



Spartan-II/Spartan-IIe Family OTP Configuration PROMs (XC17S00A)

DS078 (v1.8) November 18, 2002

Advance Product Specification

Features

- Configuration one-time programmable (OTP) read-only memory designed to store configuration bitstreams for Spartan-II/Spartan-IIe FPGA devices
- Simple interface to the Spartan device
- Programmable reset polarity (active High or active Low)
- Low-power CMOS floating gate process
- 3.3V PROM
- Available in compact plastic 8-pin DIP, 8-pin VOIC, 20-pin SOIC, or 44-pin VQFP packages.
- Programming support by leading programmer manufacturers.
- Design support using the Xilinx Alliance and Foundation series software packages.
- Guaranteed 20-year life data retention

Introduction

The XC17S00A family of PROMs provide an easy-to-use, cost-effective method for storing Spartan-II/Spartan-IIe device configuration bitstreams.

When the Spartan device is in Master Serial mode, it generates a configuration clock that drives the Spartan PROM. A short access time after the rising clock edge, data appears on the PROM DATA output pin that is connected to the Spartan device D_{IN} pin. The Spartan device generates the appropriate number of clock pulses to complete the

configuration. Once configured, it disables the PROM. When a Spartan device is in Slave Serial mode, the PROM and the Spartan device must both be clocked by an incoming signal.

For device programming, either the Xilinx Alliance or the Spartan device design file into a standard HEX format which is then transferred to most commercial PROM programmers.

| Spartan-II/IIe FPGA | Configuration Bits | Compatible Spartan-II/IIe PROM |
|-------------------------|--------------------|--------------------------------|
| XC2S15 | 197,696 | XC17S15A |
| XC2S30 | 336,768 | XC17S30A |
| XC2S50 | 559,200 | XC17S50A |
| XC2S100 | 781,216 | XC17S100A |
| XC2S150 | 1,040,096 | XC17S150A |
| XC2S200 | 1,335,840 | XC17S200A |
| XC2S50E | 630,048 | XC17S50A |
| XC2S100E | 863,840 | XC17S100A |
| XC2S150E ⁽¹⁾ | 1,134,496 | XC17S200A |
| XC2S200E | 1,442,016 | XC17S200A |
| XC2S300E | 1,875,648 | XC17S300A |
| XC2S400E | 2,693,440 | XC17V04 ⁽²⁾ |
| XC2S600E | 3,961,632 | XC17V04 ⁽²⁾ |

Notes:

1. Due to the higher configuration bit requirements of the XC2S150E device, an XC17S200A PROM is required to configure this FPGA.
2. See XC17V00 series configuration PROMs data sheet at: <http://direct.xilinx.com/bvdocs/publications/ds073.pdf>

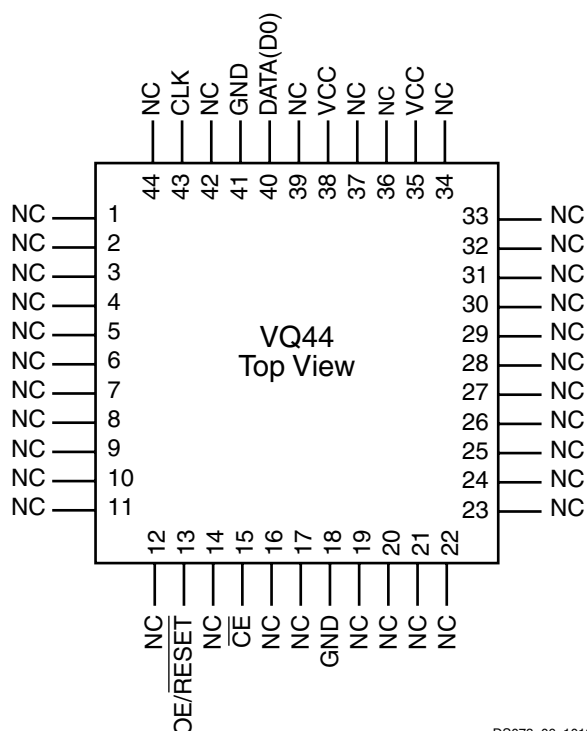
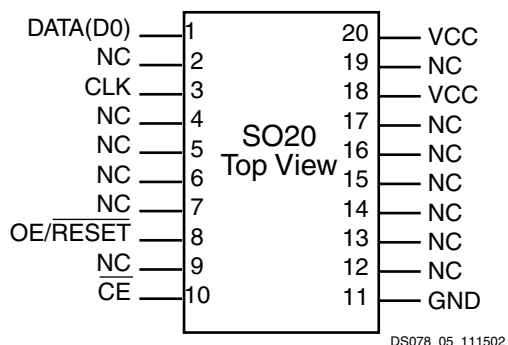
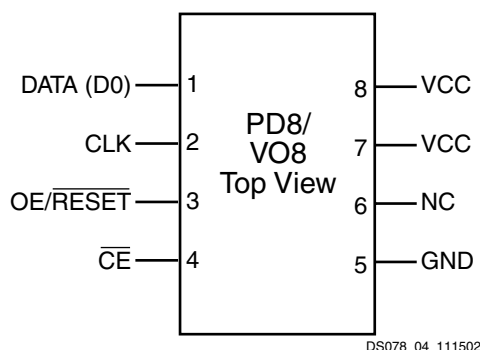
Pin Description

Pins not listed are "no connects."

Table 1: XC17S00A PROM Pinouts

| Pin Name | 8-pin PDIP (PD8) and VOIC/TSOP (VO8) | 20-pin SOIC (SO20) | 44-pin VQFP (VQ44) | Pin Description |
|--|--|--------------------------|--------------------------|---|
| DATA | 1 | 1 | 40 | Data output, High-Z state when either \overline{CE} or \overline{OE} are inactive. During programming, the DATA pin is I/O. Note that \overline{OE} can be programmed to be either active High or active Low. |
| CLK | 2 | 3 | 43 | Each rising edge on the CLK input increments the internal address counter, if both \overline{CE} and \overline{OE} are active. |
| RESET/ \overline{OE} ($\overline{OE}/\overline{RESET}$) | 3 | 8 | 13 | When High, this input holds the address counter reset and puts the DATA output in a high-impedance state. The polarity of this input pin is programmable as either RESET/ \overline{OE} or $\overline{OE}/\overline{RESET}$. To avoid confusion, this document describes the pin as RESET/ \overline{OE} , although the opposite polarity is possible on all devices. When RESET is active, the address counter is held at zero, and the DATA output is in a high-impedance state. The polarity of this input is programmable. The default is active High RESET, but the preferred option is active Low \overline{RESET} , because it can be connected to the FPGAs \overline{INIT} pin and a pull-up resistor. The polarity of this pin is controlled in the programmer interface. This input pin is easily inverted using the Xilinx HW-130 programmer software. Third-party programmers have different methods to invert this pin. |
| \overline{CE} | 4 | 10 | 15 | When High, this pin resets the internal address counter, puts the DATA output in a high-impedance state, and forces the device into low- I_{CC} standby mode. |
| GND | 5 | 11 | 18, 41 | GND is the ground connection. |
| V_{CC} | 7, 8 | 18, 20 | 38, 35 | The V_{CC} pins are to be connected to the positive voltage supply. |

Pinout Diagrams



Controlling PROMs

Connecting the Spartan device with the PROM:

- The DATA output of the PROM drives the D_{IN} input of the lead Spartan device.
- The Master Spartan device CCLK output drives the CLK input of the PROM.
- The \overline{RESET}/OE input of the PROM is connected to the \overline{INIT} pin of the Spartan device and a pull-up resistor. This connection assures that the PROM address counter is reset before the start of any (re)configuration, even when a reconfiguration is initiated by a V_{CC} glitch.
- The \overline{CE} input of the PROM is connected to the DONE pin of the Spartan device and a pull-up resistor. \overline{CE} can also be permanently tied Low, but this keeps the DATA output active and causes an unnecessary supply current of 10 mA maximum.

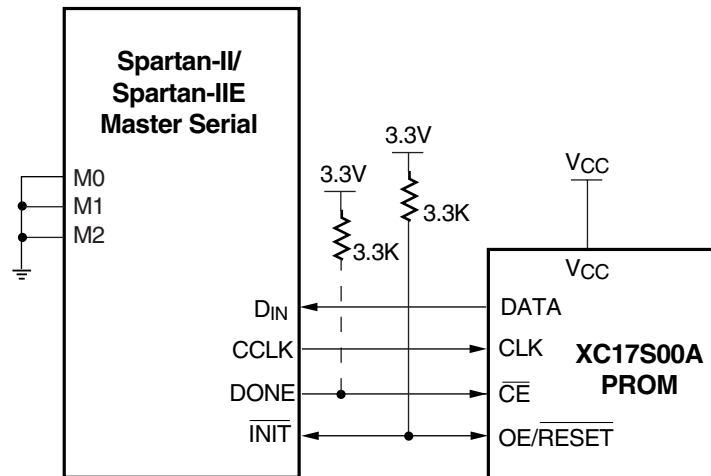
FPGA Master Serial Mode Summary

The I/O and logic functions of the Configurable Logic Block (CLB) and their associated interconnections are established by a configuration program. The program is loaded either automatically upon power up, or on command, depending on the state of the Spartan device mode pins. In Master Serial mode, the Spartan device automatically loads the configuration program from an external memory. The XC17S00A PROM has been designed for compatibility with the Master Serial mode.

Upon power-up or reconfiguration, the Spartan device enters the Master Serial mode when the mode pins are set to Master Serial mode. Data is read from the PROM sequentially on a single data line. Synchronization is provided by the rising edge of the temporary signal CCLK, which is generated during configuration.

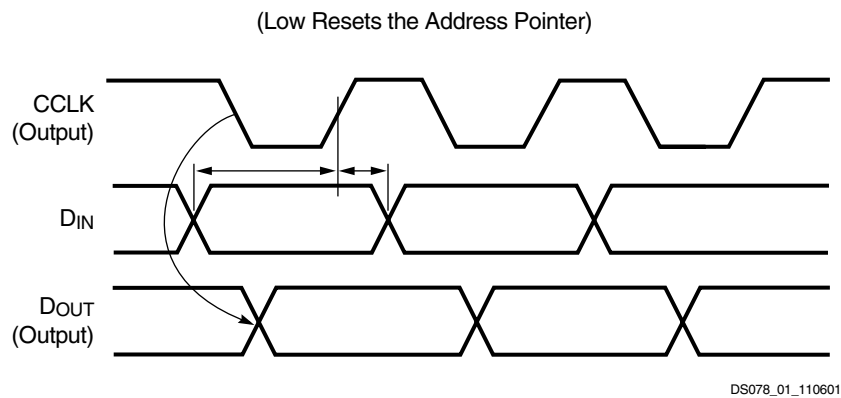
Master Serial mode provides a simple configuration interface (Figure 1). Only a serial data line, two control lines, and a clock line are required to configure the Spartan device. Data from the PROM is read sequentially, accessed via the internal address and bit counters which are incremented on every valid rising edge of CCLK.

If the user-programmable, dual-function D_{IN} pin on the Spartan device is used only for configuration, it must still be held at a defined level during normal operation. The Spartan-II/Spartan-IIE family takes care of this automatically with an on-chip pull-up/down resistor or keeper circuit.



Notes:

1. If the DriveDone configuration option is not active, pull up DONE with a 3.3k Ω resistor.



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Figure 1: Master Serial Mode

The one-time-programmable XC17S00A PROM in **Figure 1** supports automatic loading of configuration programs. An

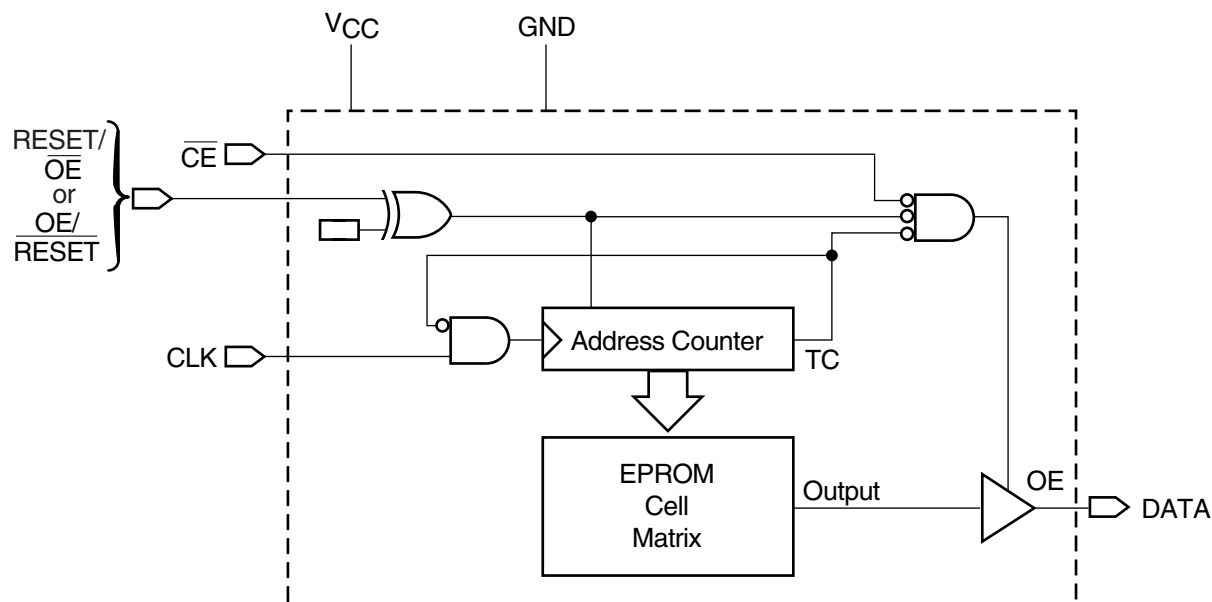
early DONE inhibits the PROM data output one CCLK cycle before the Spartan FPGA I/Os become active.

Standby Mode

The PROM enters a low-power standby mode whenever \overline{CE} is asserted High. The output remains in a high-impedance state regardless of the state of the \overline{OE} input.

Programming Spartan-II/Spartan-IIE Family PROMs

The devices can be programmed on programmers supplied by Xilinx or qualified third-party vendors. The user must ensure that the appropriate programming algorithm and the latest version of the programmer software are used. The wrong choice can permanently damage the device.



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Figure 2: Simplified Block Diagram (does not show programming circuit)

Important: Always tie the two V_{CC} pins together in your application.

Table 2: Truth Table for XC17S00A Control Inputs

| Control Inputs | | Internal Address ⁽²⁾ | Outputs | |
|----------------------|------|---|------------------|-------------------|
| RESET ⁽¹⁾ | CE | | DATA | I _{CC} |
| Inactive | Low | If address ≤ TC: increment If address > TC: don't change | Active High-Z | Active Reduced |
| Active | Low | Held reset | High-Z | Active |
| Inactive | High | Not changing | High-Z | Standby |
| Active | High | Held reset | High-Z | Standby |

Notes:

- The XC17S00A RESET input has programmable polarity
- TC = Terminal Count = highest address value. TC + 1 = address 0.

XC17S15A, XC17S30A, XC17S50A, XC17S100A, XC17S150A, XC17S200A, and XC17S300A

Absolute Maximum Ratings⁽¹⁾

| Symbol | Description | Value | Units |
|-----------|--|------------------------|-------|
| V_{CC} | Supply voltage relative to GND | -0.5 to +4.0 | V |
| V_{IN} | Input voltage with respect to GND | -0.5 to $V_{CC} + 0.5$ | V |
| V_{TS} | Voltage applied to High-Z output | -0.5 to $V_{CC} + 0.5$ | V |
| T_{STG} | Storage temperature (ambient) | -65 to +150 | °C |
| T_{SOL} | Maximum soldering temperature (10s @ 1/16 in.) | +260 | °C |

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.

Operating Conditions⁽¹⁾

| Symbol | Description | | Min | Max | Units |
|-----------|-------------|---|-----|-----|-------|
| V_{CC} | Commercial | Supply voltage relative to GND ($T_A = 0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$) | 3.0 | 3.6 | V |
| | Industrial | Supply voltage relative to GND ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$) | 3.0 | 3.6 | V |
| T_{VCC} | | V_{CC} rise time from 0V to nominal voltage | 1.0 | 50 | ms |

Notes:

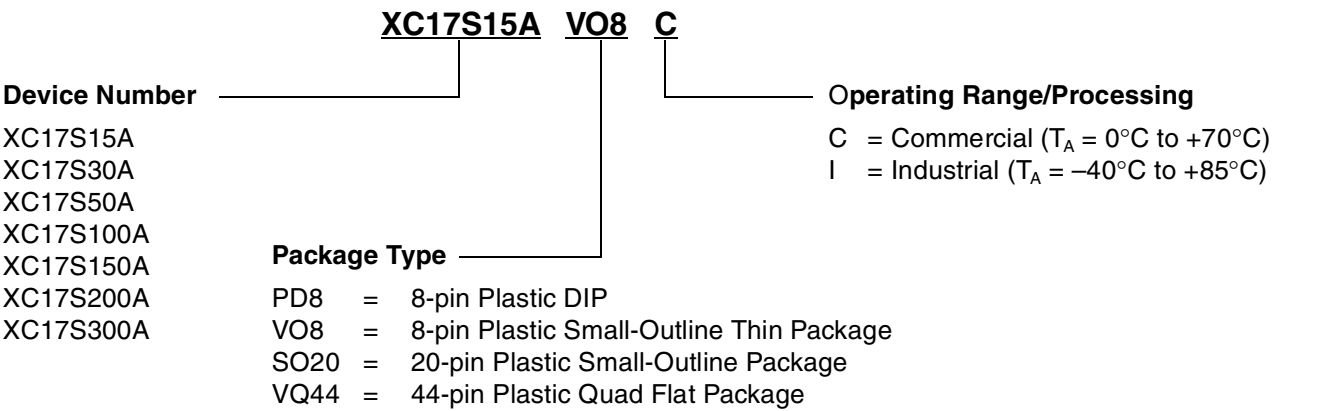
- During normal read operation, both V_{CC} pins must be connected together.
- At power-up, the device requires the V_{CC} power supply to monotonically rise from 0V to nominal voltage within the specified V_{CC} rise time. If the power supply cannot meet this requirement, then the device may not perform a power-on-reset properly.

DC Characteristics Over Operating Condition

| Symbol | Description | Min | Max | Units |
|-----------|---|-----|----------|---------------|
| V_{IH} | High-level input voltage | 2.0 | V_{CC} | V |
| V_{IL} | Low-level input voltage | 0 | 0.8 | V |
| V_{OH} | High-level output voltage ($I_{OH} = -3\text{ mA}$) | 2.4 | - | V |
| V_{OL} | Low-level output voltage ($I_{OL} = +3\text{ mA}$) | - | 0.4 | V |
| I_{CCA} | Supply current, active mode (at maximum frequency) | - | 15 | mA |
| I_{CCS} | Supply current, standby mode | - | 1 | mA |
| I_L | Input or output leakage current | -10 | 10 | μA |
| C_{IN} | Input Capacitance ($V_{IN} = \text{GND}$, $f = 1.0\text{ MHz}$) | - | 10 | pF |
| C_{OUT} | Output Capacitance ($V_{IN} = \text{GND}$, $f = 1.0\text{ MHz}$) | - | 10 | pF |

- ### AC Characteristics Over Operating Condition⁽¹⁾

Ordering Information



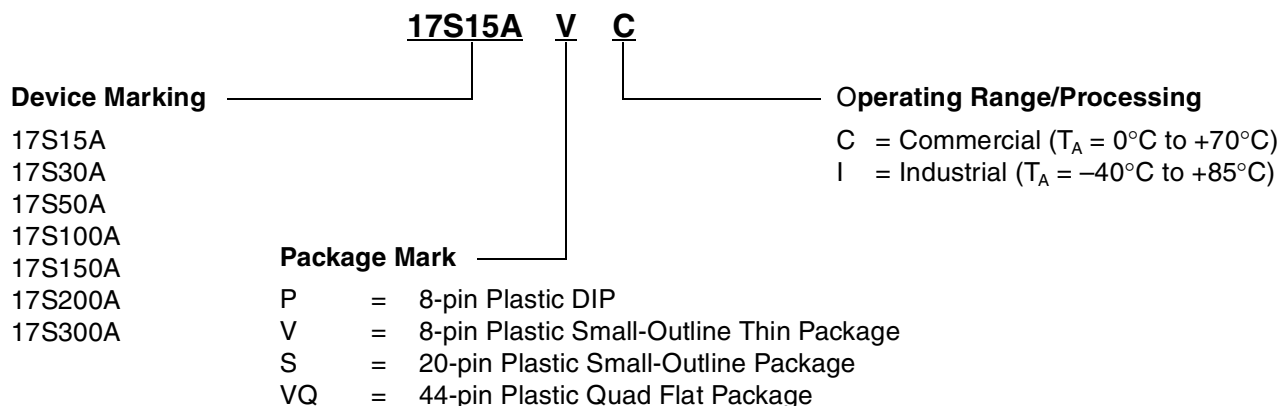
Spartan-II 3.3V Valid Ordering Combinations

| | | |
|---------------|----------------|----------------|
| XC17S15APD8C | XC17S50APD8C | XC17S150APD8C |
| XC17S15AVO8C | XC17S50AVO8C | XC17S150AVO8C |
| XC17S15ASO20C | XC17S50ASO20C | XC17S150ASO20C |
| XC17S15APD8I | XC17S50APD8I | XC17S150APD8I |
| XC17S15AVO8I | XC17S50AVO8I | XC17S150AVO8I |
| XC17S15ASO20I | XC17S50ASO20I | XC17S150ASO20I |
| XC17S30APD8C | XC17S100APD8C | XC17S200APD8C |
| XC17S30AVO8C | XC17S100AVO8C | XC17S200AVO8C |
| XC17S30ASO20C | XC17S100ASO20C | XC17S200AVQ44C |
| XC17S30APD8I | XC17S100APD8I | XC17S200APD8I |
| XC17S30AVO8I | XC17S100AVO8I | XC17S200AVO8I |
| XC17S30ASO20I | XC17S100ASO20I | XC17S200AVQ44I |
| | | XC17S300AVQ44C |
| | | XC17S300AVQ44I |

Marking Information

Due to the small size of the PROM package, the complete ordering part number cannot be marked on the package.

The XC prefix is deleted and the package code is simplified. Device marking is as follows.



Revision History

The following table shows the revision history for this document.

| Date | Revision | Revision |
|----------|----------|---|
| 09/14/00 | 1.0 | Initial Xilinx release. |
| 11/13/00 | 1.1 | Updated configuration bits. |
| 04/07/01 | 1.2 | Added to features: "Guaranteed 20 year life data retention", removed "Programming the FPGA with counters" and related text. |
| 06/20/01 | 1.3 | Revised Figure 1 resistor values to match Spartan-II data sheet. |
| 10/09/01 | 1.4 | Added note for unlisted pins, changed I_{CCA} and I_{CCS} , and added power-on supply requirements and note regarding power-on reset. |
| 11/15/01 | 1.5 | Updated for Spartan-IIE FPGA family. |
| 06/25/02 | 1.6 | Changed Table 1 . |
| 10/15/02 | 1.7 | Changed Table 1 . Added Pinout Diagrams, page 3 . |
| 11/18/02 | 1.8 | Added XC2S400E and XC2S600E to Compatible FPGAS table. Modified document title. |