AN1983

Writing to Flash and EEPROM on the tinyAVR 1-series

Introduction

On tinyAVR® 1-series devices, access to Flash memory and EEPROM has been changed from that on previous tinyAVR devices. This means that existing code for writing to Flash and EEPROM on older devices must be modified in order to function properly on tinyAVR 1-series devices. This application note describes what has changed and how to adapt code to these changes. A link is provided to example code that shows how to read and write to both Flash and EEPROM on tinyAVR 1-series devices.

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1. Relevant Devices

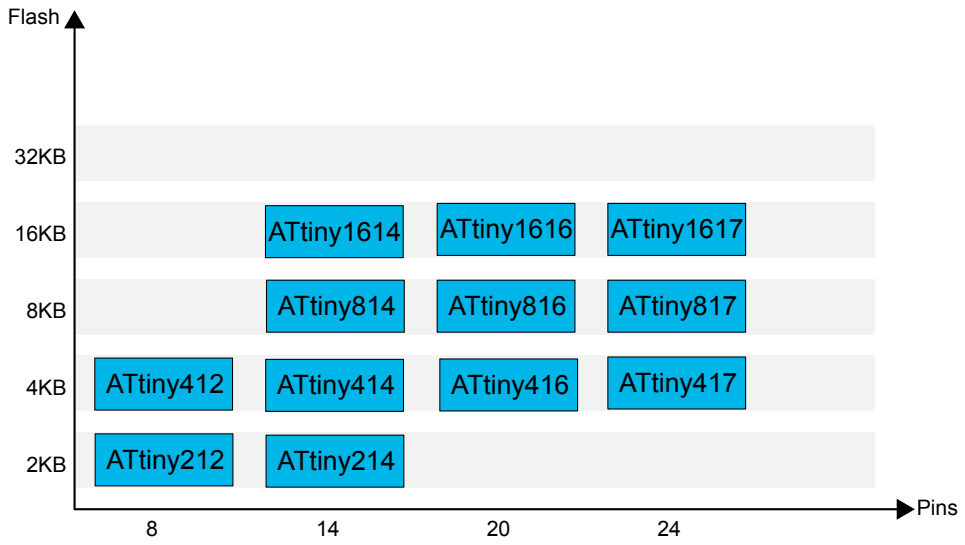
This chapter lists the relevant devices for this document.

1.1 tinyAVR 1-Series

The figure below shows the tinyAVR 1-series devices, illustrating pin count variants and memory sizes.

- Vertical migration upwards is possible without code modification, as these devices are pin compatible and provide the same or more features. Downward migration may require code modification due to fewer available instances of some peripherals.
- Horizontal migration to the left reduces the pin count and therefore the available features.

Figure 1-1. tinyAVR® 1-Series Device Overview

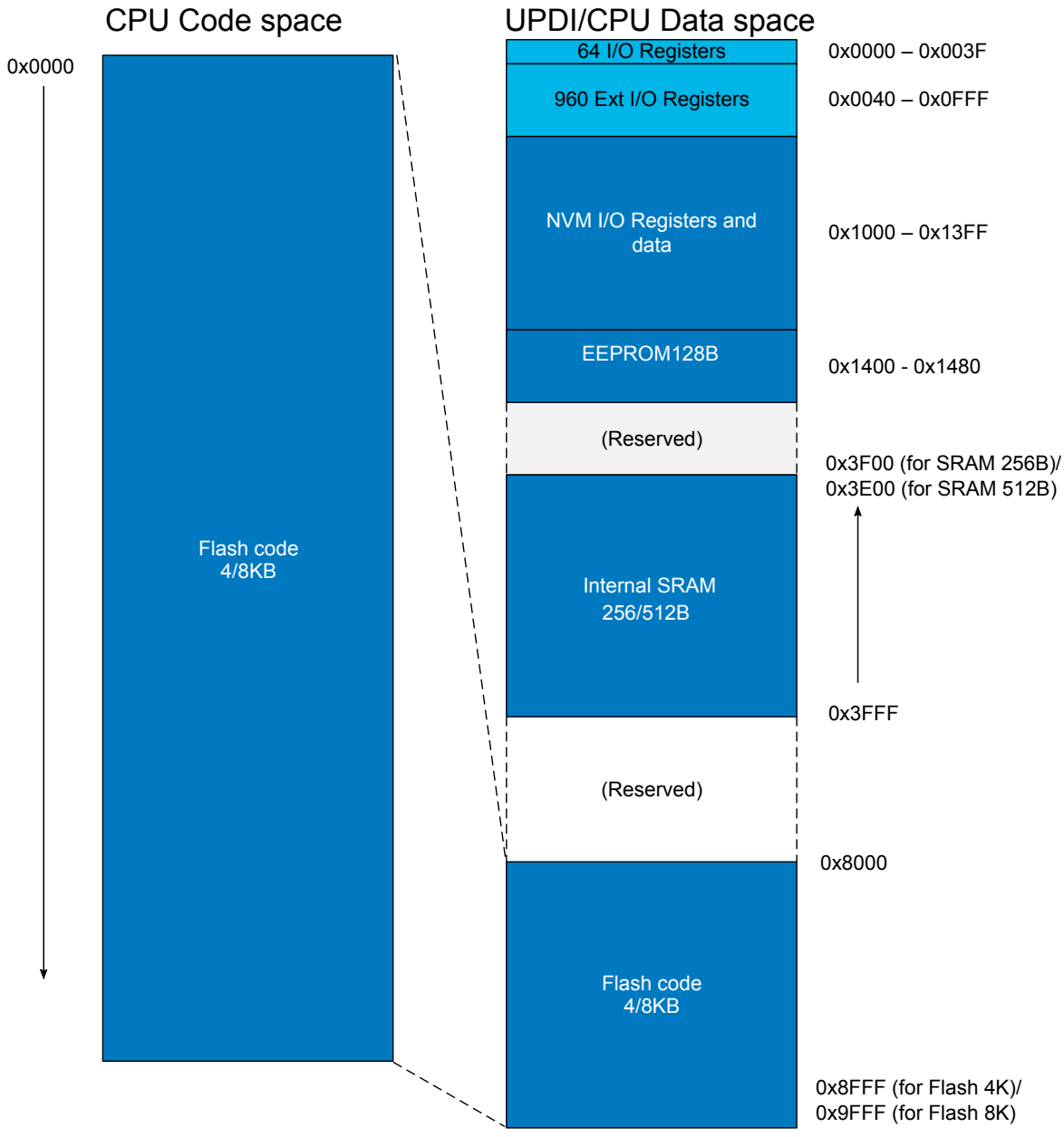


Devices with different Flash memory size typically also have different SRAM and EEPROM.

2. What Has Changed

On tinyAVR® 1-series devices, the Flash memory is included in the CPU data space. This means that it shares the same address space and instructions as SRAM, EEPROM, and I/O registers. This data space is accessible through the use of LD/ST instructions in assembly. On some of the older tinyAVR devices, Flash memory is accessible only through the LPM and SPM instructions. In tinyAVR 1-series devices, the LPM instruction is still available, but the SPM instruction has been removed. For the LPM instruction, address 0x0000 is the start of flash, but for LD and ST it is 0x8000 as shown in the memory map below.

Figure 2-1. Memory Map of tinyAVR 1-series Devices



In addition to these differences, writing to Flash must now be implemented by using the NVM controller. Previously this was done using a combination of the Z-pointer and the SPMCTRL register.

2.1 What This Means and How to Adapt

If existing assembly code that writes to Flash is to be ported from older devices to tinyAVR 1-series devices, the SPM instructions must be replaced by ST instructions. The ST instruction will not be able to access Flash directly, but instead data will be written to the page buffer. This is similar to how it has been done previously, but now page erase and page commits are handled by the NVM controller.

Where one would previously store the address to a page in Flash in the Z-pointer, this is now handled by an Address register in the NVM controller. Note that the Address register in the NVM controller is updated automatically when data is written using the ST instruction. Do not write data to a new page before committing the page buffer. If this is accidentally done, the data intended to be written to the new page will be combined with the data already in the page buffer using a bit-wise AND. The same will happen if data is written to the same address twice without committing the page buffer.

Along with the addresses, the commands to erase a page or write the page buffer are now also located in the NVM controller. The commands should now be written to the Control A register in the NVM controller. See the Control A register in the datasheet for a list of the available commands.

These changes make it necessary to modify code written in C or assembly for older tinyAVRs in order for it to function properly on tinyAVR 1-series devices. Example code is available from Atmel | START that shows how to read and write to both flash and EEPROM on tinyAVR 1-series devices.

2.2 Boot, Application Code, and Application Data Section

It is not possible to write to the section of flash the code is currently executing from. Code writing to the application code section needs to be executing from the boot section, and code writing to the application data section must be executing from either the boot section or the application code section. How large each of the respective sections are is defined by the fuses. There is one BOOTEND fuse and one APPEND variable that control this.

When BOOTEND is zero, the entire Flash is considered to be boot section, the value in APPEND is ignored, and it is not possible to write to Flash.

When BOOTEND is non-zero, the default location of the interrupt vector table pointer will be written to the start of the application code section by default. If no bootloader is used and the interrupt vector is not moved, it is possible to overwrite this by changing the IVSEL bit in the CPUINT_CTRLA register. If the IVSEL bit is changed, the interrupt vector will be pointed to the start of the bootloader section.

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3. Get Source Code from Atmel | START

The example code is available through Atmel | START, which is a web-based tool that enables configuration of application code through a Graphical User Interface (GUI). The code can be downloaded for both Atmel Studio 7.0 and IAR Embedded Workbench® via the direct example code-link(s) below or the *BROWSE EXAMPLES* button on the Atmel | START front page.

Atmel | START web page: http://microchip.com/start

Example Code

NVMCTRL driver tiny817

- http://start.atmel.com/#example/Atmel:Application_AVR_Examples:1.0.0::Application:NVMCTRL_driver_tiny817:

Press *User guide* in Atmel | START for details and information about example projects. The *User guide* button can be found in the example browser, and by clicking the project name in the dashboard view within the Atmel | START project configurator.

Atmel Studio

Download the code as an .atzip file for Atmel Studio from the example browser in Atmel | START, by clicking *DOWNLOAD SELECTED EXAMPLE*. To download the file from within Atmel | START, click *EXPORT PROJECT* followed by *DOWNLOAD PACK*.

Double-click the downloaded .atzip file and the project will be imported to Atmel Studio 7.0.

IAR Embedded Workbench

For information on how to import the project in IAR Embedded Workbench, open the Atmel | START user guide, select *Using Atmel Start Output in External Tools*, and *IAR Embedded Workbench*. A link to the Atmel | START user guide can be found by clicking *About* from the Atmel | START front page or *Help And Support* within the project configurator, both located in the upper right corner of the page.

4. Revision History

Doc. Rev.	Date	Comments
AN1983A	12/2017	Changed document number from Atmel AVR42789 to Microchip's AN1983. Also made minor typographical corrections, and added a section on how to get example code from Atmel | START
42789A	11/2016	Initial document release

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