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**Spec Title:** USING NVSRAM IN SINGLE-BOARD  
COMPUTER (SBC) APPLICATIONS - AN43055

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# Using nvSRAM in Single-Board Computer (SBC) Applications

## AN43055

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**Associated Part Family:** 256 Kb – 8 Mb nvSRAM Family

**Associated Application Notes:** None

### Application Note Abstract

This application note discusses the benefits of using the Cypress nonvolatile SRAM (nvSRAM) for a single-board computer (SBC) solution over other NVRAMs.

### Introduction

The first SBC was the MYCRO-1 built around an Intel 8080 CPU. SBCs have featured in the history of home computers (for example, in the Acorn Electron and the BBC Micro).

Initially, manufacturers designed and built their own CPU computer boards. When a product used a proprietary operating system, its unique I/O or performance requirements made it expensive. Now, industrial and commercial operating systems are used and this allows smaller manufacturers and developers to produce competitive products in less time.

This convergence has made it possible for manufacturers to produce cost-effective and successful SBC designs. These designs were initially chosen by smaller companies that lacked inhouse design capability. Now, SBC designs are preferred by large manufacturers with production runs of greater than 5,000 units. SBC designs are more convenient than proprietary boards because they are qualified for a range of operating systems that expand the methods they are used in.

### Features of nvSRAM

- nvSRAM densities:
  - 256 Kb, 1 Mb, 4 Mb, and 8 Mb
- Data integrity of the Cypress nvSRAM combined with a full-featured real-time clock (RTC)
- 20 ns, 25 ns, and 45 ns access times
- Clock alarm with programmable interrupts
- Capacitor or battery backup for RTC
- Watchdog timer
- 'Hands-off' automatic STORE on power-down with only a small capacitor
- STORE to QuantumTrap™ initiated by software, device pin, or on power-down
- RECALL to SRAM initiated by software or on power-up
- Infinite READ, WRITE, and RECALL cycles
- High reliability:
  - Endurance of up to 1 million cycles
  - Data retention: 20 years at 85 °C
- Single 3 V operation +20%, -10%, and 5 V operation + or -10%
- Industrial temperature range
- Shrinked small outline package (SSOP), small outline integrated circuit (SOIC), thin shrinked small outline package (TSSOP-II), and fine ball grid array (FBGA) packages that are (RoHS compliant)

## SBC Overview

SBCs are complete computers built on a single circuit board. The design is centered on a single microprocessor with RAM, I/O, and all the features required for a functional computer.

### When to Use a SBC

- Time to market is less
- Proven design by a vendor increases reliability and reduces risk
- For component-level designs that are too complex for in-house engineers
- Lack of internal company resources to design all the modules
- Lack of internal manufacturing expertise

### When Not to Use an SBC

- An application requires a special size or format
- For special CPUs or configurations needed for the application
- For non commercial environment use because of shock, vibration, heat, humidity, radiation, or power requirements
- For special I/O interface requirements

## Application Details

SBCs for the original equipment manufacturer (OEM) market are used in communications, industrial, military, and other embedded applications that require maximum reliability, expandability, and serviceability.

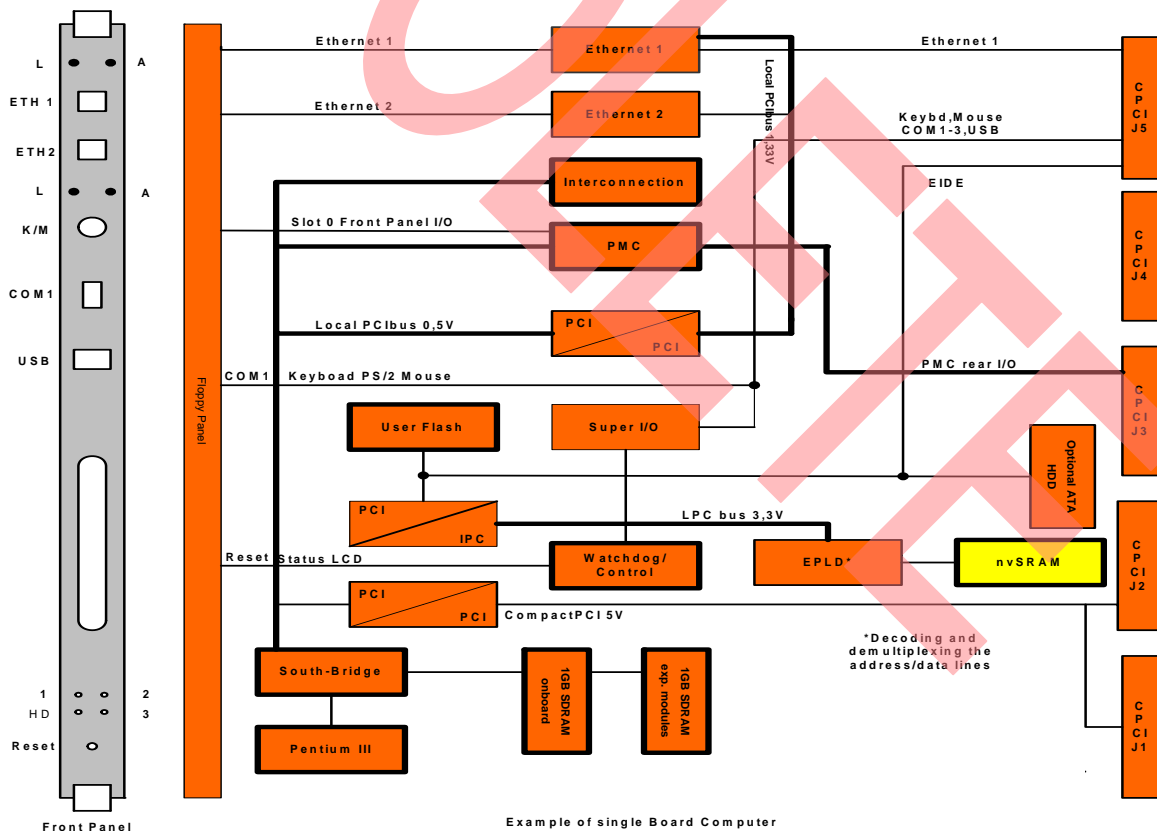
The typical characteristics of SBCs are as follows:

- Single-slot CPU board
- Ideal for emerging switch fabric applications and for building block solutions
- Enables system or peripheral slot functionality on one platform
- Provides an ideal solution for third generation (3G) wireless, voice over internet protocol (VoIP), and other demanding telecom and data communication applications
- Offers the highest performance processor on Intel's embedded roadmap with a planned scalability for up to 1 GHz performance

The nvSRAM used on these boards is used for user- or application-specific parameter storage.

A typical SBC block diagram is shown in Figure 1.

Figure 1. Example of Single Board Computer



## The nvSRAM Solution in SBC

Cypress's nvSRAM provides significant value additions and advantages to the existing solution.

The nvSRAM is used to store the board information block, which contains the various operating parameters of the hardware. The example data block containing various elements that detail specific operational parameters follow:

- Board serial number
- Board identifier
- MPU clock speed
- Bus clock speed
- Ethernet address
- Primary ATA identifier
- System serial number
- System identifier
- License identifier

Table 1. Characteristics of NVRAMs

| Parameter         | EEPROM       | BBSRAM            | FRAM         | MRAM         | NVSRAM       |
|-------------------|--------------|-------------------|--------------|--------------|--------------|
| Speed             | Slow         | Slow              | Slow         | Fast         | Fastest      |
| RoHS              | Yes          | No                | Yes          | Yes          | Yes          |
| Cycles            | Limited      | Unlimited         | Unlimited    | Unlimited    | Unlimited    |
| Retention (years) | 100          | 10                | 10           | 20           | 20           |
| Soldering         | Conventional | Special Technique | Conventional | Conventional | Conventional |

## Cypress nvSRAM Advantages

- Smallest board space area with no compromises on performance, which is the most sought after factor for SBC.
- Faster read or writes.
- Higher reliability. Data retention period is 20 years.
- Improved manufacturing. Battery-based solutions are sensitive to heat and have special manufacturing requirements. They have intrinsically higher failure rates than pure silicon solutions.
- Simpler firmware. The recall function of Cypress's nvSRAM is automatic, eliminating special firmware development for data recovery.
- Green environment. No lead or hazardous materials are present in a Cypress nvSRAM solution.

The nvSRAM is used to store critical data in military application SBCs. It is also used for data logging in real-time SBC applications where data must be periodically recorded at data collection terminals (for example, SCADA systems).

## Advantages of nvSRAM over other Solutions

SBCs require reliable and fast data storage or retrieval solutions. Operating parameters are critical for the normal operation of the system and a nonvolatile solution is imperative. Because SBCs are used in medical and other sensitive environments where an RoHS-compliant solution is required, nvSRAM provides this feature. Conventional solutions cannot be used because of the characteristics shown in Table 1.

The Cypress AutoStore nvSRAM provides fast, nonvolatile storage of data that is not lost when power is removed. During normal operation, application software reads and writes the Cypress AutoStore nvSRAM like any standard SRAM, with no special programming algorithm. When a power loss is detected, an AutoStore cycle is performed and the whole data is automatically transferred from the on-chip SRAM to the nonvolatile element using energy stored in an external capacitor. At the next power-up, a recall cycle is performed to transfer the nonvolatile element contents back to the SRAM. The application code then accesses the stored data to continue normal operations.

Cypress nvSRAM has the fast read or write speed and low power of a battery-backed SRAM, and this eliminates the need for a battery. EEPROM and Flash require long write times, wear out after being written a few times, and use a large amount of power to write data. Cypress's nvSRAM writes instantly and requires very little write power.

Cypress's nvSRAM serves as an ideal NVRAM solution in SBC with the ability to perform more functions than typical solutions, such as battery-backed SRAM or discrete SRAM powered by an external battery.

The Cypress nvSRAM has the fastest access time in the industry and stores user- or application-specific parameters with greater effectiveness. The main processor stores, retrieves, and modifies this data with the same speed as it does with a standard SRAM. The Cypress nvSRAM offers infinite read or write cycles when it is powered on, so the processor can change the user or application-specific parameters any time without restriction. The number of recall cycles is unlimited; the maximum number of store cycles is one million, and the data retention period is 20 years.

## Summary

Single-board computers are commonly used in industrial situations. They are used in the rack mount format for process control or embedded within other devices to provide control and interfacing. This creates very high levels of integration, reduced component counts, and reduced connector counts. SBCs are smaller, lighter, more power-efficient, and are more reliable than comparable multiboard computers.

The flexibility of fast nonvolatile memory for the storage of user or application-specific parameters is apparent with each new system generation. The Cypress family of fast nvSRAMs are ideally suited for this type of application. They reliably store data in a nonvolatile semiconductor memory without batteries, and yet look like a standard SRAM to the processor. Ease of implementation, ability to rapidly change data, and the ability to use modern manufacturing techniques helps to reduce costs and improves the speed of getting the product to the market.

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## Document History Page

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| Revision | ECN     | Orig. of Change | Submission Date | Description of Change  |
|----------|---------|-----------------|-----------------|--|
| **       | 1767365 | PSR             | 11/23/2007      | New application note   |
| *A       | 3122974 | GVCH            | 12/29/2010      | Updated the following in <a href="#">Features of nvSRAM</a> :<br>Updated nvSRAM densities<br>Changed endurance from 200,000 to 1 million cycles<br>Changed data retention 20 years at 55 °C to 85 °C |
| *B       | 3490330 | GVCH            | 01/11/2012      | Obsolete spec  |

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