
Atmel AVR534: Migration from ATmega645/6450/649/6490 to ATmega645P/6450P/649P/6490P



8-bit Atmel Microcontrollers

Application Note

1 Introduction

In order to optimize the manufacturing process and to further reduce current consumption, an optimized version of Atmel® ATmega645/6450/649/6490 has been introduced.

The Atmel ATmega645P/6450P/649P/6490P is an upwards compatible, drop-in replacement for the ATmega645/6450/649/6490. All devices are subject to the same qualification process and same set of production tests, but some electrical characteristics differ. The ATmega645P/6450P/649P/6490P devices are picoPower® megaAVR® microcontrollers and have lower power consumption and additional power saving features compared to the ATmega645/6450/649/6490.

ATmega645/6450/649/6490 and ATmega645P/6450P/649P/6490P have separate datasheets. This application note outlines the differences between the two devices and between the datasheets. There is also a detailed change log to assist the user at the end of the ATmega645P/6450P/649P/6490P 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 ATmega645P/6450P/649P/6490P datasheet.

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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 datasheets.

2.1 Reset

[Table 2-1](#) summarizes the differences between the reset threshold parameters of Atmel ATmega645/6450/649/6490 and Atmel ATmega645P/6450P/649P/6490P.

Table 2-1. Power-on reset threshold voltage.

Symbol	ATmega645/6450/649/6490			ATmega645P/6450P/649P/6490P			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 Low frequency crystal oscillator

In ATmega645P/6450P/649P/6490P the crystal driver strength of the low frequency crystal oscillator is reduced compared to the ATmega645/6450/649/6490. 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 the ATmega645P/6450P/649P/6490P low-frequency oscillator is typically 6pF, but the tracks to the crystal will add some additional capacitance. [Table 2-2](#) shows the ESR recommendations for ATmega645P/6450P/649P/6490P.

Table 2-2. ESR recommendation for 32.768kHz crystals for ATmega645P/6450P/649P/6490P.

Crystal CL [pF]	Maximum ESR ⁽¹⁾ [kΩ]
6.5	75
9.0	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 40kΩ respectively.

For examples of crystals that comply with the requirements, see [Appendix A](#).

The startup times are increased as shown in [Table 2-3](#).

Table 2-3. Startup times with 32.768kHz crystals.

Crystal CL [pF]	Startup time ⁽¹⁾ [ms]	Startup time ⁽¹⁾ [ms]
	ATmega645/6450/649/6490	ATmega645P/6450P/649P/6490P
6.5	-	600
9.0	300	700
12.5	400	1700

Note: 1. 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 Signature bytes

Table 3-1 summarizes the differences between the signature bytes of Atmel ATmega645/6450/649/6490 and Atmel ATmega645P/6450P/649P/6490P.

Table 3-1. Device and JTAG ID.

Part	Signature bytes address			JTAG	
	0x000	0x001	0x002	Part number	Manufacture ID
ATmega645	0x1E	0x96	0x05	9605	0x1F
ATmega645P	0x1E	0x96	0x0D	960D	0x1F
ATmega6450	0x1E	0x96	0x06	9606	0x1F
ATmega6450P	0x1E	0x96	0x0E	960E	0x1F
ATmega649	0x1E	0x96	0x03	9603	0x1F
ATmega649P	0x1E	0x96	0x0B	960B	0x1F
ATmega6490	0x1E	0x96	0x04	9604	0x1F
ATmega6490P	0x1E	0x96	0x0C	960C	0x1F



4 Datasheet changes

For a summary of changes, see the revision history at the end of the Atmel ATmega645P/6450P/649P/6490P datasheet.

5 Appendix A

Table 5-1 is a selection of crystals that meet the ESR requirements of the Atmel ATmega645P/6450P/649P/6490P. 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 ATmega645P/6450P/649P/6490P 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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