
AVR506: Migration from ATmega169 to ATmega169P

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1 Introduction

This application note summarizes the relevant differences when migrating from ATmega169 to ATmega169P. For detailed information on the devices please see the respective datasheets.

The ATmega169P is designed to be pin and functionality compatible with ATmega169, but because of improvements mentioned in this application note there may be a need for minor modifications in the application when migrating from ATmega169 to ATmega169P.



8-bit **AVR**[®]
Microcontrollers

Application Note

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2 General Porting Considerations

To make the porting process as easy as possible, we recommend to always refer to registers and bit positions using their defined names, as absolute addresses and values may change from device to device. When porting a design it is then often just necessary to include the correct definition file. 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 added features will stay in their default states when unused.

3 Register and bit names

Between ATmega169 and ATmega169P some register bits has been added, but none of the existing bits has been removed, nor moved to different locations.

In ATmega169 the USART module is named USART, while in ATmega169P 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 3-1 shows the register names for ATmega169.

Table 3-1. USART register names

| ATmega169 Register name | Atmega169 Bit names | ATmega169P Register name | ATmega169P 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 EEPROM write times are different, and can be seen Table 4-1

Table 4-1. Wait times when programming EEPROM

| Device | Typical programming time |
|------------|--------------------------|
| ATmega169 | 8.5 ms |
| ATmega169P | 3.3 ms |

5 Clock sources

The clock sources for ATmega169P have different characteristics from ATmega169 and might have to be taken into account. The differences are described in the following subsections.

5.1 Internal RC oscillator

The internal RC oscillator in ATmega169P 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 calibration of the oscillators.

5.2 Low-frequency Crystal / Timer/Counter Oscillator

The low frequency / Timer/counter crystal oscillator of the ATmega169P is optimized for very low power consumption and thus the crystal driver strength is reduced compared to the ATmega169. This means that when selecting a crystal, its load capacitance and Equivalent Series Resistance (ESR) must be taken into consideration. Both values are specified by the crystal vendor. Table 5-1 shows the ESR recommendations for ATmega169P. The internal capacitance of ATmega169P low-frequency oscillator is typically 6pF, but the tracks to the crystal will add some additional capacitance.



Table 5-1. ESR and load capacitance recommendation for 32.768 kHz crystals.

| Crystal CL [pF] | Max ESR ¹ [kΩ] |
|-----------------|---------------------------|
| 6.5 | 60 |
| 9 | 35 |

Note: 1. The values stated are for an oscillator allowance safety margin of 5. Since the oscillator's transconductance is temperature compensated one can use a safety margin of 4, thus giving a max ESR of 75 and 45 kΩ respectively.

For examples of crystals that comply with the requirements see Appendix A.

The startup times are also increased as shown in Table 5-2.

Table 5-2. Startup times with 32.768 kHz crystals.

| Crystal CL [pF] | Startup time ² [ms] | |
|-----------------|--------------------------------|------------|
| | ATmega169 | Atmega169P |
| 6.5 | - | 800 |
| 9 | 300 | 1200 |
| 12.5 | 400 | - |

Note: 2. Crystals usually need ~3000ms before they are completely stable with any oscillator design. The time stated is before the crystal is running with a sufficient amplitude and frequency stability.

6 IO pins

ATmega169P 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.

7 Appendix A

Table 7-1 is a selection of crystals that meet the ESR requirements of the ATmega169P. The crystals are listed based on datasheet information and are not tested with the ATmega169P. Any other crystal that complies with the ESR requirements can also be used. Availability and RoHS compliance has not been investigated.

Table 7-1. Examples of crystals compliant with ATmega169P Low-frequency Crystal Oscillator requirements.

| Vendor | Type | Mounting (SMD/HOLE) | Frequency Tolerance [±ppm] | Load Capacitance [pF] | Equivalent Series Resistance (ESR) [kΩ] |
|----------|----------------|---------------------|----------------------------|-----------------------|-----------------------------------------|
| C-MAC | WATCH CRYSTALS | HOLE | 20 | 6 | 50 |
| C-MAC | 85SMX | SMD | 20 | 6 | 55 |
| C-MAC | 90SMX | SMD | 20 | 6 | 60 |
| ECLIPTEK | E4WC | HOLE | 20 | 6 | 50 |
| ENDRICH | 90SMX | SMD | 5 | 6 | 50 |
| EPSON | C-001R | HOLE | 20 | 6 | 35 |

| Vendor | Type | Mounting (SMD/HOLE) | Frequency Tolerance [±ppm] | Load Capacitance [pF] | Equivalent Series Resistance (ESR) [kΩ] |
|--------------|-----------------------|---------------------|----------------------------|-----------------------|-----------------------------------------|
| EPSON | C-002RX | HOLE | 20 | 6 | 50 |
| EPSON | C-004R | HOLE | 20 | 6 | 50 |
| EPSON | C-005R | HOLE | 20 | 6 | 50 |
| EPSON | MC-30A | SMD | 20 | 6 | 50 |
| EPSON | MC-306 | SMD | 20 | 6 | 50 |
| EPSON | MC-405 | SMD | 20 | 6 | 50 |
| EPSON | MC-406 | SMD | 20 | 6 | 50 |
| GOLLEDGE | GWX | HOLE | 5 | 6 | 35 |
| GOLLEDGE | GSWX-26 | SMD | 10 | 6 | 35 |
| GOLLEDGE | GDX1 | HOLE | 10 | 6 | 42 |
| GOLLEDGE | GSX-200 | SMD | 5 | 6 | 50 |
| IQD | WATCH CRYSTALS | HOLE | 20 | 6 | 50 |
| IQD | 90SMX | HOLE | 10 | 6 | 60 |
| IQD | 91SMX | HOLE | 10 | 6 | 60 |
| MICROCRYSTAL | MS2V-T1R | HOLE | 20 | 7 | 65 |
| MICROCRYSTAL | MS3V-T1R | HOLE | 20 | 7 | 65 |
| MMD | WC26 | HOLE | 8 | 6 | 35 |
| MMD | WCSMC | SMD | 20 | 6 | 50 |
| OSCILENT | SERIES 111 | HOLE | 10 | 6 | 30 |
| OSCILENT | SERIES 112 | HOLE | 10 | 6 | 40 |
| OSCILENT | SERIES 223 | SMD | 20 | 6 | 50 |
| RALTRON | SERIES R38 | HOLE | 5 | 6 | 35 |
| RALTRON | SERIES R26 | HOLE | 5 | 6 | 35 |
| RALTRON | SERIES RSE A, B, C, D | SMD | 20 | 6 | 50 |
| SBTRON | SBX-13 | SMD | 20 | 6 | 50 |
| SBTRON | SBX-20 | SMD | 20 | 6 | 50 |
| SBTRON | SBX-21 | SMD | 20 | 6 | 50 |
| SBTRON | SBX-24 | SMD | 20 | 6 | 50 |
| SBTRON | SBX-23 | SMD | 20 | 6 | 50 |
| SBTRON | SBX-22 | SMD | 20 | 6 | 50 |
| SBTRON | SBX-14 | HOLE | 20 | 6 | 50 |
| SUNTSU | SCT1 | HOLE | 20 | 6 | 40 |
| SUNTSU | SCT2 | HOLE | 20 | 6 | 50 |
| SUNTSU | SCT3 | HOLE | 20 | 6 | 50 |
| SUNTSU | SCP1 | SMD | 20 | 6 | 50 |
| SUNTSU | SCT2G | SMD | 20 | 6 | 50 |



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