AVR098: Migration between ATmega169, ATmega329 and ATmega649

8-bit AVR® Microcontrollers

Application Note

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1 Introduction

This application note summarizes the differences between ATmega169, ATmega329 and ATmega649. For detailed information on the devices please refer to the datasheets. Also note that there are separate datasheets and migration notes for Pico Power devices (P suffix in device name).

The ATmega169, ATmega329 and ATmega649 are designed to be a pin and functionality compatible sub family, but because of the differences in memory sizes and other issues mentioned in this application note there may be a need for minor modifications in the application when porting code between the devices.

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2 General porting considerations

To make the porting process as easy as possible, always refer to registers and bit positions using their defined names. Avoid using absolute addresses and values. In most cases, the register and bit names are unchanged from device to device. When you are porting a design, it is more convenient to include the correct definition file for the new device, rather than manually changing all your addresses and bit values. It is also considered good programming practice to use named references instead of absolute values. Some examples are shown below.

```
PORTE |=  (1<<PORTE5);         // Set pin 5 on port E high
DDR   &= ~(1<<PORTE5);         // Set pin 5 on port E as input
// Configure USI
USICR  =  (1<<USISIE)|(0<<USIOIE)|(1<<USIWM1)|(0<<USIWM0)|
          (1<<USICS1)|(0<<USICS0)|(0<<USICLK)|(0<<USITC);
```

To avoid conflicts with added features and register functionality, never access registers that are marked as reserved. Reserved bits should always be written to zero if accessed. This ensures forward compatibility, and that added features will stay in their default states if not used.

3 Register and bit names

In ATmega169 and ATmega329/649, some register bits are in different locations within a register, but neither the registers nor the bits have different names, nor are any bits relocated into other registers. Table 3-1 shows the register bits that have been moved.

Table 3-1. Moved register bits.

Bit names			
PCIE1	PCIE0	PCIF1	PCIF0

In ATmega169 the USART module is named USART, while in ATmega329/649 it is called USART0. This has consequences for all USART register and bit names, and depending on the compiler used this might have consequences when porting the code. Table 3-2 shows the register names for ATmega169 and ATmega329/649

Table 3-2. USART register names

ATmega169 Register name	Atmega169 Bit names	ATmega329/649 Register name	ATmega329/649 Bit names
UDR	RXB[7:0]	UDR0	RXB0[7:0]
	TXB[7:0]		TXB0[7:0]
UCSRA	RXC	UCSR0A	RXC0
	TXC		TXC0
	UDRE		UDRE0
	FE		FE0
	DOR		DOR0
	UPE		UPE0
	U2X		U2X0

	MPCM		MPCM0
UCSRB	RXCIE	UCSR0B	RXCIE0
	TXCIE		TXCIE0
	UDRIEN		UDRIEN0
	RXEN		RXEN0
	TXEN		TXEN0
	UCSZ2		UCSZ02
	RXB8		RXB80
	TXB8		TXB80
UCSRC	-	UCSR0C	-
	UMSEL		UMSEL0
	UPM1		UPM01
	UPM0		UPM00
	USBS		USBS0
	UCSZ1		UCSZ01
	UCSZ0		UCSZ00
	UCPOL		UCPOL0
UBRRH	UBRR[11:8]	UBRR0H	UBRR0[11:8]
UBRRL	UBRR[7:0]	UBRR0L	UBRR0[7:0]

4 Memory

The sizes of the memories are the main difference between the ATmega169 and ATmega329/649. They are all summarized in Table 4-1. The alternatives of the boot flash section size vary from part to part, and are summarized in Table 4-2. When programming the Flash and EEPROM, the memories are accessed in groups by pages. The different page sizes are listed in Table 4-3.

The EEPROM write time is different between ATmega169 and ATmega329/649. Typical programming times are listed in Table 4-4.

Table 4-1. Memory sizes

Device	FLASH [bytes]	SRAM [bytes]	EEPROM [bytes]
ATmega169	16384	1024	512
ATmega329	32768	2048	1024
ATmega649	65536	4096	2048

Table 4-2. Boot flash section sizes

Device	BOOTSZ: 11 [words]	BOOTSZ: 10 [words]	BOOTSZ: 01 [words]	BOOTSZ: 00 [words]
ATmega169	128	256	512	1024
ATmega329	256	512	1024	2048

ATmega649	512	1024	2048	4096

Table 4-3. Programming page sizes

Device	FLASH page size [words]	EEPROM page size [bytes]
ATmega169	64	4
ATmega329	64	4
ATmega649	128	8

Table 4-4. Wait times when programming EEPROM

Device	Typical programming time
ATmega169	8.5 ms
ATmega329/649	3.3 ms

5 Clock sources

The internal RC oscillator in ATmega329/649 is based on a different design than the ATmega169. The OSCCAL register is 8-bit instead of 7-bit, where the high bit selects one of two overlapping frequency ranges. Refer to the datasheets for information on the oscillators.

6 IO pins

ATmega329/649 have an option to disable the external reset feature. The /RESET pin then becomes an input only IO pin. The reset disable feature is not available on ATmega169.

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