

## Migrating from T89C51CC01 to AT89C51CC03

This application note is a guide to assist T89C51CC01 users in converting existing designs to the AT89C51CC03 devices. In addition to the functional changes, the electrical characteristics of the AT89C51CC03 are different including an increase in operating power supply range. Check the datasheet for detailed information.

To ease the product migration, this application note compares the memory organization/accesses, the new features and electrical parameters.

### Feature Comparison

| Description                 | T89C51CC01                                                                    | AT89C51CC03                                  |
|-----------------------------|-------------------------------------------------------------------------------|----------------------------------------------|
| Program Memory              | 32K Bytes                                                                     | <b>64K Bytes</b>                             |
| In-System Programming (ISP) | 2K Bytes Flash UART or CAN bootloader.                                        | 2K Bytes Flash UART or CAN bootloader.       |
| RAM                         | 256 Bytes                                                                     | 256 Bytes                                    |
| XRAM                        | 1024 Bytes                                                                    | <b>2048 Bytes</b>                            |
| On-Chip EEPROM data         | 2048 Bytes<br>128 Bytes page write                                            | 2048 Bytes<br>128 Bytes page write           |
| 16-bit Timers               | Yes (3)                                                                       | Yes (3)                                      |
| X2 Mode                     | CPU & Programmable separately by peripherals                                  | CPU & Programmable separately by peripherals |
| SPI Interface               | No                                                                            | <b>Yes (PLCC52 or QFP64)</b>                 |
| POR/PFD                     | No                                                                            | <b>Yes</b>                                   |
| Maximum Frequency @ 5V      | 40 MHz X1 mode<br>20 MHz X2 mode                                              | 40 MHz X1 mode<br>20 MHz X2 mode             |
| Power Supply                | 3V to 5.5V                                                                    | 3V to 5.5V                                   |
| Pinout                      | T89C51CC01 and AT89C51CC03 are pinout compatible in PLCC44 and QFP44 version. |                                              |



## CAN Microcontrollers

### Application Note

Rev. 4321B–CAN–06/05

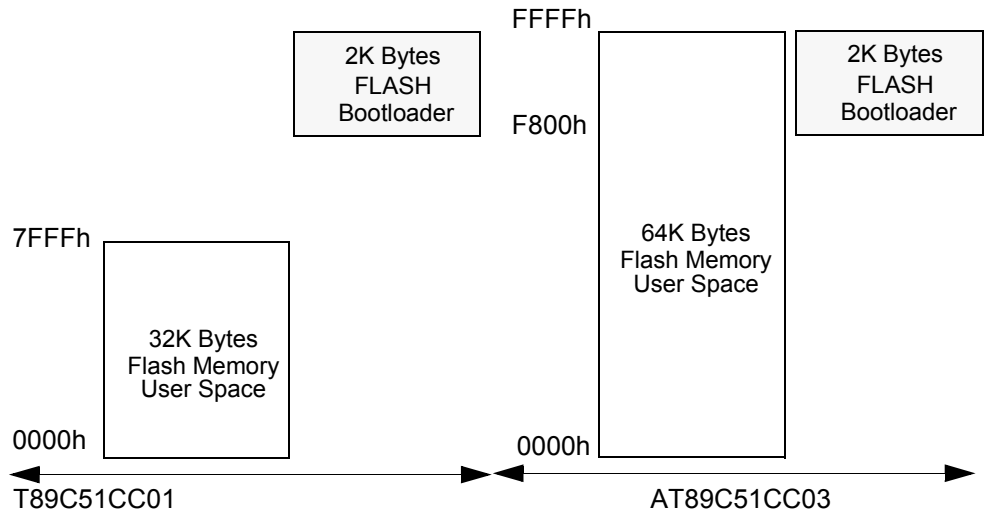


## Memory Organization

### Code Memory Organization

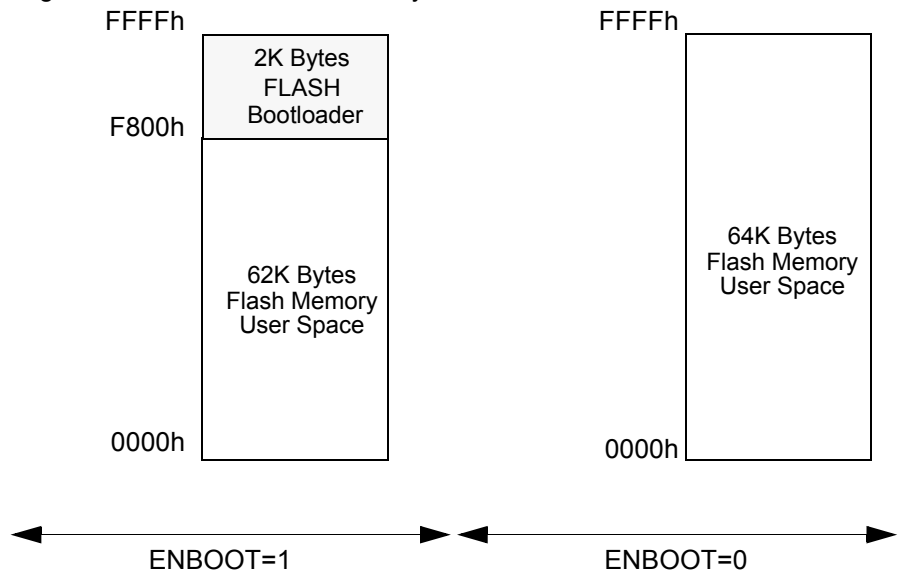
The AT89C51CC03 implements 64K Bytes (instead of 32K Bytes for the T89C51CC01) of on-chip program/code memory and a 2K Bytes Flash dedicated for bootloader (CAN or UART). By default the microcontroller addresses the 64K Bytes of on-chip Flash program/code memory. To address the upper 2K Bytes Flash bootloader, the ENBOOT bit in AUXR1 register must be set (to access Flash API from user space for example).

**Figure 1.** Code Memory Organization



The ENBOOT bit operates as a chip select between the on-chip Flash memory and the bootloader memory in the logical upper 2 K Bytes code memory space of the microcontroller (see Figure 2).

**Figure 2.** Logical Addressable Code Memory for AT89C51CC03



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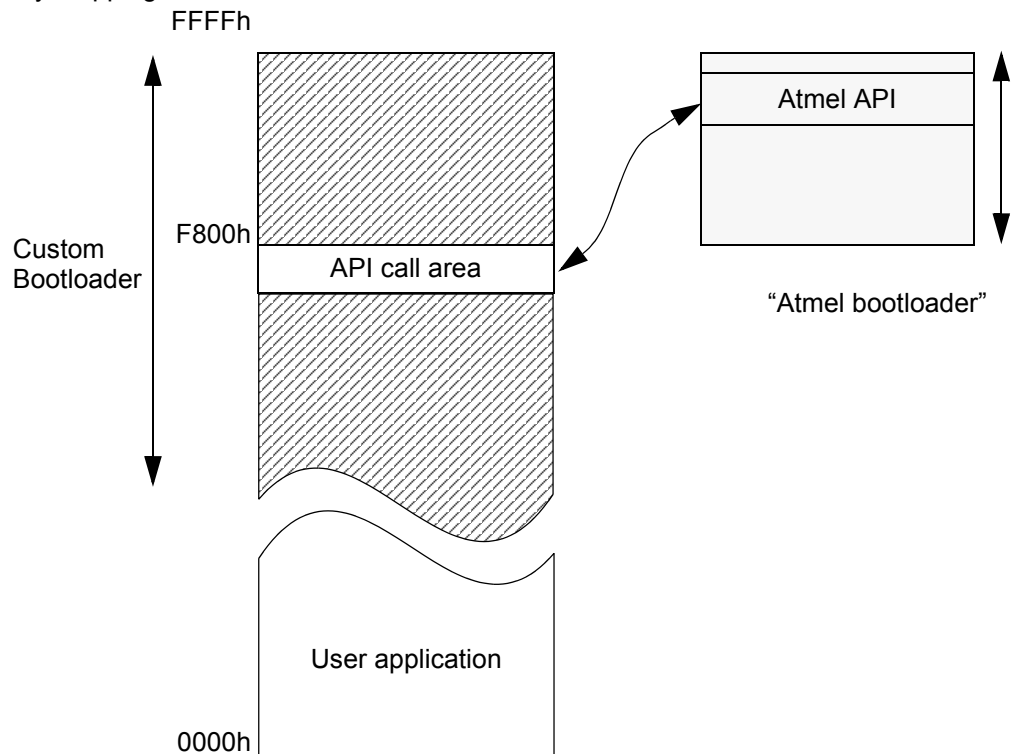
## **Consequence:**

Applications that embed “Custom bootloader” and that use on-chip Atmel API calls should take care of the following point:

A custom bootloader can be located anywhere in the 64K Bytes of the on-chip Flash memory, even in the 2K Bytes in overlap with the bootloader memory (between 0F800h and FFFFh), the only restriction is that the API call to the Atmel bootloader must be located outside the overlapped range address (see Figure 1).

As the access to the “Atmel bootloader” API requires the ENBOOT to be set, it is impossible to call an API from the 2K Bytes of the overlapped memory.

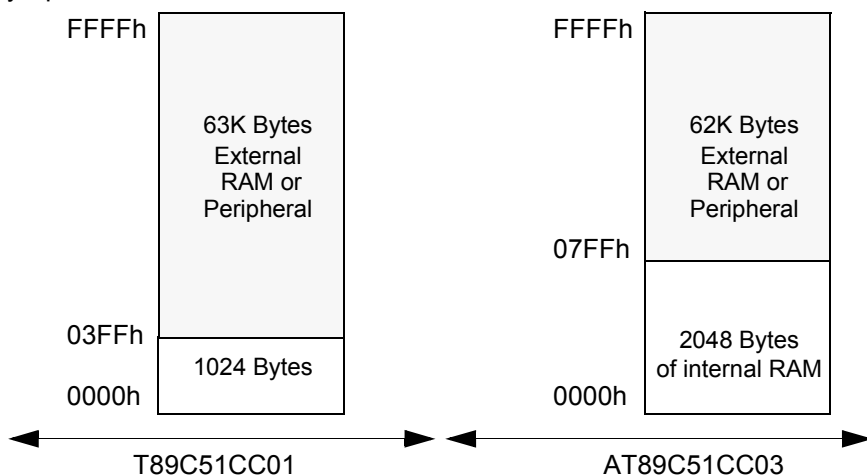
**Figure 1.** Custom Bootloader Memory Mapping



## On-chip RAM/XRAM Memory

Both T89C51CC01 and AT89C51CC03 have 256 Bytes of scratch pad RAM. The AT89C51CC03 has 2048 Bytes of internal XRAM, whereas the T89C51CC01 has 1024 Bytes.

**Figure 2.** XRAM Logical Addressable Memory Space



### Consequence:

T89C51CC01 applications using the 1K byte of external memory space between 03FFh and 07FFh to address external components should:

- Change this external memory space area outside the internal
- Or limit the internal RAM space to 1K byte by setting the XRS2:0 bits of AUXR register to “011” (See Table 1.)

**Table 1.** AUXR Register  
AUXR Register (SFR:8Eh)

| AUXR        | 7                   | 6 | 5  | 4    | 3    | 2    | 1      | 0  |
|-------------|---------------------|---|----|------|------|------|--------|----|
| T89C51CC01  | -                   | - | M0 | -    | XRS1 | XRS0 | EXTRAM | A0 |
| AT89C51CC03 | Note <sup>(1)</sup> | - | M0 | XRS2 | XRS1 | XRS0 | EXTRAM | A0 |

Note: 1. This bit is initialized at 0 at reset and should never be set (= 1).

Thanks to the new XRS2 bit the AT89C51CC03 provides different internal XRAM size compatible with the T89C51CC01 (See AT89C51CC03 data sheet for details).

**Table 2.** XRAM Size configuration

| XRS2 | XRS1 | XRS0 | Internal XRAM Size Configuration |
|------|------|------|----------------------------------|
| 0    | 0    | 0    | 256                              |
| 0    | 0    | 1    | 512                              |
| 0    | 1    | 0    | 768                              |
| 0    | 1    | 1    | 1024                             |
| 1    | 0    | 0    | 1792                             |
| 0    | 0    | 1    | 2048 (Default Configuration)     |
| 0    | 0    | 0    | Reserved                         |
| 0    | 0    | 1    | Reserved                         |

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## Improvements

The AT89C51CC03 implements a set of improvements.

## Product Robustness

### Integrated POR/PFD

The AT89C51CC03 provides a Power Fail Detector that monitors the internal power supply of the CPU core and memories and maintains a reset state if the power supply fails below a safety level.

This new feature allows to save the implementation of an external reset circuit as recommended in the T89C51CC01.

### Flash controller

This section involved only the applications where the user wants to develop its own bootloader located in the 2K Bytes Flash boot area (FM1) instead of the “Atmel bootloader”.

The Flash controller of the AT89C51CC03 implements a set of new functionalities and security improvements accessible through the FSTA register (see AT89C51CC03 datasheet):

- Sequence error in the Flash write sequence
- Columns latch loaded

The user involved with these special manipulations of the Flash controller should also take care regarding the new behavior of the FBUSY flag described in the AT89C51CC03 datasheet (see AT89C51CC03 datasheet, section “Program/Code Memory”).

## New Features

### SPI Module

To improve interconnection with other devices, the AT89C51CC03 provides a new Serial Port Interface module. As this module is available only on PLCC52 and VQFP64 packages, and accessible only with T89C51CC01 unused registers, this new feature will not interfere with previous T89C51CC01 designs.

## DC Parameters

| Symbol           | Parameters            | T89C51CC01 |     |     | AT89C51CC03 |     |     | Unit |
|------------------|-----------------------|------------|-----|-----|-------------|-----|-----|------|
|                  |                       | Min        | Typ | Max | Min         | Typ | Max |      |
| R <sub>RST</sub> | RST Pulldown Resistor | 15         | 40  | 200 | 50          | 100 | 200 | kΩ   |

For applications generating their reset pulse from an external Capacitor tied to Vcc, the new Pulldown Reset value of the AT89C51CC03 will double the reset pulse length and delay the microcontroller start.

## References

T89C51CC01 datasheet (doc4129)

AT89C51CC03 datasheet (doc4182)



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