AVR095: Migrating between ATmega48, ATmega88 and ATmega168

8-bit AVR® Microcontrollers

Application Note

Features

- **Memories**
- **Interrupt Vectors**
- **Boot Loader Support**
- **Programming Interface**

Introduction

The ATmega48, ATmega88, and ATmega168 are designed to be a complete pin and functionality compatible sub family. This was done to ensure the simplest possible migration between the parts. Because of the differences in memory sizes, there may still be a need for some minor modifications in the application.

This application note summarizes the differences between ATmega48, ATmega88 and ATmega168. Refer to the datasheets for detailed information on the devices.

Rev. 2554A-AVR-02/04

Memories

The main difference between ATmega48, ATmega88 and ATmega168 is the difference in memory sizes. Se Table 1 for a comparison of the devices.

Table 1. Comparison of Memory sizes

	ATmega48	ATmega88	ATmega168
FLASH [bytes]	4096	8192	16384
EEPROM [bytes]	256	512	512
SRAM [bytes]	512	1024	1024

Interrupt Vectors

The interrupt vectors in ATmega48, ATmega88 and ATmega168 are generally the same, except that each Interrupt Vector occupies two instruction words in ATmega168, and one instruction word in ATmega48 and ATmega88.

Table 2. Comparison of Interrupt vectors

Vector No.	ATmega48 & ATmega88 Program Address	ATmega168 Program Address	Interrupt Source
1	0x000	0x0000	RESET
2	0x001	0x0002	INT0
3	0x002	0x0004	INT1
4	0x003	0x0006	PCINT0
5	0x004	0x0008	PCINT1
6	0x005	0x000A	PCINT2
7	0x006	0x000C	WDT
8	0x007	0x000E	TIMER2 COMPA
9	0x008	0x0010	TIMER2 COMPB
10	0x009	0x0012	TIMER2 OVF
11	0x00A	0x0014	TIMER1 CAPT
12	0x00B	0x0016	TIMER1 COMPA
13	0x00C	0x0018	TIMER1 COMPB
14	0x00D	0x001A	TIMER1 OVF
15	0x00E	0x001C	TIMER0 COMPA
16	0x00F	0x001E	TIMER0 COMPB
17	0x010	0x0020	TIMER0 OVF
18	0x011	0x0022	SPI, STC
19	0x012	0x0024	USART, RX
20	0x013	0x0026	USART, UDRE
21	0x014	0x0028	USART, TX
22	0x015	0x002A	ADC
23	0x016	0x002C	EE READY
24	0x017	0x002E	ANALOG COMP
25	0x018	0x0030	TWI
26	0x019	0x0032	SPM READY

Boot Loader support

ATmega88 and ATmega168 have Boot Loader Support that provides a Read-While-Write Self-Programming mechanism. In ATmega48, there is no Read-While-Write support, and no separate Boot Loader Section. However, if enabled, the SPM instruction can be executed from any location in the complete Flash. Since there is no Read-While-Write support on ATmega48, the CPU will halt during the SPM operation. Note that if the SPM Interrupt Enable (SPMIE) bit in SPMCSR is set on ATmega48, the interrupt vector will be executed after CPU recovers from the SPM write halt.

The ATmega48 does not have the Boot Loader security lock bits. Nor does it have the Boot Sector size fuses. ATmega48 does instead have a Self Programming Enable (SELFPRGEN) fuse that ATmega88 or ATmega168 does not have.

Although the ATmega48 does not have the Boot Loader Support, it is still possible to use it for all the same operations as a boot loader would be used. When doing so, note that there are no security lock bits to protect the boot loader code from self-destructive erroneous code.

Table 3. Comparison of Boot Sector sizes, listed by boot sector fuse settings.

BOOTSZ1	BOOTSZ0	ATmega48	ATmega88 & ATmega168 [bytes]
0	0	N/A	2048
0	1	N/A	1024
1	0	N/A	512
1	1	N/A	256

Programming Interface

The programming algorithms in ATmega48, ATmega88 and ATmega168 differ to reflect the differences in:

- Memory sizes. Table 1.
- Flash page sizes. Table 4
- Fuses. Table 7
- Lock bits. Table 5
- Signatures. Table 6

Table 4. Comparison of Flash Page sizes

	ATmega48 & ATmega88	ATmega168
Flash Page size [bytes]	64	128

Table 5. Comparison of Lock bits

Bit #	ATmega48	ATmega88 & ATmega168	Description
7	–	–	–
6	–	–	–
5	–	BLB12	Boot Lock bit
4	–	BLB11	Boot Lock bit
3	–	BLB02	Boot Lock bit
2	–	BLB01	Boot Lock bit
1	LB2	LB2	Lock bit
0	LB1	LB1	Lock bit

Table 6- Comparison of device signatures

	ATmega48	ATmega88	ATmega168
Signature	0x1E 0x92 0x05	0x1E 0x93 0x0A	0x1E 0x94 0x06

Table 7. Comparison of Fuses

	Bit #	ATmega48	ATmega88 & ATmega168
Extended Fuse Byte	7	–	–
	6	–	–
	5	–	–
	4	–	–
	3	–	–
	2	–	**BOOTSZ1**
	1	–	**BOOTSZ0**
	0	**SELFPRGEN**	**BOOTRST**
High Fuse Byte	7	RSTDISBL	RSTDISBL
	6	DWEN	DWEN
	5	SPIEN	SPIEN
	4	WDTON	WDTON
	3	EESAVE	EESAVE
	2	BODLEVEL2	BODLEVEL2
	1	BODLEVEL1	BODLEVEL1
	0	BODLEVEL0	BODLEVEL0
Low Fuse Byte	7	CKDIV8	CKDIV8
	6	CKOUT	CKOUT
	5	SUT1	SUT1
	4	SUT0	SUT0
	3	CKSEL3	CKSEL3
	2	CKSEL2	CKSEL2
	1	CKSEL1	CKSEL1
	0	CKSEL0	CKSEL0

Atmel Corporation

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 487-2600

Regional Headquarters

Europe
Atmel Sarl
Route des Arsenaux 41
Case Postale 80
CH-1705 Fribourg
Switzerland
Tel: (41) 26-426-5555
Fax: (41) 26-426-5500

Asia
Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimshatsui
East Kowloon
Hong Kong
Tel: (852) 2721-9778
Fax: (852) 2722-1369

Japan
9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
Tel: (81) 3-3523-3551
Fax: (81) 3-3523-7581

Atmel Operations

Memory
2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 436-4314

Microcontrollers
2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 436-4314

La Chantrerie
BP 70602
44306 Nantes Cedex 3, France
Tel: (33) 2-40-18-18-18
Fax: (33) 2-40-18-19-60

ASIC/ASSP/Smart Cards
Zone Industrielle
13106 Rousset Cedex, France
Tel: (33) 4-42-53-60-00
Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906, USA
Tel: 1(719) 576-3300
Fax: 1(719) 540-1759

Scottish Enterprise Technology Park
Maxwell Building
East Kilbride G75 0QR, Scotland
Tel: (44) 1355-803-000
Fax: (44) 1355-242-743

RF/Automotive
Theresienstrasse 2
Postfach 3535
74025 Heilbronn, Germany
Tel: (49) 71-31-67-0
Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906, USA
Tel: 1(719) 576-3300
Fax: 1(719) 540-1759

Biometrics/Imaging/Hi-Rel MPU/
High Speed Converters/RF Datacom
Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
Tel: (33) 4-76-58-30-00
Fax: (33) 4-76-58-34-80

Literature Requests
www.atmel.com/literature

2554A-AVR-02/04