

## Introduction

The Spartan™-XL 3.3V FPGA Automotive IQ product family is a high-volume production FPGA solution that delivers all the key requirements for ASIC replacement up to 40,000 gates. These requirements include high-performance, on-chip RAM, core solutions, and prices that, in high volume, approach and in many cases, are equivalent to mask programmed ASIC devices. By streamlining the Spartan-XL series feature set, leveraging process technology and focusing on total cost management, the Spartan-XL series delivers the key features required by ASIC and other high-volume logic users while avoiding the initial cost, long development cycles, and inherent risk of conventional ASICs.

## Features

- Guaranteed to meet full electrical specifications over  $T_J = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- ASIC replacement FPGA for high-volume production with on-chip RAM
- Density up to 1,862 logic cells or 40,000 system gates
- Streamlined feature set based on XC4000 architecture
- Broad set of AllianceCORE™ and LogiCORE™ predefined solutions available
- Unlimited reprogrammability
- System level features
  - On-chip SelectRAM™ memory
  - Full readback capability for program verification and internal node observability
  - Dedicated high-speed carry logic
  - Internal 3-state bus capability
  - Eight global low-skew clock or signal networks
  - IEEE 1149.1-compatible Boundary Scan logic
  - Footprint compatibility in common packages
- Fully supported by powerful Xilinx development system
  - ISE Foundation™ Series: Integrated, shrink-wrap software
  - ISE Alliance Series™: Dozens of PC and workstation third party development systems supported
  - Fully automatic mapping, placement and routing
- 3.3V supply for low power with 5V tolerant I/Os
- Power down input
- Higher performance
- Faster carry logic
- More flexible high-speed clock network
- Latch capability in Configurable Logic Blocks
- Input fast capture latch
- Optional mux or 2-input function generator on outputs
- 12 mA or 24 mA output drive
- Enhanced Boundary Scan
- Express Mode configuration
- Refer to Spartan-XL and Spartan FPGAs complete data sheet (DS060) for product description, AC and DC specifications

Table 1: Spartan-XL Field Programmable Gate Arrays

| Device  | Logic Cells | Max System Gates | Typical Gate Range (Logic and RAM) <sup>(1)</sup> | CLB Matrix | Total CLBs | No. of Flip-flops | Max. Avail. User I/O | Total Distributed RAM Bits |
|---------|-------------|------------------|---------------------------------------------------|------------|------------|-------------------|----------------------|----------------------------|
| XCS05XL | 238         | 5,000            | 2,000-5,000                                       | 10 x 10    | 100        | 360               | 77                   | 3,200                      |
| XCS10XL | 466         | 10,000           | 3,000-10,000                                      | 14 x 14    | 196        | 616               | 112                  | 6,272                      |
| XCS20XL | 950         | 20,000           | 7,000-20,000                                      | 20 x 20    | 400        | 1,120             | 160                  | 12,800                     |
| XCS30XL | 1,368       | 30,000           | 10,000-30,000                                     | 24 x 24    | 576        | 1,536             | 192                  | 18,432                     |
| XCS40XL | 1,862       | 40,000           | 13,000-40,000                                     | 28 x 28    | 784        | 2,016             | 224                  | 25,088                     |

### Notes:

1. Max values of Typical Gate Range include 20-30% of CLBs used as RAM.

## DC Specifications

### Spartan-XL Absolute Maximum Ratings<sup>(1)</sup>

| Symbol    | Description                                        | Min  | Max            | Units |
|-----------|----------------------------------------------------|------|----------------|-------|
| $V_{CC}$  | Supply voltage relative to GND <sup>(2)</sup>      | -0.5 | 4.0            | V     |
| $V_{IN}$  | Input voltage relative to GND <sup>(2,3)</sup>     | -0.5 | $V_{CC} + 0.5$ | V     |
| $V_{TS}$  | Voltage applied to 3-state output <sup>(2,3)</sup> | -0.5 | $V_{CC} + 0.5$ | V     |
| $T_{STG}$ | Storage temperature (ambient)                      | -65  | +150           | °C    |
| $T_J$     | Junction temperature                               | -    | +135           | °C    |

#### Notes:

- Stresses beyond those listed under Absolute Maximum Ratings may 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 may affect device reliability.
- With 5V Tolerant I/Os selected, the Maximum DC overshoot must be limited to either +5.5V or 10 mA and undershoot (below GND) must be limited to either 0.5V or 10 mA, whichever is easier to achieve.
- With 5V Tolerant I/Os selected, the Maximum AC (during transitions) conditions are as follows; the device pins may undershoot to -2.0V or overshoot to +7.0V, provided this overshoot or undershoot lasts no more than 11 ns with a forcing current no greater than 100 mA.
- Without 5V Tolerant I/Os selected, the Maximum DC overshoot or undershoot must be limited to either 0.5V or 10 mA, whichever is easier to achieve.
- Without 5V Tolerant I/Os selected, the Maximum AC conditions are as follows; the device pins may undershoot to -2.0V or overshoot to  $V_{CC} + 2.0V$ , provided this overshoot or undershoot lasts no more than 11 ns with a forcing current no greater than 100 mA.
- For soldering guidelines, see the Package Information on the Xilinx website.

### Spartan-XL Recommended Operating Conditions

| Symbol   | Description                             | Min             | Max             | Units |
|----------|-----------------------------------------|-----------------|-----------------|-------|
| $T_J$    | Junction temperature                    | -40             | +125            | °C    |
| $V_{CC}$ | Supply voltage relative to GND          | 3.0             | 3.6             | V     |
| $V_{IH}$ | High-level input voltage <sup>(1)</sup> | 50% of $V_{CC}$ | 5.5             | V     |
| $V_{IL}$ | Low-level input voltage <sup>(1)</sup>  | 0               | 30% of $V_{CC}$ | V     |
| $T_{IN}$ | Input signal transition time            | -               | 250             | ns    |

#### Notes:

- Input and output measurement threshold is ~50% of  $V_{CC}$ .

## Spartan-XL Product Availability

Table 2 shows the package and speed grades available for Spartan-XL family devices. Table 3 shows the maximum user I/Os available on the device and the number of user I/Os available for each device/package combination.

Table 2: Spartan-XL Package and Speed Grade Availability

| Device  | Pins | 100          | 144          | 208          | 256         |
|---------|------|--------------|--------------|--------------|-------------|
|         | Type | Plastic VQFP | Plastic TQFP | Plastic PQFP | Plastic BGA |
|         | Code | VQ100        | TQ144        | PQ208        | BG256       |
| XCS05XL | -4   | Q            | -            | -            | -           |
| XCS10XL | -4   | Q            | -            | -            | -           |
| XCS20XL | -4   | Q            | Q            | Q            | -           |
| XCS30XL | -4   | -            | Q            | Q            | -           |
| XCS40XL | -4   | -            | -            | Q            | Q           |

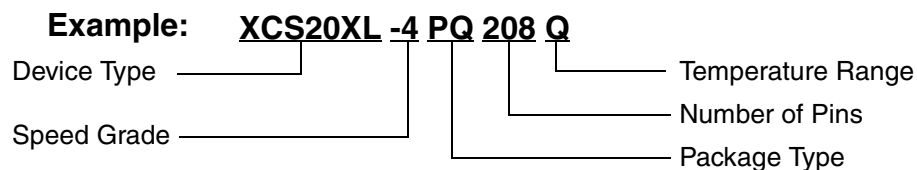
**Notes:**

- Q = Automotive IQ,  $T_J = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Table 3: Spartan-XL User I/O Chart

| Device  | Max I/O | Package Type |       |       |       |
|---------|---------|--------------|-------|-------|-------|
|         |         | VQ100        | TQ144 | PQ208 | BG256 |
| XCS05XL | 80      | 77           | -     | -     | -     |
| XCS10XL | 112     | 77           | -     | -     | -     |
| XCS20XL | 160     | 77           | 113   | 160   | -     |
| XCS30XL | 192     | -            | 113   | 169   | -     |
| XCS40XL | 224     | -            | -     | 169   | 205   |

## Ordering Information



## Device Ordering Options

| Device  | Speed Grade             | Number of Pins / Package Type |                               | Temperature Range (T <sub>J</sub> ) |                 |
|---------|-------------------------|-------------------------------|-------------------------------|-------------------------------------|-----------------|
| XCS05XL | -4 Standard Performance | VQ100                         | 100-pin Plastic Very Thin QFP | Q = Automotive IQ                   | -40°C to +125°C |
| XCS10XL |                         | TQ144                         | 144-pin Plastic Thin QFP      |                                     |                 |
| XCS20XL |                         | PQ208                         | 208-pin Plastic QFP           |                                     |                 |
| XCS30XL |                         | BG256                         | 256-ball Plastic BGA          |                                     |                 |
| XCS40XL |                         |                               |                               |                                     |                 |

## Revision History

The following table shows the revision history for this document.

| Date     | Version | Description                                                                 |
|----------|---------|-----------------------------------------------------------------------------|
| 07/17/02 | 1.0     | Initial Xilinx release.                                                     |
| 02/03/03 | 1.1     | Added reference to Spartan/XL data sheet in features.                       |
| 04/29/03 | 1.2     | Updated V <sub>CC</sub> max from 7.0V to 4.0V.                              |
| 06/14/04 | 1.3     | Updated the XCS20XL, VQ100 cells of Table 2 and Table 3.                    |
| 10/18/04 | 1.4     | Added "Not to be used in new designs" watermark; moved to "Mature Products" |