AVR508: Migration from ATmega644 to ATmega644P

8-bit AVR® Microcontrollers

Application Note

Features

- **General Porting Considerations**
- **Register and bit names**
- **Low-frequency Crystal and Timer/Counter Oscillator**

1 Introduction

This application note summarizes the relevant differences when migrating from ATmega644 to ATmega644P. For detailed information on the devices please see the respective datasheets.

The ATmega644P is designed to be pin and functionality compatible with ATmega644, but because of improvements mentioned in this application note there may be a need for minor modifications in the application when migrating from ATmega644 to ATmega644P.

Further an additional USART has been added making the ATmega644P fully compatible with ATmega164P/324P.

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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 ATmega644 and ATmega644P some register bits has been added, but none of the existing bits has been removed, nor moved to different locations.

4 Low-frequency Crystal and Timer/Counter Oscillator

The low-frequency crystal / Timer/counter oscillator of the ATmega644P is optimized for very low power consumption and thus the crystal driver strength is reduced compared to the ATmega644. 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 4-1 shows the ESR recommendations for ATmega644P. The internal capacitance of ATmega644P low-frequency oscillator is typically 6pF, but the tracks to the crystal will add some additional capacitance.

Table 4-1. ESR recommendation for 32.768 kHz crystals for ATmega644P

Crystal CL [pF]	Max ESR[1] [kΩ]
6.5	75
9	65
12.5	30

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 90, 80 and 40 kΩ respectively.

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

The startup times are also increased as shown in Table 4-2.

Table 4-2. Startup times with 32.768 kHz crystals

Crystal CL [pF]	Startup time[2] [ms] ATmega644	Startup time[2] [ms] ATmega644P
6.5	-	600
9	300	700
12.5	400	1700

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.

5 Appendix A

Table 5-1 is a selection of crystals that meet the ESR requirements of the ATmega644P. The crystals are listed based on datasheet information and are not tested with the actual device. Any other crystal that complies with the ESR requirements can also be used. Availability and RoHS compliance has not been investigated.

Table 5-1. Examples of crystals compliant with ATmega644P low-frequency Crystal Oscillator.

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 -> 12.5 (specify)	35
EPSON	C-002RX	HOLE	20	6 -> 10 (specify)	50
EPSON	C-004R	HOLE	20	6 -> 10 (specify)	50
EPSON	C-005R	HOLE	20	6 -> 10 (specify)	50
EPSON	MC-30A	SMD	20	6 -> 10 (specify)	50
EPSON	MC-306	SMD	20	6 -> 10 (specify)	50
EPSON	MC-405	SMD	20	6 -> 10 (specify)	50
EPSON	MC-406	SMD	20	6 -> 10 (specify)	50
GOLLEDGE	GWX	HOLE	5	6, 8 or 12.5	35
GOLLEDGE	GSWX-26	SMD	10	6 , 8 or 12.5	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

Vendor	Type	Mounting (SMD/HOLE)	Frequency Tolerance [±ppm]	Load Capacitance [pF]	Equivalent Series Resistance (ESR) [kΩ]
MICROCRYSTAL	MS3V-T1R	HOLE	20	7 or 9	65
MICROCRYSTAL	MS2V-T1R	HOLE	20	7 or 9	65
MICROCRYSTAL	CC4V-T1A	SMD	30	9	65
MICROCRYSTAL	CC1V-T1A	SMD	30	9	60
MICROCRYSTAL	CC7V-T1A	SMD	30	9	70
MMD	WC26	HOLE	8	8	35
MMD	WC38	HOLE	8	8	35
MMD	WC155	HOLE	8	8	40
MMD	WCSMC	SMD	20	6	50
OSCILENT	SERIES 111	HOLE	10	6 or 12.5	30
OSCILENT	SERIES 112	HOLE	10	6 or 12.5	40
OSCILENT	SERIES 113	HOLE	10	8	40
OSCILENT	SERIES 223	SMD	20	6	50
RALTRON	SERIES R38	HOLE	5	6 or 12.5	35
RALTRON	SERIES R26	HOLE	5	6 or 12.5	35
RALTRON	SERIES R145	HOLE	5	8	40
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, 8, 10 or 12.5	40
SUNTSU	SCT2	HOLE	20	6, 8, 10	50
SUNTSU	SCT3	HOLE	20	6, 8, 10	50
SUNTSU	SCP1	SMD	20	6	50
SUNTSU	SCT2G	SMD	20	6 or 10	50

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