AVR532: Migration from ATmega48/88/168 to ATmega48A/88A/168A

8-bit AVR® Microcontrollers

Application Note

1 Introduction

The ATmega48A/88A/168A is a functionally identical, drop-in replacement for the ATmega48/88/168. All devices are subject to the same qualification process and same set of production tests, but as the manufacturing process is not the same some electrical characteristics differ.

ATmega48/88/168 and ATmega48A/88A/168A have separate datasheets. This application note outlines the differences between the two devices and the datasheets. There is also a detailed change log to assist the user at the end of the ATmega48A/88A/168A datasheet. Remember to always use the latest revision of the device datasheet.

Minor differences in typical characteristics are not discussed in this document as long as the low and high limits remain the same. For detailed information about the typical characteristics, see sections “Electrical Characteristics” and “Typical Characteristics” of the device datasheets.

Note: This application note serves as a guide to ease migration. For complete device details, always refer to the most recent version of the ATmega48A/88A/168A data sheet.

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2 Changes in Characteristics

This section outlines such differences in characteristics that may have an effect on the application in which the device is used. For detailed information, refer to the most recent version of the device data sheets.

2.1 Reset

The table below summarizes the differences between the reset threshold parameters of ATmega48/88/168 and that of ATmega48A/88A/168A.

Table 2-4. Power-On Reset threshold voltage

Symbol	ATmega48/88/168			ATmega48A/88A/168A			Unit
	Min	Typ	Max	Min	Typ	Max	
V_{POT} Rising	0.7	1.0	1.4	1.1	1.4	1.6	V
V_{POT} Falling	0.05	0.9	1.3	0.6	1.3	1.6	V

2.2 TWI

If another interrupt (e.g., INT0) occurs during TWI Power-down address match and wakes up the CPU in ATmega48/88/168, the TWI aborts operation and return to it's idle state.

This limitation is not present in ATmega48A/88A/168A

2.3 Analog MUX errata

In ATmega48A/88A/168A there is an errata affecting the analog MUXes. When migrating from ATmega48/88/168 it must be checked if this errata will affect program execution and the documented workaround should be applied.

See the errata section of the ATmega48A/88A/168A data sheet for details.

2.4 Low-frequency Crystal Oscillator

In ATmega48A/88A/168A the crystal driver strength of the Low Frequency Crystal Oscillator is reduced compared to the ATmega48/88/168. 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. The internal capacitance of ATmega48A/88A/168A low-frequency oscillator is typically 6pF, but the tracks to the crystal will add some additional capacitance. Table 2-5 shows the ESR recommendations for ATmega48A/88A/168A.

Table 2-5**.** ESR recommendation for 32.768 kHz crystals for ATmega48A/88A/168A.

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 the comply with the requirements see Appendix A

The startup times are increased as shown in Table 2-6.

Table 2-6. Startup times with 32.768 kHz crystals.

Crystal CL [pF]	Startup time[2] [ms] Atmega48/88/168	Startup time[2] [ms] Atmega48A/88A/168A
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.

3 Appendix A

Table 4-1 is a selection of crystals that meet the ESR requirements of the ATmega48A/88A/168A. 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 4-1. Examples of crystals compliant with ATmega48P/88P/168P 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
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

Vendor	Type	Mounting (SMD/HOLE)	Frequency Tolerance [±ppm]	Load Capacitance [pF]	Equivalent Series Resistance (ESR) [kΩ]
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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