

# SX to SX-A Design Migration

## Introduction

SX-A is fabricated using a 0.22/0.25 $\mu$  CMOS process. These advanced processes result in a lower core voltage for the die. In addition to using advanced processes, the SX-A family includes many enhancements over the SX family of devices. This application note compares the features of the SX and SX-A families and describes methods of converting a design from an SX device to an SX-A device.

## Advanced I/O Features

The SX-A devices have a variety of advanced I/O features that are not available in the SX devices, including:

- **Hot Swapping:** All I/Os can be programmed to be hot swappable. The SX-A I/Os are always 5V tolerant regardless of  $V_{CCI}$ .
- **PCI Compliance:** All I/Os can be programmed to be fully compliant with the 3.3V PCI or 5V PCI local bus specification.
- **Higher System Performance:** SX-A devices are approximately 10% faster than SX devices because they are fabricated with a thinner gate oxide.
- **Input Threshold Voltage:** All I/Os can be programmed to support 5V TTL, 3.3V TTL, 5V PCI, or 3.3V PCI input trip points.
- **Slew-Rate Control:** All outputs can be programmed to either a high slew or a low slew, thus providing greater control when dealing with ground-bounce problems associated with the simultaneous switching of many outputs.

- **Configurable Output State During Power Up:** All outputs can be programmed to either weak resistor pull up or weak resistor pull down for output tristate.

Table 1 summarizes SX-A's advanced I/O features.

## Design Migration Considerations

There are restrictions and specific requirements to consider when migrating designs from SX to SX-A, including power supply and timing issues. In addition, the design migration process will be affected by whether the device is being converted to the same density or to a larger density device. Some of the SX packages do not facilitate a migration path. Table 2 on page 2 displays the package availability for both families.

## Power Supply Considerations

The SX-A devices are fabricated using a 0.22/0.25 $\mu$  CMOS process, which results in a 2.5V core voltage. If these devices are powered with 5V or 3.3V, they may suffer from high-field-effect failures such as hot-carrier injection. Because SX devices have a core voltage of 3.3V, a power supply incompatibility results between SX and SX-A devices (Table 3 on page 2). For a smooth device migration, the  $V_{CCA}$  power supply should always be separated from  $V_{CCI}$  with a jumper.  $V_{CCR}$  is not required for SX-A devices. Because the  $V_{CCR}$  pins are not connected in the SX-A die, there is no need to separate them from the original DC source.

In order to use SX-A devices, the printed circuit board (PCB) must have a 2.5V power supply to  $V_{CCA}$ . A simple and inexpensive 2.5V supply can be created from either a 5V or 3.3V DC source ( $V_{IN}$ ) using a linear regulator, as shown in Figure 1 on page 3.

Table 1 • I/O Comparison

|   | SX Regular I/Os | SX PCI I/Os | SX-A Hot-Swappable I/Os |
|---|-----------------|-------------|-------------------------|
| Output Slew-Rate Control                  | None            | None        | High Slew or Low Slew   |
| Power-Up Sequence Friendly                | No              | No          | Yes                     |
| Output Tristate at Power Up               | No*             | No          | Yes                     |
| PCI Compliance                            | No              | Yes         | Yes                     |
| Configurable Output State During Power Up | No              | No          | Yes                     |

\*Tristate can be achieved under the proper conditions.

### Timing Considerations

Because of the different process technologies and device geometries, timing in asynchronous paths will change. When migrating designs, users should verify that the faster timing of the SX-A devices does not cause timing errors. In addition, after a design is converted, timing simulation should be re-run to make sure the functionality is correct and the design can run at the same system clocking speed.

### Density and Package Considerations

In general, if designers want to convert their designs from a smaller density SX device to a larger density SX-A device in the same package, they will not need to redesign the PCB. However, some of the PQ208 package pins are not compatible between the two families. The biggest difference occurs when migrating to the A54SX72A device. Incompatible pins in the PQ208 package are listed in [Table 4 on page 3](#).

If the original PCBs provide 2.5V, 3.3V, and 5V power supplies, same density and package conversions between the SX and SX-A families can be done by switching the  $V_{CCA}$  jumper from 3.3V to 2.5V for SX-A devices.

All  $V_{CCR}$  pins in the A54SX08, A54SX16, and A54SX32 devices are NC in the A54SX08A, A54SX16A, and A54SX32A devices, respectively. Because these  $V_{CCR}$  pins are not connected in the SX-A die, there is no need to separate them from the original DC source.

If the original PCB does not provide a 2.5V power supply, a 2.5V power supply to  $V_{CCA}$  must be added. For more information, refer to the [“Power Supply Considerations” section on page 1](#).

**Table 2 • Package Availability**

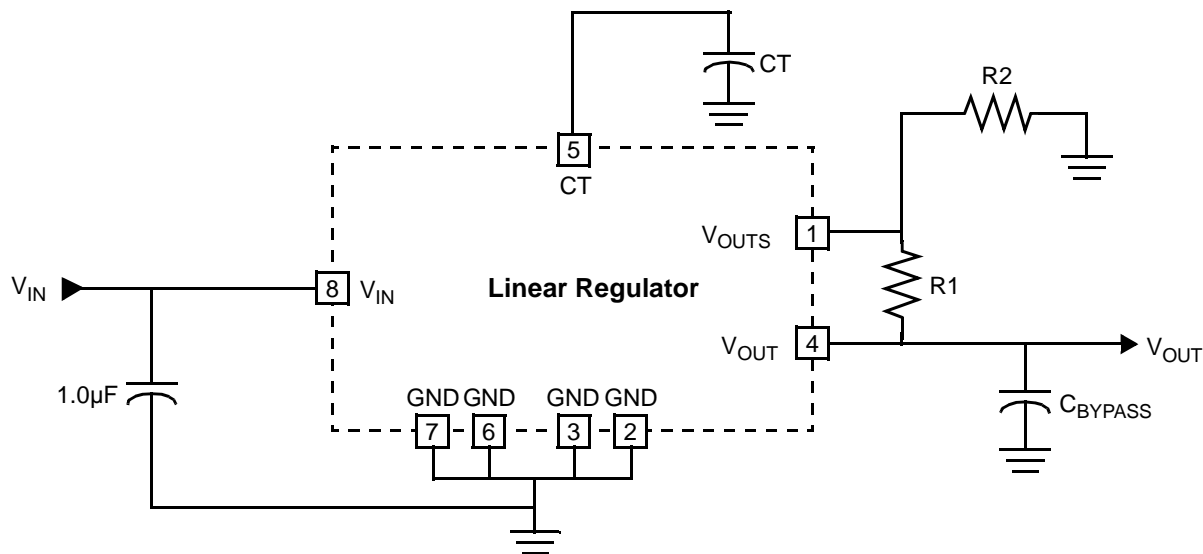
| Packages              | Devices              |                      |          |          |
|-----------------------|----------------------|----------------------|----------|----------|
| PLCC 84 <sup>1</sup>  | A54SX08              |                      |          |          |
| PQFP 208              | A54SX08              | A54SX16,<br>A54SX16P | A54SX32  |          |
|                       | A54SX08A             | A54SX16A             | A54SX32A | A54SX72A |
| VQFP 100 <sup>2</sup> | A54SX08              | A54SX16,<br>A54SX16P |          |          |
| TQFP 100              | A54SX08A             | A54SX16A             | A54SX32A |          |
| TQFP 144              | A54SX08              | A54SX16P             | A54SX32  |          |
|                       | A54SX08A             | A54SX16A             | A54SX32A |          |
| TQFP 176              | A54SX08              | A54SX16,<br>A54SX16P | A54SX32  |          |
|                       |                      |                      | A54SX32A |          |
| PBGA 313 <sup>1</sup> |                      |                      | A54SX32  |          |
| PBGA 329              |                      |                      | A54SX32  |          |
|                       |                      |                      | A54SX32A |          |
| FBGA 144              | A54SX08,<br>A54SX08A | A54SX16A             | SX32A    |          |
| FBGA 256              |                      | A54SX16A             | A54SX32A | A54SX72A |
| FBGA 484              |                      |                      | A54SX32A | A54SX72A |

**Notes:**

1. The A54SX08-PL84 and A54SX32-BG313 devices do not have a direct migration path.
2. SX-VQ100 has the same footprint as SX-A-TQ100, so designers can use SX-A-TQ100 in SX-VQ100 designs.

**Table 3 • Power Supply Comparison**

|  | V <sub>CCA</sub><br>Power Supply<br>for Array | V <sub>CCR</sub><br>Power Supply for<br>Input Tolerance<br>(required for<br>internal biasing) | V <sub>CCI</sub><br>Power Supply<br>for I/Os | Input<br>Tolerance | Output<br>Drive |
|--|---|---|--|--------------------|-----------------|
| SX regular I/Os<br>(0.6μ RT54SX16, RT54SX32)<br>(0.35μ A54SX08, A54SX16,<br>A54SX32) | 3.3V  | 5V  | 3.3V   | 5V                 | 3.3V            |
|  | 3.3V  | 3.3V  | 3.3V   | 3.3V               | 3.3V            |
| 5V   |   | 3.3V  | 5V   | 3.3V               |                 |
| 5V   |   | 5V  | 5V   | 5V                 |                 |
| SX-A Hot-Swappable I/Os<br>(0.25μ SX-A)<br>(0.22μ SX-A)                              | 2.5V  | not required  | 2.5V   | 5V                 | 2.5V            |
|  |   |   | 3.3V   | 5V                 | 3.3V            |
|  |   |   | 5V   | 5V                 | 5V              |



- Notes:**
1.  $C_T$  = Timing capacitor. Set at 1500pF.
  2.  $C_{BYPASS}$  = Bypass capacitance for target 2.5V device(s).
  3.  $R_1 = R_2$  for 2.5V  $V_{OUT}$ . Use 50 k $\Omega$ .

Figure 1 • Application Circuit

Table 4 • Incompatible Pins in the PQ208 Package

| PQ208 Pin Numbers                |     |                  |                  |     |       |                  |                  |       |     |                  |                  |       |                  |                  |       |
|----------------------------------|-----|------------------|------------------|-----|-------|------------------|------------------|-------|-----|------------------|------------------|-------|------------------|------------------|-------|
|                                  | 18  | 19               | 25               | 65  | 74    | 80               | 83               | 84    | 116 | 117              | 132              | 178   | 182              | 187              | 190   |
| SX Packages                      |     |                  |                  |     |       |                  |                  |       |     |                  |                  |       |                  |                  |       |
| A54SX08,<br>A54SX16,<br>A54SX16P | I/O | I/O              | V <sub>CCR</sub> | I/O | I/O   | V <sub>CCR</sub> | I/O              | I/O   | NC  | I/O              | V <sub>CCR</sub> | I/O   | V <sub>CCR</sub> | I/O              | I/O   |
| A54SX32                          | I/O | I/O              | V <sub>CCR</sub> | NC  | I/O   | V <sub>CCR</sub> | I/O              | I/O   | I/O | I/O              | V <sub>CCR</sub> | I/O   | V <sub>CCR</sub> | I/O              | I/O   |
| SX-A Packages                    |     |                  |                  |     |       |                  |                  |       |     |                  |                  |       |                  |                  |       |
| A54SX32A                         | I/O | I/O              | NC               | NC  | I/O   | NC               | I/O              | I/O   | I/O | I/O              | NC               | I/O   | NC               | I/O              | I/O   |
| A54SX72A                         | GND | V <sub>CCA</sub> | I/O              | I/O | QCLKA | NC               | V <sub>CCI</sub> | QCLKB | GND | V <sub>CCA</sub> | I/O              | QCLKD | NC               | V <sub>CCI</sub> | QCLKC |

## Conclusion

The SX-A family is an enhanced version of the SX family with increased performance and lower cost. Keeping in mind power supply timing, and package migration considerations designers can quickly and easily convert their designs and take advantage of the benefits offered by SX-A.

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