 3.3V, 25°C).

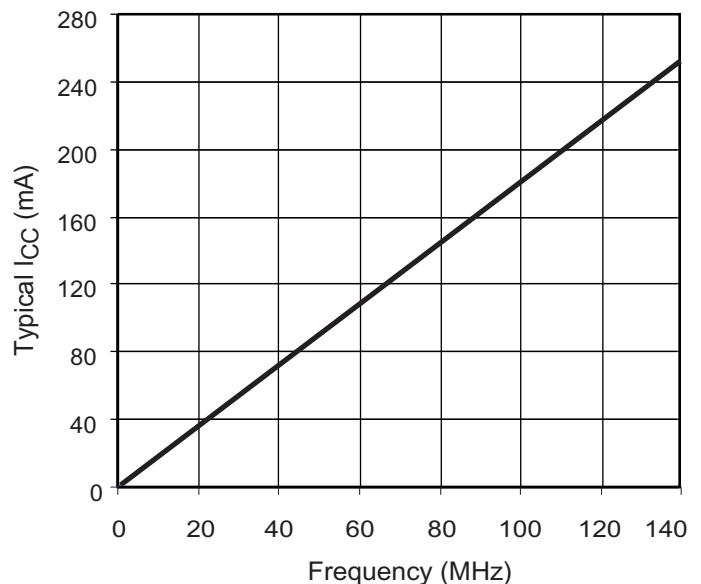


Figure 1: Typical I_{CC} vs. Frequency at $V_{CC} = 3.3V, 25^\circ C$

Table 1: Typical I_{CC} vs. Frequency at $V_{CC} = 3.3V, 25^\circ C$

| Frequency (MHz) | 0 | 1 | 10 | 20 | 40 | 60 | 80 | 100 | 120 | 140 |
|-----------------------|-------|-----|------|------|------|-------|-------|-------|-------|-------|
| Typical I_{CC} (mA) | 0.018 | 2.2 | 24.4 | 42.4 | 82.6 | 123.0 | 155.6 | 187.8 | 227.5 | 258.1 |

DC Electrical Characteristics Over Recommended Operating Conditions⁽¹⁾

| Symbol | Parameter | Test Conditions | Typical | Min. | Max. | Unit |
|------------------|--|--|---------|--------------------|------|---------|
| $V_{OH}^{(2)}$ | Output High voltage | $V_{CC} = 3.0V$ to $3.6V$, $I_{OH} = -8$ mA | - | 2.4 | - | V |
| | | $V_{CC} = 2.7V$ to $3.0V$, $I_{OH} = -8$ mA | - | 2.0 | - | V |
| | | $I_{OH} = -500$ μA | - | 90% $V_{CC}^{(3)}$ | - | V |
| V_{OL} | Output Low voltage | $I_{OL} = 8$ mA | - | - | 0.4 | V |
| I_{IL} | Input leakage current | $V_{IN} = GND$ or V_{CC} to $5.5V$ | - | -10 | 10 | μA |
| I_{IH} | I/O High-Z leakage current | $V_{IN} = GND$ or V_{CC} to $5.5V$ | - | -10 | 10 | μA |
| $I_{CCSB}^{(7)}$ | Standby current | $V_{CC} = 3.6V$ | 31.5 | - | 100 | μA |
| I_{CC} | Dynamic current ^(4,5) | $f = 1$ MHz | - | - | 5 | mA |
| | | $f = 50$ MHz | - | - | 140 | mA |
| C_{IN} | Input pin capacitance ⁽⁶⁾ | $f = 1$ MHz | - | - | 8 | pF |
| C_{CLK} | Clock input capacitance ⁽⁶⁾ | $f = 1$ MHz | - | - | 12 | pF |
| $C_{I/O}$ | I/O pin capacitance ⁽⁶⁾ | $f = 1$ MHz | - | - | 10 | pF |

Notes:

1. See the CoolRunner XPLA3 family data sheet ([DS012](#)) for recommended operating conditions
2. See [Figure 2](#) for output drive characteristics of the CoolRunner XPLA3 family.
3. This parameter guaranteed by design and characterization, not by testing.
4. See [Table 1](#), [Figure 1](#) for typical values.
5. This parameter measured with a 16-bit, resettable up/down counter loaded into every function block, with all outputs disabled and unloaded. Inputs are tied to V_{CC} or ground. This parameter guaranteed by design and characterization, not testing.
6. Typical values, not tested.
7. Typical value at $70^{\circ}C$.

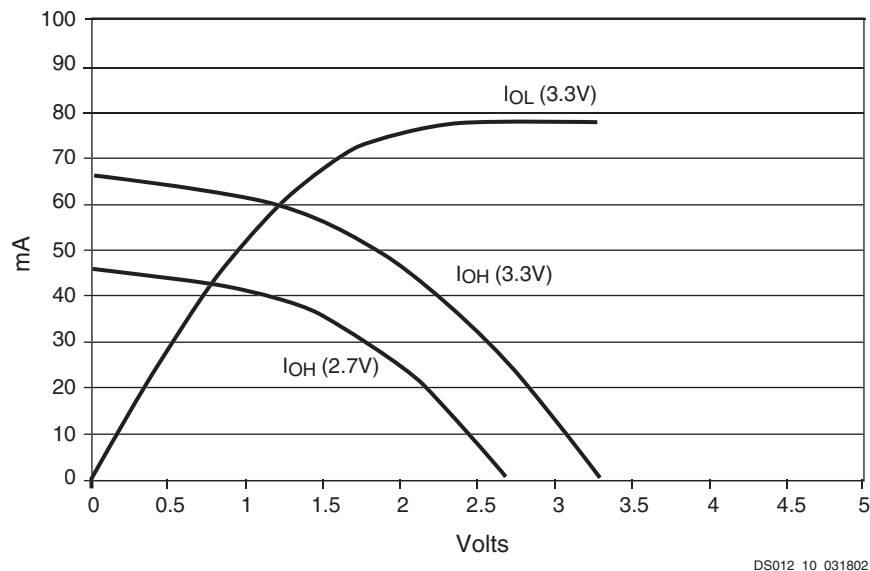


Figure 2: Typical I/V Curve for the CoolRunner XPLA3 Family, 25°C

AC Electrical Characteristics Over Recommended Operating Conditions^(1,2)

| Symbol | Parameter | -7 | | -10 | | -12 | | Unit |
|------------------------------------|---|------|------|------|------|------|------|------|
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| T _{PD1} | Propagation delay time (single p-term) | - | 7.0 | - | 9.0 | - | 10.8 | ns |
| T _{PD2} | Propagation delay time (OR array) ⁽³⁾ | - | 7.5 | - | 10.0 | - | 12.0 | ns |
| T _{CO} | Clock to output (global synchronous pin clock) | - | 4.5 | - | 5.8 | - | 6.9 | ns |
| T _{SUF} | Setup time (fast input register) | 2.5 | - | 3.0 | - | 3.0 | - | ns |
| T _{SU1} ⁽⁴⁾ | Setup time (single p-term) | 4.3 | - | 5.5 | - | 6.7 | - | ns |
| T _{SU2} | Setup time (OR array) | 4.8 | - | 6.5 | - | 7.9 | - | ns |
| T _H ⁽⁴⁾ | Hold time | 0 | - | 0 | - | 0 | - | ns |
| T _{WLH} ⁽⁴⁾ | Global Clock pulse width (High or Low) | 3.0 | - | 4.0 | - | 5.0 | - | ns |
| T _{PLH} ⁽⁴⁾ | P-term clock pulse width | 4.5 | - | 6.0 | - | 7.5 | - | ns |
| T _{APRPW} | Asynchronous preset/reset pulse width (High or Low) | 4.5 | - | 6.0 | - | 7.5 | - | ns |
| T _R ⁽⁴⁾ | Input rise time | - | 20 | - | 20 | - | 20 | ns |
| T _L ⁽⁴⁾ | Input fall time | - | 20 | - | 20 | - | 20 | ns |
| f _{SYSTEM} ⁽⁴⁾ | Maximum system frequency | - | 135 | - | 102 | - | 83 | MHz |
| T _{CONFIG} ⁽⁴⁾ | Configuration time ⁽⁵⁾ | - | 200 | - | 200 | - | 200 | μs |
| T _{INIT} ⁽⁴⁾ | ISP initialization time | - | 200 | - | 200 | - | 200 | μs |
| T _{POE} ⁽⁴⁾ | P-term OE to output enabled | - | 9.0 | - | 11.0 | - | 13.0 | ns |
| T _{POD} ⁽⁴⁾ | P-term OE to output disabled ⁽⁶⁾ | - | 9.0 | - | 11.0 | - | 13.0 | ns |
| T _{PCO} ⁽⁴⁾ | P-term clock to output | - | 8.0 | - | 10.3 | - | 12.4 | ns |
| T _{PAO} ⁽⁴⁾ | P-term set/reset to output valid | - | 9.0 | - | 11.0 | - | 13.0 | ns |

Notes:

1. Specifications measured with one output switching.
2. See the CoolRunner XPLA3 family data sheet ([DS012](#)) for recommended operating conditions.
3. See [Figure 4](#) for derating.
4. These parameters guaranteed by design and/or characterization, not testing.
5. Typical current draw during configuration is 13 mA at 3.6V.
6. Output C_L = 5 pF.

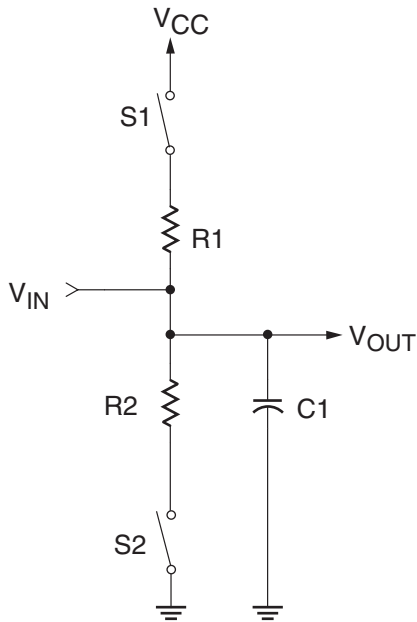
Internal Timing Parameters^(1,2)

| Symbol | Parameter | -7 | | -10 | | -12 | | Unit |
|---|--------------------------------------|------|------|------|------|------|------|------|
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| Buffer Delays | | | | | | | | |
| T _{IN} | Input buffer delay | - | 2.5 | - | 3.3 | - | 4.0 | ns |
| T _{FIN} | Fast input buffer delay | - | 2.7 | - | 3.3 | - | 3.3 | ns |
| T _{GCK} | Global clock buffer delay | - | 1.0 | - | 1.3 | - | 1.5 | ns |
| T _{OUT} | Output buffer delay | - | 2.5 | - | 3.2 | - | 3.8 | ns |
| T _{EN} | Output buffer enable/disable delay | - | 4.5 | - | 5.2 | - | 6.0 | ns |
| Internal Register and Combinatorial Delays | | | | | | | | |
| T _{LDI} | Latch transparent delay | - | 1.3 | - | 1.6 | - | 2.0 | ns |
| T _{SUI} | Register setup time | 0.8 | - | 1.0 | - | 1.2 | - | ns |
| T _{HI} | Register hold time | 0.3 | - | 0.5 | - | 0.7 | - | ns |
| T _{ECSU} | Register clock enable setup time | 2.0 | - | 2.5 | - | 3.0 | - | ns |
| T _{ECHO} | Register clock enable hold time | 3.0 | - | 4.5 | - | 5.5 | - | ns |
| T _{COI} | Register clock to output delay | - | 1.0 | - | 1.3 | - | 1.6 | ns |
| T _{AOI} | Register async. S/R to output delay | - | 2.0 | - | 2.0 | - | 2.2 | ns |
| T _{RAI} | Register async. recovery | - | 5.0 | - | 7.0 | - | 8.0 | ns |
| T _{PTCK} | Product term clock delay | - | 2.0 | - | 2.5 | - | 3.0 | ns |
| T _{LOGI1} | Internal logic delay (single p-term) | - | 2.0 | - | 2.5 | - | 3.0 | ns |
| T _{LOGI2} | Internal logic delay (PLA OR term) | - | 2.5 | - | 3.5 | - | 4.2 | ns |
| Feedback Delays | | | | | | | | |
| T _F | ZIA delay | - | 3.1 | - | 4.0 | - | 5.0 | ns |
| Time Adders | | | | | | | | |
| T _{LOGI3} | Fold-back NAND delay | - | 2.0 | - | 2.5 | - | 3.0 | ns |
| T _{UDA} | Universal delay | - | 2.2 | - | 2.8 | - | 3.5 | ns |
| T _{SLEW} | Slew rate limited delay | - | 4.0 | - | 5.0 | - | 6.0 | ns |

Notes:

1. These parameters guaranteed by design and/or characterization, not testing.
2. See the CoolRunner XPLA3 family data sheet ([DS012](#)) for timing model.

Switching Characteristics



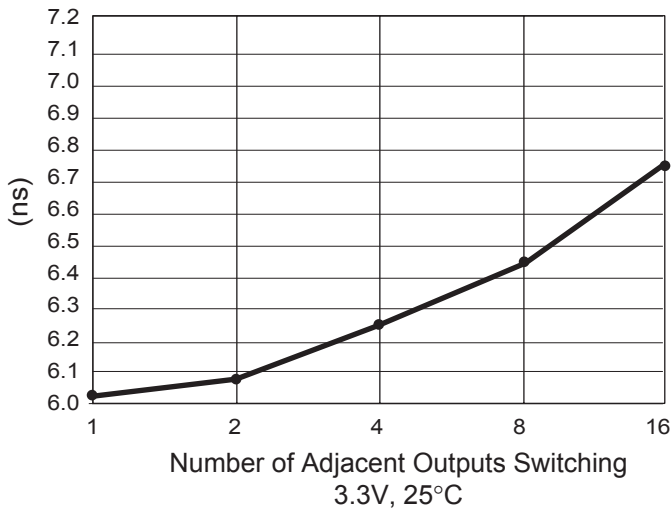
| Component | Values |
|-----------|--------|
| R1 | 390Ω |
| R2 | 390Ω |
| C1 | 35 pF |

| Measurement | S1 | S2 |
|-------------------------|--------|--------|
| T _{POE} (High) | Open | Closed |
| T _{POE} (Low) | Closed | Open |
| T _P | Closed | Closed |

Note: For T_{POD}, C1 = 5 pF. Delay measured at output level of V_{OL} + 300 mV, V_{OH} - 300 mV.

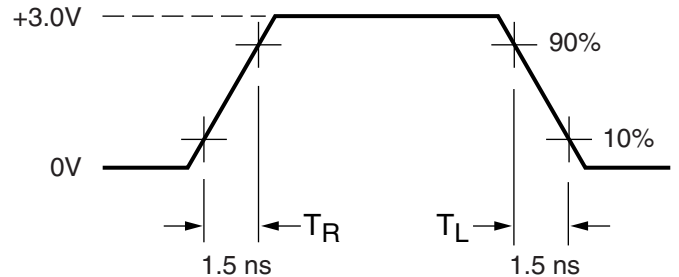
DS023_03_102401

Figure 3: AC Load Circuit



DS024_04_061802

Figure 4: Derating Curve for T_{PD2}



Measurements:

All circuit delays are measured at the +1.5V level of inputs and outputs, unless otherwise specified.

DS017_05_042800

Figure 5: Voltage Waveform

Pin Descriptions

Table 2: XCR3384XL User I/O Pins

| | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|---------------------|----------------------|-------|-------|-------|
| Total User I/O Pins | 118 | 172 | 212 | 220 |

Notes:

1. XCR3384XL TQ144 JTAG pins are not compatible with other members of the CoolRunner XPLA3 family in the TQ144 package.

Table 3: XCR3384XL I/O Pins

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 1 | 1 | 94 | - | E15 | G22 |
| 1 | 2 | - | - | F13 | H20 |
| 1 | 3 | - | 13 | E16 | H21 |
| 1 | 4 | - | 15 | F14 | J19 |
| 1 | 5 | 93 | 16 | F15 | J21 |
| 1 | 6 | - | - | - | - |
| 1 | 7 | - | - | - | - |
| 1 | 8 | - | - | - | - |
| 1 | 9 | - | - | - | - |
| 1 | 10 | - | - | - | - |
| 1 | 11 | - | - | - | - |
| 1 | 12 | - | - | - | - |
| 1 | 13 | 92 | 17 | G12 | J22 |
| 1 | 14 | - | 18 | G15 | K19 |
| 1 | 15 | - | 19 | G13 | K21 |
| 1 | 16 | 91 | 20 | F16 | K22 |
| 2 | 1 | - | 12 | E14 | G21 |
| 2 | 2 | 96 | 11 | D16 | G19 |
| 2 | 3 | 97 | 10 | F12 | F22 |
| 2 | 4 | 98 | 9 | C16 | F21 |
| 2 | 5 | 99 | 8 | E13 | F20 |
| 2 | 6 | - | - | - | - |
| 2 | 7 | - | - | - | - |
| 2 | 8 | - | - | - | - |
| 2 | 9 | - | - | - | - |
| 2 | 10 | - | - | - | - |
| 2 | 11 | - | - | - | - |
| 2 | 12 | - | - | - | - |
| 2 | 13 | 100 | - | D15 | E22 |
| 2 | 14 | 101 | 7 | D14 | E21 |
| 2 | 15 | 102 | 6 | B16 | F19 |
| 2 | 16 | 103 | - | C15 | E20 |
| 3 | 1 | - | 21 | G14 | L19 |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------------------|--------------------|--------------------|
| 3 | 2 | - | 22 | G16 | L20 |
| 3 | 3 | - | - | H13 | L21 |
| 3 | 4 | 90 | - | - | M20 |
| 3 | 5 | 89 | 24 | H12 | M19 |
| 3 | 6 | - | - | - | - |
| 3 | 7 | - | - | - | - |
| 3 | 8 | - | - | - | - |
| 3 | 9 | - | - | - | - |
| 3 | 10 | - | - | - | - |
| 3 | 11 | - | - | - | - |
| 3 | 12 | - | - | - | - |
| 3 | 13 | - | 25 | H15 | M22 |
| 3 | 14 | 88 | 26 | H14 | N22 |
| 3 | 15 | - | 27 | H16 | N21 |
| 3 | 16 | 87 | 28 | J14 | N19 |
| 4 | 1 | 104 | 4 | A16 | D22 |
| 4 | 2 | 106 | 3 | E12 | C22 |
| 4 | 3 | 107 | - | - | B21 |
| 4 | 4 | 110 | - | C14 | B20 |
| 4 | 5 | 111 | 207 | D13 | C19 |
| 4 | 6 | - | - | - | - |
| 4 | 7 | - | - | - | - |
| 4 | 8 | - | - | - | - |
| 4 | 9 | - | - | - | - |
| 4 | 10 | - | - | - | - |
| 4 | 11 | - | - | - | - |
| 4 | 12 | - | - | - | - |
| 4 | 13 | 112 | 206 | A15 | B19 |
| 4 | 14 | 113 | 205 | B15 | A20 |
| 4 | 15 | 114 | 204 | B14 | C18 |
| 4 | 16 | 116 | 203 | C13 | B18 |
| 5 | 1 | - | 29 | J15 | P22 |
| 5 | 2 | 86 ^(1,2) | 30 ⁽²⁾ | J13 ⁽²⁾ | P20 ⁽²⁾ |
| 5 | 3 | - | 31 | J16 | P19 |
| 5 | 4 | - | - | L14 | R22 |
| 5 | 5 | 84 | - | K15 | R21 |
| 5 | 6 | - | - | - | - |
| 5 | 7 | - | - | - | - |
| 5 | 8 | - | - | - | - |
| 5 | 9 | - | - | - | - |
| 5 | 10 | - | - | - | - |
| 5 | 11 | - | - | - | - |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 5 | 12 | - | - | - | - |
| 5 | 13 | - | 33 | K14 | R20 |
| 5 | 14 | 83 | 34 | K16 | T22 |
| 5 | 15 | 82 | 35 | K13 | T21 |
| 5 | 16 | 81 | 36 | L15 | T20 |
| 6 | 1 | 67 | 62 | R13 | AA16 |
| 6 | 2 | - | 61 | M11 | Y16 |
| 6 | 3 | - | 60 | T14 | W16 |
| 6 | 4 | - | 59 | N12 | AB17 |
| 6 | 5 | - | 58 | R14 | AA17 |
| 6 | 6 | - | - | - | - |
| 6 | 7 | - | - | - | - |
| 6 | 8 | - | - | - | - |
| 6 | 9 | - | - | - | - |
| 6 | 10 | - | - | - | - |
| 6 | 11 | - | - | - | - |
| 6 | 12 | - | - | - | - |
| 6 | 13 | - | 57 | P13 | AB18 |
| 6 | 14 | - | 56 | T15 | AA18 |
| 6 | 15 | 68 | - | P14 | W17 |
| 6 | 16 | 69 | - | T16 | AA19 |
| 7 | 1 | 80 | 37 | K12 | T19 |
| 7 | 2 | 79 | 38 | L16 | U22 |
| 7 | 3 | 78 | 39 | M15 | U21 |
| 7 | 4 | 77 | 40 | N15 | U20 |
| 7 | 5 | - | - | L13 | V22 |
| 7 | 6 | - | - | - | - |
| 7 | 7 | - | - | - | - |
| 7 | 8 | - | - | - | - |
| 7 | 9 | - | - | - | - |
| 7 | 10 | - | - | - | - |
| 7 | 11 | - | - | - | - |
| 7 | 12 | - | - | - | - |
| 7 | 13 | - | - | M16 | U19 |
| 7 | 14 | - | 42 | M14 | V21 |
| 7 | 15 | 75 | 43 | N16 | V20 |
| 7 | 16 | - | 44 | L12 | W22 |
| 8 | 1 | 70 | 55 | M12 | Y18 |
| 8 | 2 | 71 | 51 | R15 | AA20 |
| 8 | 3 | 72 | - | N13 | Y19 |
| 8 | 4 | - | - | - | AA21 |
| 8 | 5 | - | 49 | P16 | Y20 |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|--------------------|--------------------|--------------------|
| 8 | 6 | - | - | - | - |
| 8 | 7 | - | - | - | - |
| 8 | 8 | - | - | - | - |
| 8 | 9 | - | - | - | - |
| 8 | 10 | - | - | - | - |
| 8 | 11 | - | - | - | - |
| 8 | 12 | - | - | - | - |
| 8 | 13 | - | 48 | N14 | Y21 |
| 8 | 14 | - | 47 | R16 | W20 |
| 8 | 15 | - | 46 | M13 | W21 |
| 8 | 16 | 74 | 45 | P15 | Y22 |
| 9 | 1 | 122 | 187 | D9 | C13 |
| 9 | 2 | - | 188 | A9 | D13 |
| 9 | 3 | 121 ^(1,2) | 189 ⁽²⁾ | C10 ⁽²⁾ | B14 ⁽²⁾ |
| 9 | 4 | - | 190 | A10 | C14 |
| 9 | 5 | 120 | - | D10 | D14 |
| 9 | 6 | - | - | - | - |
| 9 | 7 | - | - | - | - |
| 9 | 8 | - | - | - | - |
| 9 | 9 | - | - | - | - |
| 9 | 10 | - | - | - | - |
| 9 | 11 | - | - | - | - |
| 9 | 12 | - | - | - | - |
| 9 | 13 | - | - | B11 | A15 |
| 9 | 14 | - | 192 | C11 | B15 |
| 9 | 15 | - | 193 | B12 | C15 |
| 9 | 16 | - | 194 | E10 | A16 |
| 10 | 1 | - | 178 | B8 | B11 |
| 10 | 2 | - | 177 | D8 | C11 |
| 10 | 3 | 131 ^(1,2) | 176 ⁽²⁾ | A7 ⁽²⁾ | D11 ⁽²⁾ |
| 10 | 4 | 132 | 175 | C8 | A10 |
| 10 | 5 | - | - | - | B10 |
| 10 | 6 | - | - | - | - |
| 10 | 7 | - | - | - | - |
| 10 | 8 | - | - | - | - |
| 10 | 9 | - | - | - | - |
| 10 | 10 | - | - | - | - |
| 10 | 11 | - | - | - | - |
| 10 | 12 | - | - | - | - |
| 10 | 13 | - | - | C7 | C10 |
| 10 | 14 | - | 173 | B7 | D10 |
| 10 | 15 | 133 | 172 | D7 | A9 |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 10 | 16 | 134 | 171 | A6 | B9 |
| 11 | 1 | - | - | A14 | A19 |
| 11 | 2 | - | 202 | E11 | D17 |
| 11 | 3 | - | 201 | A13 | A18 |
| 11 | 4 | - | - | D12 | C17 |
| 11 | 5 | 117 | 199 | B13 | B17 |
| 11 | 6 | - | - | - | - |
| 11 | 7 | - | - | - | - |
| 11 | 8 | - | - | - | - |
| 11 | 9 | - | - | - | - |
| 11 | 10 | - | - | - | - |
| 11 | 11 | - | - | - | - |
| 11 | 12 | - | - | - | - |
| 11 | 13 | - | 198 | C12 | A17 |
| 11 | 14 | - | 197 | A12 | D16 |
| 11 | 15 | 118 | 196 | D11 | C16 |
| 11 | 16 | 119 | 195 | A11 | B16 |
| 12 | 1 | 139 | 163 | E6 | D7 |
| 12 | 2 | - | 164 | A4 | C7 |
| 12 | 3 | 138 | - | C5 | B7 |
| 12 | 4 | 137 | - | B5 | A7 |
| 12 | 5 | - | 166 | D6 | C8 |
| 12 | 6 | - | - | - | - |
| 12 | 7 | - | - | - | - |
| 12 | 8 | - | - | - | - |
| 12 | 9 | - | - | - | - |
| 12 | 10 | - | - | - | - |
| 12 | 11 | - | - | - | - |
| 12 | 12 | - | - | - | - |
| 12 | 13 | 136 | 167 | A5 | B8 |
| 12 | 14 | - | 168 | C6 | A8 |
| 12 | 15 | - | 169 | B6 | D9 |
| 12 | 16 | - | 170 | E7 | C9 |
| 13 | 1 | 61 | 70 | N10 | W13 |
| 13 | 2 | - | 69 | P11 | AB14 |
| 13 | 3 | 62 | 68 | M10 | AA14 |
| 13 | 4 | 63 | 67 | R11 | Y14 |
| 13 | 5 | - | 66 | T12 | W14 |
| 13 | 6 | - | - | - | - |
| 13 | 7 | - | - | - | - |
| 13 | 8 | - | - | - | - |
| 13 | 9 | - | - | - | - |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 13 | 10 | - | - | - | - |
| 13 | 11 | - | - | - | - |
| 13 | 12 | - | - | - | - |
| 13 | 13 | - | 65 | R12 | AB15 |
| 13 | 14 | 65 | 64 | N11 | AA15 |
| 13 | 15 | - | - | T13 | Y15 |
| 13 | 16 | 66 | - | P12 | AB16 |
| 14 | 1 | - | 91 | R6 | AA8 |
| 14 | 2 | 47 | 92 | M7 | Y8 |
| 14 | 3 | 46 | 93 | T5 | AB7 |
| 14 | 4 | - | - | T6 | AA7 |
| 14 | 5 | - | - | R5 | Y7 |
| 14 | 6 | - | - | - | - |
| 14 | 7 | - | - | - | - |
| 14 | 8 | - | - | - | - |
| 14 | 9 | - | - | - | - |
| 14 | 10 | - | - | - | - |
| 14 | 11 | - | - | - | - |
| 14 | 12 | - | - | - | - |
| 14 | 13 | 45 | 95 | N6 | W7 |
| 14 | 14 | 44 | 96 | T4 | AB6 |
| 14 | 15 | - | 97 | P5 | AA6 |
| 14 | 16 | 43 | 98 | R4 | Y6 |
| 15 | 1 | - | - | T11 | Y13 |
| 15 | 2 | - | - | - | AA13 |
| 15 | 3 | 60 | 71 | R10 | AB13 |
| 15 | 4 | - | 73 | P10 | W12 |
| 15 | 5 | 56 | 76 | T10 | AA12 |
| 15 | 6 | - | - | - | - |
| 15 | 7 | - | - | - | - |
| 15 | 8 | - | - | - | - |
| 15 | 9 | - | - | - | - |
| 15 | 10 | - | - | - | - |
| 15 | 11 | - | - | - | - |
| 15 | 12 | - | - | - | - |
| 15 | 13 | 55 | 77 | N9 | AB12 |
| 15 | 14 | - | 78 | R9 | Y11 |
| 15 | 15 | - | 79 | P9 | AA11 |
| 15 | 16 | 54 | 80 | T9 | W11 |
| 16 | 1 | - | 90 | N7 | AB8 |
| 16 | 2 | 48 | 89 | T7 | W9 |
| 16 | 3 | - | 88 | P6 | Y9 |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 16 | 4 | 49 | 87 | R7 | AA9 |
| 16 | 5 | - | 86 | P7 | AB9 |
| 16 | 6 | - | - | - | - |
| 16 | 7 | - | - | - | - |
| 16 | 8 | - | - | - | - |
| 16 | 9 | - | - | - | - |
| 16 | 10 | - | - | - | - |
| 16 | 11 | - | - | - | - |
| 16 | 12 | - | - | - | - |
| 16 | 13 | - | - | T8 | W10 |
| 16 | 14 | - | - | N8 | Y10 |
| 16 | 15 | - | 84 | R8 | AA10 |
| 16 | 16 | 53 | 81 | P8 | AB11 |
| 17 | 1 | - | 147 | E4 | E2 |
| 17 | 2 | - | 148 | D1 | F3 |
| 17 | 3 | 6 | 149 | F5 | F4 |
| 17 | 4 | 5 | 150 | C2 | D1 |
| 17 | 5 | 4 | 151 | D3 | D2 |
| 17 | 6 | - | - | - | - |
| 17 | 7 | - | - | - | - |
| 17 | 8 | - | - | - | - |
| 17 | 9 | - | - | - | - |
| 17 | 10 | - | - | - | - |
| 17 | 11 | - | - | - | - |
| 17 | 12 | - | - | - | - |
| 17 | 13 | - | - | C1 | E3 |
| 17 | 14 | - | - | - | C2 |
| 17 | 15 | 2 | 153 | B1 | B2 |
| 17 | 16 | 1 | 154 | B2 | D3 |
| 18 | 1 | 7 | 146 | D2 | E1 |
| 18 | 2 | 8 | 145 | E3 | F2 |
| 18 | 3 | 9 | 144 | E1 | G4 |
| 18 | 4 | 10 | - | F4 | G3 |
| 18 | 5 | - | - | F1 | G2 |
| 18 | 6 | - | - | - | - |
| 18 | 7 | - | - | - | - |
| 18 | 8 | - | - | - | - |
| 18 | 9 | - | - | - | - |
| 18 | 10 | - | - | - | - |
| 18 | 11 | - | - | - | - |
| 18 | 12 | - | - | - | - |
| 18 | 13 | - | 142 | G5 | H3 |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 18 | 14 | - | 141 | E2 | H2 |
| 18 | 15 | 11 | 140 | F3 | H1 |
| 18 | 16 | 12 | 139 | F2 | J4 |
| 19 | 1 | - | 155 | C3 | C4 |
| 19 | 2 | 143 | 156 | D4 | B4 |
| 19 | 3 | - | - | A2 | C5 |
| 19 | 4 | 142 | - | A1 | B5 |
| 19 | 5 | 141 | 158 | B3 | A4 |
| 19 | 6 | - | - | - | - |
| 19 | 7 | - | - | - | - |
| 19 | 8 | - | - | - | - |
| 19 | 9 | - | - | - | - |
| 19 | 10 | - | - | - | - |
| 19 | 11 | - | - | - | - |
| 19 | 12 | - | - | - | - |
| 19 | 13 | - | 159 | C4 | D6 |
| 19 | 14 | - | 160 | A3 | A5 |
| 19 | 15 | 140 | 161 | D5 | C6 |
| 19 | 16 | - | 162 | B4 | B6 |
| 20 | 1 | 14 | 138 | G4 | J3 |
| 20 | 2 | - | 137 | G1 | J2 |
| 20 | 3 | - | 136 | G3 | K4 |
| 20 | 4 | 15 | 135 | H1 | K3 |
| 20 | 5 | - | - | H4 | K2 |
| 20 | 6 | - | - | - | - |
| 20 | 7 | - | - | - | - |
| 20 | 8 | - | - | - | - |
| 20 | 9 | - | - | - | - |
| 20 | 10 | - | - | - | - |
| 20 | 11 | - | - | - | - |
| 20 | 12 | - | - | - | - |
| 20 | 13 | - | - | G2 | K1 |
| 20 | 14 | 16 | 133 | H3 | L4 |
| 20 | 15 | - | 132 | J1 | L3 |
| 20 | 16 | 18 | 131 | J3 | L2 |
| 21 | 1 | - | 99 | M6 | AB5 |
| 21 | 2 | - | 100 | T3 | W6 |
| 21 | 3 | 42 | 101 | N5 | AB4 |
| 21 | 4 | 41 | 102 | R3 | AA5 |
| 21 | 5 | - | 103 | P4 | Y5 |
| 21 | 6 | - | - | - | - |
| 21 | 7 | - | - | - | - |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|--------------------|-------------------|-------------------|
| 21 | 8 | - | - | - | - |
| 21 | 9 | - | - | - | - |
| 21 | 10 | - | - | - | - |
| 21 | 11 | - | - | - | - |
| 21 | 12 | - | - | - | - |
| 21 | 13 | 40 | 104 | T2 | AA4 |
| 21 | 14 | 39 | - | - | AB3 |
| 21 | 15 | 38 | - | R2 | Y4 |
| 21 | 16 | 37 | 106 | N4 | AA3 |
| 22 | 1 | 19 | - | H2 | M2 |
| 22 | 2 | - | 130 | J5 | M3 |
| 22 | 3 | 20 | 129 | J2 | M4 |
| 22 | 4 | 21 | 128 | J4 | N1 |
| 22 | 5 | 22 ^(1,2) | 127 ⁽²⁾ | K1 ⁽²⁾ | N2 ⁽²⁾ |
| 22 | 6 | - | - | - | - |
| 22 | 7 | - | - | - | - |
| 22 | 8 | - | - | - | - |
| 22 | 9 | - | - | - | - |
| 22 | 10 | - | - | - | - |
| 22 | 11 | - | - | - | - |
| 22 | 12 | - | - | - | - |
| 22 | 13 | 23 | 126 | K3 | N3 |
| 22 | 14 | - | - | - | N4 |
| 22 | 15 | - | 124 | K2 | P1 |
| 22 | 16 | 25 | 123 | L1 | P2 |
| 23 | 1 | 36 | 108 | M5 | AA2 |
| 23 | 2 | - | 109 | P2 | Y3 |
| 23 | 3 | - | 110 | P3 | Y2 |
| 23 | 4 | - | 111 | T1 | W3 |
| 23 | 5 | - | - | N3 | W2 |
| 23 | 6 | - | - | - | - |
| 23 | 7 | - | - | - | - |
| 23 | 8 | - | - | - | - |
| 23 | 9 | - | - | - | - |
| 23 | 10 | - | - | - | - |
| 23 | 11 | - | - | - | - |
| 23 | 12 | - | - | - | - |
| 23 | 13 | - | - | R1 | W1 |
| 23 | 14 | 35 | 112 | M4 | V3 |
| 23 | 15 | - | 113 | P1 | U4 |
| 23 | 16 | - | 114 | L5 | V2 |
| 24 | 1 | 26 | 122 | K4 | P3 |

Table 3: XCR3384XL I/O Pins (Continued)

| Function Block | Macro-cell | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|----------------|------------|----------------------|-------|-------|-------|
| 24 | 2 | 27 | 121 | L3 | P4 |
| 24 | 3 | 28 | 120 | K5 | R1 |
| 24 | 4 | 29 | 119 | M1 | R2 |
| 24 | 5 | 30 | - | L2 | R3 |
| 24 | 6 | - | - | - | - |
| 24 | 7 | - | - | - | - |
| 24 | 8 | - | - | - | - |
| 24 | 9 | - | - | - | - |
| 24 | 10 | - | - | - | - |
| 24 | 11 | - | - | - | - |
| 24 | 12 | - | - | - | - |
| 24 | 13 | 31 | 118 | M2 | T2 |
| 24 | 14 | 32 | 117 | L4 | T3 |
| 24 | 15 | - | - | M3 | U2 |
| 24 | 16 | 34 | 115 | N2 | U3 |

Notes:

1. XCR3384XL TQ144 JTAG pins are not compatible with other members of the CoolRunner XPLA3 family in the TQ144 package.
2. JTAG pins.

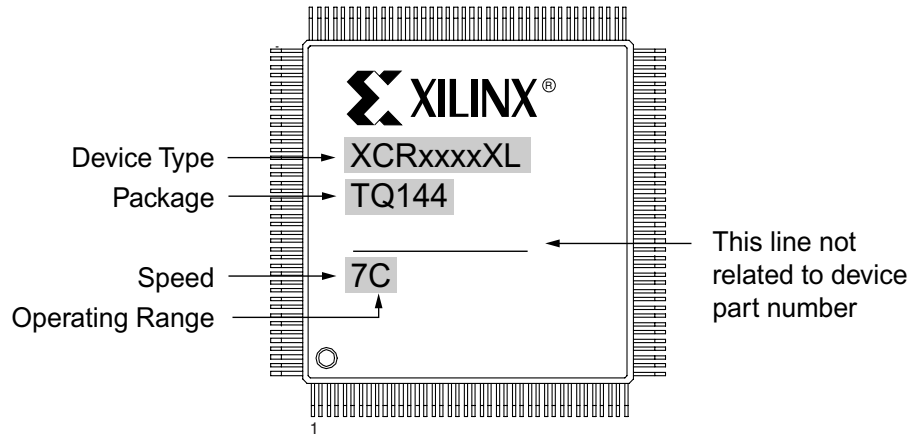
Table 4: XCR3384XL Global, JTAG, Port Enable, Power, and No Connect Pins

| Pin Type | TQ144 ⁽¹⁾ | PQ208 | FT256 | FG324 |
|-----------------|--|--|---|--|
| IN0 / CLK0 | 128 | 181 | B9 | C12 |
| IN1 / CLK1 | 127 | 182 | A8 | B12 |
| IN2 / CLK2 | 126 | 183 | C9 | D12 |
| IN3 / CLK3 | 125 | 184 | B10 | A12 |
| TCK | 86 ⁽¹⁾ | 30 | J13 | P20 |
| TDI | 131 ⁽¹⁾ | 176 | A7 | D11 |
| TDO | 121 ⁽¹⁾ | 189 | C10 | B14 |
| TMS | 22 ⁽¹⁾ | 127 | K1 | N2 |
| PORT_EN | 33 ⁽²⁾ | 116 ⁽²⁾ | N1 ⁽²⁾ | T4 ⁽²⁾ |
| V _{CC} | 24, 50, 51, 58, 73, 76, 95, 115, 123, 130, 144 | 5, 23, 41, 63, 74, 83, 85, 107, 125, 143, 165, 179, 186, 191 | E8, E9, F7, F8, F9, F10, G6, G11, H5, H6, H11, J6, J11, J12, K6, K11, L7, L8, L9, L10, M8, M9 | A11, A13, D8, D15, H4, H19, J10, J11, J12, J13, K9, K14, L9, L14, M1, M9, M14, N9, N14, N20, P10, P11, P12, P13, R4, R19, W8, W15, Y12, AB10 |
| GND | 3, 13, 17, 52, 57, 59, 64, 85, 105, 124, 129, 135, | 14, 32, 50, 72, 75, 82, 94, 134, 152, 174, 180, 185, 200 | E5, F6, F11, G7, G8, G9, G10, H7, H8, H9, H10, J7, J8, J9, J10, K7, K8, K9, K10, L6, L11 | D4, D5, D18, D19, E4, E19, J9, J14, K10, K11, K12, K13, L10, L11, L12, L13, M10, M11, M12, M13, N10, N11, N12, N13, P9, P14, V4, V19, W4, W5, W18, W19 |
| No Connects | 108, 109 | 1, 2, 52, 53, 54, 105, 157, 208 | - | A1, A2, A3, A6, A14, A21, A22, B1, B3, B13, B22, C1, C3, C20, C21, D20, D21, F1, G1, G20, H22, J1, J20, K20, L1, L22, M21, P21, T1, U1, V1, Y1, Y17, AA1, AA22, AB1, AB2, AB19, AB20, AB21, AB22 |

Notes:

1. XCR3384XL TQ144 JTAG pins are not compatible with other members of the CoolRunner XPLA3 family in the TQ144 package.
2. Port Enable is brought High to enable JTAG pins when JTAG pins are used as I/O. See family data sheet ([DS012](#)) for full explanation.

Device Part Marking and Ordering Combination Information



Sample package with part marking.

| Device Ordering and Part Marking Number | Speed (pin-to-pin delay) | Pkg. Symbol | No. of Pins | Package Type | Operating Range ⁽¹⁾ |
|---|--------------------------|-------------|-------------|--|--------------------------------|
| XCR3384XL-7TQ144C | 7.5 ns | TQ144 | 144-pin | Thin Quad Flat Pack (TQFP) | C |
| XCR3384XL-7TQG144C | 7.5 ns | TQG144 | 144-pin | Thin Quad Flat Pack (TQFP); Pb-Free | C |
| XCR3384XL-7PQ208C | 7.5 ns | PQ208 | 208-pin | Plastic Quad Flat Pack (PQFP) | C |
| XCR3384XL-7PQG208C | 7.5 ns | PQG208 | 208-pin | Plastic Quad Flat Pack (PQFP); Pb-Free | C |
| XCR3384XL-7FT256C | 7.5 ns | FT256 | 256-ball | Fine-Pitch BGA (FT) | C |
| XCR3384XL-7FG324C | 7.5 ns | FG324 | 324-ball | Fineline BGA Package (FG) | C |
| XCR3384XL-10TQ144C | 10 ns | TQ144 | 144-pin | Thin Quad Flat Pack (TQFP) | C |
| XCR3384XL-10TQG144C | 10 ns | TQG144 | 144-pin | Thin Quad Flat Pack (TQFP); Pb-Free | C |
| XCR3384XL-10PQ208C | 10 ns | PQ208 | 208-pin | Plastic Quad Flat Pack (PQFP) | C |
| XCR3384XL-10PQG208C | 10 ns | PQG208 | 208-pin | Plastic Quad Flat Pack (PQFP); Pb-Free | C |
| XCR3384XL-10FT256C | 10 ns | FT256 | 256-ball | Fine-Pitch BGA (FT) | C |
| XCR3384XL-10FG324C | 10 ns | FG324 | 324-ball | Fineline BGA Package (FG) | C |
| XCR3384XL-10TQ144I | 10 ns | TQ144 | 144-pin | Thin Quad Flat Pack (TQFP) | I |
| XCR3384XL-10TQG144I | 10 ns | TQG144 | 144-pin | Thin Quad Flat Pack (TQFP); Pb-Free | I |
| XCR3384XL-10PQ208I | 10 ns | PQ208 | 208-pin | Plastic Quad Flat Pack (PQFP) | I |
| XCR3384XL-10PQG208I | 10 ns | PQG208 | 208-pin | Plastic Quad Flat Pack (PQFP); Pb-Free | I |
| XCR3384XL-10FT256I | 10 ns | FT256 | 256-ball | Fine-Pitch BGA (FT) | I |
| XCR3384XL-10FG324I | 10 ns | FG324 | 324-ball | Fineline BGA Package (FG) | I |
| XCR3384XL-12TQ144C | 12 ns | TQ144 | 144-pin | Thin Quad Flat Pack (TQFP) | C |
| XCR3384XL-12TQG144C | 12 ns | TQG144 | 144-pin | Thin Quad Flat Pack (TQFP); Pb-Free | C |
| XCR3384XL-12PQ208C | 12 ns | PQ208 | 208-pin | Plastic Quad Flat Pack (PQFP) | C |
| XCR3384XL-12PQG208C | 12 ns | PQG208 | 208-pin | Plastic Quad Flat Pack (PQFP); Pb-Free | C |
| XCR3384XL-12FT256C | 12 ns | FT256 | 256-ball | Fine-Pitch BGA (FT) | C |
| XCR3384XL-12FG324C | 12 ns | FG324 | 324-ball | Fineline BGA Package (FG) | C |
| XCR3384XL-12TQ144I | 12 ns | TQ144 | 144-pin | Thin Quad Flat Pack (TQFP) | I |
| XCR3384XL-12TQG144I | 12 ns | TQG144 | 144-pin | Thin Quad Flat Pack (TQFP); Pb-Free | I |
| XCR3384XL-12PQ208I | 12 ns | PQ208 | 208-pin | Plastic Quad Flat Pack (PQFP) | I |
| XCR3384XL-12PQG208I | 12 ns | PQG208 | 208-pin | Plastic Quad Flat Pack (PQFP); Pb-Free | I |

| Device Ordering and Part Marking Number | Speed (pin-to-pin delay) | Pkg. Symbol | No. of Pins | Package Type | Operating Range ⁽¹⁾ |
|---|--------------------------|-------------|-------------|---------------------------|--------------------------------|
| XCR3384XL-12FT256I | 12 ns | FT256 | 256-ball | Fine-Pitch BGA (FT) | I |
| XCR3384XL-12FG324I | 12 ns | FG324 | 324-ball | Fineline BGA Package (FG) | I |

Notes:

1. C = Commercial: $T_A = 0^\circ$ to $+70^\circ\text{C}$; I = Industrial: $T_A = -40^\circ$ to $+85^\circ\text{C}$

Warranty Disclaimer

THESE PRODUCTS ARE SUBJECT TO THE TERMS OF THE XILINX LIMITED WARRANTY WHICH CAN BE VIEWED AT <http://www.xilinx.com/warranty.htm>. THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY USE OF THE PRODUCTS IN AN APPLICATION OR ENVIRONMENT THAT IS NOT WITHIN THE SPECIFICATIONS STATED ON THE THEN-CURRENT XILINX DATA SHEET FOR THE PRODUCTS. PRODUCTS ARE NOT DESIGNED TO BE FAIL-SAFE AND ARE NOT WARRANTED FOR USE IN APPLICATIONS THAT POSE A RISK OF PHYSICAL HARM OR LOSS OF LIFE. USE OF PRODUCTS IN SUCH APPLICATIONS IS FULLY AT THE RISK OF CUSTOMER SUBJECT TO APPLICABLE LAWS AND REGULATIONS.

Additional Information

[CoolRunner XPLA3 Data Sheets and Application Notes](#) [Device Packages](#)

[Device Package User Guide](#)

Revision History

The following table shows the revision history for this document

| Date | Version | Revision |
|----------|---------|---|
| 02/08/01 | 1.0 | Initial Xilinx release. |
| 04/11/01 | 1.1 | Update TSUF spec to meet UMC characterization data. Added Typical I/V curve, Figure 2 ; added Table 2 : Total User I/O; changed V_{OH} spec. Added 324-ball Fineline BGA pinouts and package. |
| 04/19/01 | 1.2 | Updated Typical I/V curve, Figure 2 : added voltage levels. |
| 08/10/01 | 1.3 | Updated AC Electrical Characteristics; Internal Timing Parameters; added TQ144 package and pinouts. |
| 01/08/02 | 1.4 | Updated T_{SUF} spec to match software timing. Added single p-term setup time (T_{SU1}) to AC Table, renamed T_{SU} to T_{SU2} for setup time through the OR array. Updated T_{INIT} spec and T_{CONFIG} spec. Updated T_{HI} spec to correct a typo. Updated AC Load Circuit diagram to more closely resemble true test conditions, added note for T_{POD} delay measurement. Changed TQ144 pinout for pins 34 and 35. |
| 01/06/03 | 1.5 | Changed to Preliminary, updated AC and DC specs per characterization review. Updated Note 5 on AC Specifications from 10 mA to 13 mA at 3.6V. Updated T_{PCO} (added T_{PTCK}). Updated Ordering Information format. |
| 07/15/03 | 1.6 | Updated test conditions for I_{IL} and I_{IH} . |
| 08/21/03 | 1.7 | Updated Package Device Marking Pin 1 orientation. |
| 02/13/04 | 1.8 | Add solder temperature specification. Add links to application notes, data sheets, and packages. |
| 04/08/05 | 1.9 | Added I_{CCSB} Typical and T_{APRPW} specifications. Removed T_{SOL} specification. |
| 03/31/06 | 2.0 | Added Warranty Disclaimer; Added Pb-Free ordering information. |