



ATMEL[®] CORPORATION

AVR[®] Microcontrollers: Product Line Reference

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1 AVR Product Family

1.1 Product Selection Guide - tinyAVR®

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 10bit (Channels)	Ana.Comp.	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATtiny12	P	1	64	c)	6		1								Y	Y	Y	Y		6	2	1.8-5.5V	1,2	PDIP8, SOIC8	Y	-40°C to +85°C	
	P	1	64	c)	6		1						Y		Y	Y	Y			6	2	2.7-5.5V	4	PDIP8, SOIC8	Y	-40°C to +85°C	
	P	1	64	c)	6		1						Y		Y	Y	Y			6	2	4.0-5.5V	8	PDIP8, SOIC8	Y	-40°C to +85°C	
ATtiny13	P	1	64	64	6		1	2					Y	4	Y	Y	Y	Y		10	2	Y	1.8-5.5V	10	MLF20, MLF10, PDIP8, SOIC8	Y	-40°C to +85°C
	P	1	64	64	6		1	2					Y	4	Y	Y	Y	Y		10	2	Y	2.7-5.5V	20	MLF20, MLF10, PDIP8, SOIC8	Y	-40°C to +85°C
ATtiny2313	P	2	128	128	18	1	1	4		USI	1	USI	Y		Y	Y	Y	Y		19	3	Y	1.8-5.5V	10	MLF20, PDIP20, SOIC20	Y	-40°C to +85°C
	P	2	128	128	18	1	1	4		USI	1	USI	Y		Y	Y	Y	Y		19	3	Y	2.7-5.5V	20	MLF20, PDIP20, SOIC20	Y	-40°C to +85°C
ATtiny24	P	2	128	128	12	1	1	4		USI		USI	Y	8	Y	Y	Y	Y		17	3	Y	1.8-5.5V	10	MLF20, PDIP14, SOIC14	Y	-40°C to +85°C
	P	2	128	128	12	1	1	4		USI		USI	Y	8	Y	Y	Y	Y		17	3	Y	2.7-5.5V	20	MLF20, PDIP14, SOIC14	Y	-40°C to +85°C
ATtiny25	P	2	128	128	6		2 e)	4 f)		USI		USI	Y	4	Y	Y	Y	Y		15	2	Y	1.8-5.5V	10	MLF20, PDIP8, SOIC8	Y	-40°C to +85°C
	P	2	128	128	6		2 e)	4 f)		USI		USI	Y	4	Y	Y	Y	Y		15	2	Y	2.7-5.5V	20	MLF20, PDIP8, SOIC8	Y	-40°C to +85°C
ATtiny26	P	2	128	128	16		2	2		USI		USI	Y	11	Y	Y	Y	Y		12	2		2.7-5.5V	8	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
	P	2	128	128	16		2	2		USI		USI	Y	11	Y	Y	Y	Y		12	2		4.5-5.5V	16	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
ATtiny261	P	2	128	128	16	1	1 e)	5 g)		USI		USI	Y	11	Y	Y	Y	Y		19	3	Y	1.8-5.5V	10	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
	P	2	128	128	16	1	1 e)	5 g)		USI		USI	Y	11	Y	Y	Y	Y		19	3	Y	2.7-5.5V	20	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
ATtiny28	P	2		c)	11		1								Y		Y	Y		6	2		1.8-5.5V	1,2	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	P	2		c)	11		1								Y		Y	Y		6	2		2.7-5.5V	4	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATtiny44	P	4	256	256	12	1	1	4		USI		USI	Y	8	Y	Y	Y	Y		17	3	Y	1.8-5.5V	10	MLF20, PDIP14, SOIC14	Y	-40°C to +85°C
	P	4	256	256	12	1	1	4		USI		USI	Y	8	Y	Y	Y	Y		17	3	Y	2.7-5.5V	20	MLF20, PDIP14, SOIC14	Y	-40°C to +85°C
ATtiny45	P	4	256	256	6		2 e)	4 f)		USI		USI	Y	4	Y	Y	Y	Y		15	2	Y	1.8-5.5V	10	MLF20, PDIP8, SOIC8	Y	-40°C to +85°C
	P	4	256	256	6		2 e)	4 f)		USI		USI	Y	4	Y	Y	Y	Y		15	2	Y	2.7-5.5V	20	MLF20, PDIP8, SOIC8	Y	-40°C to +85°C
ATtiny461	P	4	256	256	16	1	1 e)	5 g)		USI		USI	Y	11	Y	Y	Y	Y		19	3	Y	1.8-5.5V	10	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
	P	4	256	256	16	1	1 e)	5 g)		USI		USI	Y	11	Y	Y	Y	Y		19	3	Y	2.7-5.5V	20	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
ATtiny84	I	8	512	512	12	1	1	4		USI		USI	Y	8	Y	Y	Y	Y		17	3	Y	1.8-5.5V	10	MLF20, PDIP14, SOIC14	Y	-40°C to +85°C
	I	8	512	512	12	1	1	4		USI		USI	Y	8	Y	Y	Y	Y		17	3	Y	2.7-5.5V	20	MLF20, PDIP14, SOIC14	Y	-40°C to +85°C
ATtiny85	P	8	512	512	6		2 e)	4 f)		USI		USI	Y	4	Y	Y	Y	Y		15	2	Y	1.8-5.5V	10	MLF20, PDIP8, SOIC8	Y	-40°C to +85°C
	P	8	512	512	6		2 e)	4 f)		USI		USI	Y	4	Y	Y	Y	Y		15	2	Y	2.7-5.5V	20	MLF20, PDIP8, SOIC8	Y	-40°C to +85°C
ATtiny861	P	8	512	512	16	1	1 e)	5 g)		USI		USI	Y	11	Y	Y	Y	Y		19	3	Y	1.8-5.5V	10	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C
	P	8	512	512	16	1	1 e)	5 g)		USI		USI	Y	11	Y	Y	Y	Y		19	3	Y	2.7-5.5V	20	MLF32, PDIP20, SOIC20	Y	-40°C to +85°C



1.2 Product Selection Guide - megaAVR®

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (2C)	ISP	ADC 10bit (Channels)	Ana.Comp.	BOD	WDT	Int. RC	PWM/MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATmega48	P	4	256	512	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, MLF28, PDIP28	Y	-40°C to +85°C
	P	4	256	512	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, MLF28, PDIP28	Y	-40°C to +85°C
ATmega8	P	8	512	1K	23	1	2	3	Y		1	Y	Y	8	Y	Y	Y	Y	Y	19	2	Y	2.7-5.5V	8	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	P	8	512	1K	23	1	2	3	Y		1	Y	Y	8	Y	Y	Y	Y	Y	19	2	Y	4.5-5.5V	16	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega88	P	8	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	P	8	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega8515	P	8	512	512	35	1	1	3			1	Y	Y		Y	Y	Y	Y	Y	17	3	Y	2.7-5.5V	8	TQFP44, PLCC44, MLF44, PDIP40	Y	-40°C to +85°C
	P	8	512	512	35	1	1	3			1	Y	Y		Y	Y	Y	Y	Y	17	3	Y	4.5-5.5V	16	TQFP44, PLCC44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega8535	P	8	512	512	32	1	2	4			1	Y	Y	8	Y	Y	Y	Y	Y	21	3	Y	2.7-5.5V	8	TQFP44, PLCC44, MLF44, PDIP40	Y	-40°C to +85°C
	P	8	512	512	32	1	2	4			1	Y	Y	8	Y	Y	Y	Y	Y	21	3	Y	4.5-5.5V	16	TQFP44, PLCC44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega16	P	16	512	1K	32	1	2	4	Y		1	Y	Y	8	Y	Y	Y	Y	Y	21	3	Y	2.7-5.5V	8	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	16	512	1K	32	1	2	4	Y		1	Y	Y	8	Y	Y	Y	Y	Y	21	3	Y	4.5-5.5V	16	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega162	P	16	512	1K	35	2	2	6	Y		1	2	Y		Y	Y	Y	Y	Y	28	5	Y	1.8-5.5V	8	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	16	512	1K	35	2	2	6	Y		1	2	Y		Y	Y	Y	Y	Y	28	5	Y	2.7-5.5V	16	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega168	P	16	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	P	16	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega32	P	32	1K	2K	32	1	2	4	Y		1	Y	Y	8	Y	Y	Y	Y	Y	21	3	Y	2.7-5.5V	8	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	32	1K	2K	32	1	2	4	Y		1	Y	Y	8	Y	Y	Y	Y	Y	21	3	Y	4.5-5.5V	16	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega325	P	32	1K	2K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	32	1K	2K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega3250	I	32	1K	2K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	24	5	Y	1.8-5.5V	8	TQFP100	Y	-40°C to +85°C
	I	32	1K	2K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	24	5	Y	2.7-5.5V	16	TQFP100	Y	-40°C to +85°C
ATmega64	P	64	2K	4K	54	2	2	6+2	Y		1	2	Y	8	Y	Y	Y	Y	Y	35	8	Y	2.7-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	64	2K	4K	54	2	2	6+2	Y		1	2	Y	8	Y	Y	Y	Y	Y	35	8	Y	4.5-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega640	P	64	4K	8K	86	4	2	12+4	Y	1+USART	4	Y	Y	16	Y	Y	Y	Y	Y	57	11	Y	1.8-5.5V	8	TQFP100, CBGA100	Y	-40°C to +85°C
	P	64	4K	8K	86	4	2	12+4	Y	1+USART	4	Y	Y	16	Y	Y	Y	Y	Y	57	11	Y	2.7-5.5V	16	TQFP100, CBGA100	Y	-40°C to +85°C
ATmega644	P	64	2K	4K	32	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	28	7	Y	1.8-5.5V	10	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	64	2K	4K	32	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	28	7	Y	2.7-5.5V	20	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega645	P	64	2K	4K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	64	2K	4K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega6450	I	64	2K	4K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	24	5	Y	1.8-5.5V	8	TQFP100	Y	-40°C to +85°C
	I	64	2K	4K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	24	5	Y	2.7-5.5V	16	TQFP100	Y	-40°C to +85°C
ATmega128	P	128	4K	4K	53	2	2	6+2	Y		1	2	Y	8	Y	Y	Y	Y	Y	35	8	Y	2.7-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	128	4K	4K	53	2	2	6+2	Y		1	2	Y	8	Y	Y	Y	Y	Y	35	8	Y	4.5-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega1280	P	128	4K	8K	86	4	2	12+4	Y	1+USART	4	Y	Y	16	Y	Y	Y	Y	Y	57	11	Y	1.8-5.5V	8	TQFP100, CBGA100	Y	-40°C to +85°C
	P	128	4K	8K	86	4	2	12+4	Y	1+USART	4	Y	Y	16	Y	Y	Y	Y	Y	57	11	Y	2.7-5.5V	16	TQFP100, CBGA100	Y	-40°C to +85°C
ATmega1281	P	128	4K	8K	54	4	2	6+4	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	48	10	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	128	4K	8K	54	4	2	6+4	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	48	10	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega2560	P	256	4K	8K	86	4	2	12+4	Y	1+USART	4	Y	Y	16	Y	Y	Y	Y	Y	57	11	Y	1.8-5.5V	8	TQFP100, CBGA100	Y	-40°C to +85°C
	P	256	4K	8K	86	4	2	12+4	Y	1+USART	4	Y	Y	16	Y	Y	Y	Y	Y	57	11	Y	4.5-5.5V	16	TQFP100, CBGA100	Y	-40°C to +85°C
ATmega2561	P	256	4K	8K	54	4	2	6+4	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	48	10	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	256	4K	8K	54	4	2	6+4	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	48	10	Y	4.5-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C



1.3 Product Selection Guide – picoPower™ AVR

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 10bit (Channels)	Ana.Comp.	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATmega48P	P	4	256	512	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	P	4	256	512	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega88P	I	8	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	I	8	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega164P	P	16	512	1K	32	1	2	6	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	31	7	Y	1.8-5.5V	10	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	16	512	1K	32	1	2	6	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	31	7	Y	2.7-5.5V	20	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega165P	P	16	512	1K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	16	512	1K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega168P	P	16	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	P	16	512	1K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega324P	P	32	1K	2K	32	1	2	6	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	31	7	Y	1.8-5.5V	10	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	32	1K	2K	32	1	2	6	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	31	7	Y	2.7-5.5V	20	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega325P	I	32	1K	2K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	1.8-5.5V	10	TQFP64, MLF64	Y	-40°C to +85°C
	I	32	1K	2K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	22	3	Y	2.7-5.5V	20	TQFP64, MLF64	Y	-40°C to +85°C
ATmega3250P	I	32	1K	2K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	24	5	Y	1.8-5.5V	10	TQFP100	Y	-40°C to +85°C
	I	32	1K	2K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	24	5	Y	2.7-5.5V	20	TQFP100	Y	-40°C to +85°C
ATmega328P	I	32	1K	2K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	1.8-5.5V	10	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
	I	32	1K	2K	23	1	2	6	Y	1+USART	1	Y	Y	8	Y	Y	Y	Y	Y	26	5	Y	2.7-5.5V	20	TQFP32, MLF32, PDIP28	Y	-40°C to +85°C
ATmega644P	P	64	2K	4K	32	1	2	6	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	31	7	Y	1.8-5.5V	10	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
	P	64	2K	4K	32	1	2	6	Y	1+USART	2	Y	Y	8	Y	Y	Y	Y	Y	31	7	Y	2.7-5.5V	20	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega169P	P	16	512	1K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	23	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	16	512	1K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	23	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega329P	P	32	1K	2K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	23	3	Y	1.8-5.5V	10	TQFP64, MLF64	Y	-40°C to +85°C
	P	32	1K	2K	54	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	23	3	Y	2.7-5.5V	20	TQFP64, MLF64	Y	-40°C to +85°C
ATmega3290P	I	32	1K	2K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	25	5	Y	1.8-5.5V	10	TQFP100	Y	-40°C to +85°C
	I	32	1K	2K	69	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	Y	25	5	Y	2.7-5.5V	20	TQFP100	Y	-40°C to +85°C



1.4 Product Selection Guide – AVR XMEGA™

Product	Status	Flash (KBytes)	Boot code (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	DMA (Channels)	Event (Channels)	I/O	Timers 16bit	PWM (Channels)	RTC 16-bit	SPI	TWI (I2C)	USART	ADC 12bit (Channels)	DAC 12bit (Channels)	Ana.Comp.	BOD	WDT	Calibrated Int. RC	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	JTAG	PDI	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATxmega64A1	I	64	4	2K	4K	4	8	78	8	24	Y	4	4	8	2x8	2x2	4	Y	Y	32MHz, 2MHz, 32kHz	122	78	Y	Y	1.8-3.6V	32	TQFP100, CBGA100	Y	-40°C to +85°C
ATxmega128A1	I	128	8	2K	8K	4	8	78	8	24	Y	4	4	8	2x8	2x2	4	Y	Y	32MHz, 2MHz, 32kHz	122	78	Y	Y	1.8-3.6V	32	TQFP100, CBGA100	Y	-40°C to +85°C
ATxmega256A1	I	256	8	4K	16K	4	8	78	8	24	Y	4	4	8	2x8	2x2	4	Y	Y	32MHz, 2MHz, 32kHz	122	78	Y	Y	1.8-3.6V	32	TQFP100, CBGA100	Y	-40°C to +85°C
ATxmega64A3	I	64	4	2K	4K	4	8	50	8	24	Y	4	2	8	2x8	1x2	4	Y	Y	32MHz, 2MHz, 32kHz	102	50	Y	Y	1.8-3.6V	32	TQFP64, MLF64	Y	-40°C to +85°C
ATxmega128A3	I	128	8	2K	8K	4	8	50	8	24	Y	4	2	8	2x8	1x2	4	Y	Y	32MHz, 2MHz, 32kHz	102	50	Y	Y	1.8-3.6V	32	TQFP64, MLF64	Y	-40°C to +85°C
ATxmega256A3	I	256	8	4K	16K	4	8	50	8	24	Y	4	2	8	2x8	1x2	4	Y	Y	32MHz, 2MHz, 32kHz	102	50	Y	Y	1.8-3.6V	32	TQFP64, MLF64	Y	-40°C to +85°C
ATxmega16A4	I	16	4	1K	2K	4	8	36	5	16	Y	2	3	5	1x12	1x2	2	Y	Y	32MHz, 2MHz, 32kHz	81	36	N	Y	1.8-3.6V	32	TQFP44, MLF44	Y	-40°C to +85°C
ATxmega32A4	I	32	4	2K	4K	4	8	36	5	16	Y	2	3	5	1x12	1x2	2	Y	Y	32MHz, 2MHz, 32kHz	81	36	N	Y	1.8-3.6V	32	TQFP44, MLF44	Y	-40°C to +85°C
ATxmega64A4	I	64	4	2K	4K	4	8	36	5	16	Y	2	3	5	1x12	1x2	2	Y	Y	32MHz, 2MHz, 32kHz	81	36	N	Y	1.8-3.6V	32	TQFP44, MLF44	Y	-40°C to +85°C
ATxmega128A4	I	128	4	2K	8K	4	8	36	5	16	Y	2	3	5	1x12	1x2	2	Y	Y	32MHz, 2MHz, 32kHz	81	36	N	Y	1.8-3.6V	32	TQFP44, MLF44	Y	-40°C to +85°C



1.5 Product Selection Guide - AVR for LCD

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	LCD	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 10bit (Channels)	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATmega169P	P	16	512	1K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	16	512	1K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega329	P	32	1K	2K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	32	1K	2K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega329P	P	32	1K	2K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	1.8-5.5V	10	TQFP64, MLF64	Y	-40°C to +85°C
	P	32	1K	2K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	2.7-5.5V	20	TQFP64, MLF64	Y	-40°C to +85°C
ATmega3290	P	32	1K	2K	69	4x40 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	25	5	Y	1.8-5.5V	8	TQFP100	Y	-40°C to +85°C
	P	32	1K	2K	69	4x40 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	25	5	Y	2.7-5.5V	16	TQFP100	Y	-40°C to +85°C
ATmega3290P	I	32	1K	2K	69	4x40 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	25	5	Y	1.8-5.5V	10	TQFP100	Y	-40°C to +85°C
	I	32	1K	2K	69	4x40 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	25	5	Y	2.7-5.5V	20	TQFP100	Y	-40°C to +85°C
ATmega649	P	64	2K	4K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	1.8-5.5V	8	TQFP64, MLF64	Y	-40°C to +85°C
	P	64	2K	4K	54	4x25 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	23	3	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
ATmega6490	I	64	2K	4K	69	4x40 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	25	5	Y	1.8-5.5V	8	TQFP100	Y	-40°C to +85°C
	I	64	2K	4K	69	4x40 seg	1	2	4	Y	1+USI	1	USI	Y	8	Y	Y	Y	Y	25	5	Y	2.7-5.5V	16	TQFP100	Y	-40°C to +85°C



1.6 Product Selection Guide - AVR for Smart Battery

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	Bat.Prot.	CC-ADC (Channels)	FET type	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 12bit (Channels)	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATmega406	P	40	512	2K	18		1		1	1	1		1		Y	Y	10	Y	Y	Y	Y	23	6	Y	4.0-25V	1	LQFP48	Y	-30°C to +85°C
ATmega16HVA	I	16	256	512	6	1	1		2				1		Y		5	Y	Y	Y	Y	21	3	Y	1.8-9.0V	4	LGA36, TSOP28	Y	-20°C to +85°C

1.7 Product Selection Guide - AVR for USB

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	USB Host/OTG	USB DRAM (Bytes)	USB Endpoints	USB Full speed	USB Low speed	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 10bit (Channels)	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
AT90USB82	P	8	512	512	22		176	4	Y		1	1	5		1	1		Y		Y	Y	Y		29	10	Y	2.7-5.5V	16	MLF32	Y	-40°C to +85°C
AT90USB162	P	16	512	512	22		176	4	Y		1	1	5		1	1		Y		Y	Y	Y		29	10	Y	2.7-5.5V	16	TQFP32, MLF32	Y	-40°C to +85°C
AT90USB646	P	64	2K	4K	48		832	7	Y	Y	2	2	6+2	Y	1	1	Y	Y	8	Y	Y	Y	Y	38	9	Y	2.7-5.5V	16	MLF64	Y	-40°C to +85°C
AT90USB647	P	64	2K	4K	48	1	832	7	Y	Y	2	2	6+2	Y	1	1	Y	Y	8	Y	Y	Y	Y	38	9	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
AT90USB1286	P	128	4K	8K	48		832	7	Y	Y	2	2	6+2	Y	1	1	Y	Y	8	Y	Y	Y	Y	38	9	Y	2.7-5.5V	16	MLF64	Y	-40°C to +85°C
AT90USB1287	P	128	4K	8K	48	1	832	7	Y	Y	2	2	6+2	Y	1	1	Y	Y	8	Y	Y	Y	Y	38	9	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C



1.8 Product Selection Guide - AVR for CAN

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	CAN (CAN mess.obj.)	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 10bit (Channels)	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	V _{cc} (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
AT90CAN32	P	32	1K	2K	53	15	2	2	6+2	Y	1	2	Y	Y	8	Y	Y	Y	Y	37	8	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
AT90CAN64	I	64	2K	4K	53	15	2	2	6+2	Y	1	2	Y	Y	8	Y	Y	Y	Y	37	8	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C
AT90CAN128	P	128	4K	4K	53	15	2	2	6+2	Y	1	2	Y	Y	8	Y	Y	Y	Y	37	8	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +85°C

1.9 Product Selection Guide - AVR for Lighting and Motor Control

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	DALI	Timers 16bit	Timers 8bit	PWM (Channels)	RTC	SPI	USART	TWI (I2C)	ISP	ADC 10bit (Channels)	BOD	WDT	Int. RC	HW MULT	Interrupts (Interrupts)	Interrupts Ext. (Interrupts)	SPM	V _{cc} (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
AT90PWM1	P	8	512	512	19		1	1	7		1	1		Y	8	Y	Y	Y	Y	26	4	Y	2.7-5.5V	16	SOIC24	Y	-40°C to +105°C
AT90PWM2	P	8	512	512	19	Y	1	1	7	Y	1	1		Y	8	Y	Y	Y	Y	29	4	Y	2.7-5.5V	16	SOIC24	Y	-40°C to +105°C
AT90PWM3	P	8	512	512	27	Y	1	1	10	Y	1	1		Y	11	Y	Y	Y	Y	29	4	Y	2.7-5.5V	16	QFN32, SOIC32	Y	-40°C to +105°C
AT90PWM216	P	16	512	1024	19	Y	1	1	7	Y	1	1		Y	8	Y	Y	Y	Y	29	4	Y	2.7-5.5V	16	SOIC24	Y	-40°C to +105°C
AT90PWM316	P	16	512	1024	27	Y	1	1	10	Y	1	1		Y	11	Y	Y	Y	Y	29	4	Y	2.7-5.5V	16	QFN32, SOIC32	Y	-40°C to +105°C



1.10 Product Selection Guide – AVR Z-Link®

Product	Status	MCU	RF dev	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	ISM Band (GHz)	ISM Sensitivity (dBm)	ISM Output Power (dBm)	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
AT86RF230	P					128	2,4	-101	-17 to 3	1.8-3.6V	0	QFN32	Y	-40°C to +85°C
ATmega64RZA	I	ATmega644	AT86RF230	64	2K	4K	2,4	-101	3	1.8-3.6V	10	TQFP44, MLF44, PDIP40	Y	-40°C to +85°C
ATmega64RZAP	I	ATmega644P	AT86RF230	64	2K	4K	2,4	-101	3	1.8-3.6V	10	TQFP44, MLF44	Y	-40°C to +85°C
ATmega128RZA	I	ATmega1281	AT86RF230	128	4K	8K	2,4	-101	3	1.8-3.6V	8	TQFP64, MLF64	Y	-40°C to +85°C
ATmega128RZB	I	ATmega1280	AT86RF230	128	4K	8K	2,4	-101	3	1.8-3.6V	8	TQFP100, CBGA100	Y	-40°C to +85°C
ATmega256RZA	I	ATmega2561	AT86RF230	256	4K	8K	2,4	-101	3	1.8-3.6V	8	TQFP64, MLF64	Y	-40°C to +85°C
ATmega256RZB	I	ATmega2560	AT86RF230	256	4K	8K	2,4	-101	3	1.8-3.6V	8	TQFP100, CBGA100	Y	-40°C to +85°C



1.11 Product Selection Guide – Automotive AVR

Product	Status	Flash (KBytes)	EEPROM (Bytes)	SRAM (Bytes)	I/O	CAN (CAN mess.obj.)	LIN	USART	UART	USI	SPI	Timers 8bit	Timers 12bit	Timers 16bit	PWM (Channels)	ADC 10bit (Channels)	Analog Gain (Channels)	DebugWIRE	JTAG	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
ATtiny24	I	2	128	128	12		S			1	USI	1		1	4	8	Y	Y		2.7-5.5V	16	MLF20, SOIC14	Y	-40°C to +125°C
ATtiny25	P	2	128	128	6		S			1	USI	2 e)			4 f)	4	Y	Y		1.8-3.6V	8	SOIC8	Y	-40°C to +85°C
	P	2	128	128	6		S			1	USI	2 e)			4 f)	4	Y	Y		2.7-5.5V	16	MLF20, SOIC8	Y	-40°C to +125°C
ATtiny44	I	4	256	256	12		S			1	USI	1		1	4	8	Y	Y		2.7-5.5V	16	MLF20, SOIC14	Y	-40°C to +125°C
ATtiny45	P	4	256	256	6		S			1	USI	2 e)			4 f)	4	Y	Y		1.8-3.6V	8	SOIC8	Y	-40°C to +85°C
	P	4	256	256	6		S			1	USI	2 e)			4 f)	4	Y	Y		2.7-5.5V	16	MLF20, SOIC8	Y	-40°C to +125°C
ATtiny84	I	8	512	512	12		S			1	USI	1		1	4	8	Y	Y		2.7-5.5V	16	MLF20	Y	-40°C to +125°C
ATtiny85	P	8	512	512	6		S			1	USI	2 e)			4 f)	4	Y	Y		1.8-3.6V	8	SOIC8	Y	-40°C to +85°C
	P	8	512	512	6		S			1	USI	2 e)			4 f)	4	Y	Y		2.7-5.5V	16	MLF20, SOIC8	Y	-40°C to +125°C
ATmega48	P	4	256	512	23		S	1			1+USART	2		1	6	8 i)		Y		2.7-5.5V	16	TQFP32, MLF32	Y	-40°C to +125°C
ATmega88	P	8	512	1K	23		S	1			1+USART	2		1	6	8 i)		Y		1.8-3.6V	8	TQFP32, MLF32	Y	-40°C to +85°C
	P	8	512	1K	23		S	1			1+USART	2		1	6	8 i)		Y		2.7-5.5V	16	TQFP32, MLF32	Y	-40°C to +150°C
ATmega164P	P	16	512	1K	32		S	2			1+USART	2		1	6	8	Y	Y		2.7-5.5V	16	TQFP44, MLF44	Y	-40°C to +125°C
ATmega168	P	16	512	1K	23		S	1			1+USART	2		1	6	8 i)		Y		2.7-5.5V	16	TQFP32, MLF32	Y	-40°C to +150°C
ATmega324P	P	32	1K	2K	32		S	2			1+USART	2		1	6	8	Y	Y		2.7-5.5V	16	TQFP44, MLF44	Y	-40°C to +125°C
ATmega644P	P	64	2K	4K	32		S	2			1+USART	2		1	6	8	Y	Y		2.7-5.5V	16	TQFP44, MLF44	Y	-40°C to +125°C
ATmega16M1	I	16	1K	2K	32	6	H			1		1	1	1	6+4 f)	11	Y	Y		2.7-5.5V	16	TQFP32, QFN32	Y	-40°C to +125°C
ATmega32C1	I	32	1K	2K	32	6	H			1		1	1	1	4	11	Y	Y		2.7-5.5V	16	TQFP32, QFN32	Y	-40°C to +125°C
ATmega32M1	I	32	1K	2K	32	6	H			1		1	1	1	6+4 f)	11	Y	Y		2.7-5.5V	16	TQFP32, QFN32	Y	-40°C to +125°C
ATmega64C1	I	64	2K	4K	32	6	H			1		1	1	1	4	11	Y	Y		2.7-5.5V	16	TQFP32, QFN32	Y	-40°C to +125°C
ATmega64M1	I	64	2K	4K	32	6	H			1		1	1	1	6+4 f)	11	Y	Y		2.7-5.5V	16	TQFP32, QFN32	Y	-40°C to +125°C
AT90CAN32	P	32	1K	2K	53	15	S	2				1	2		2	6+2	8	Y	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +125°C
AT90CAN64	P	64	2K	4K	53	15	S	2				1	2		2	6+2	8	Y	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +125°C
AT90CAN128	P	128	4K	4K	53	15	S	2				1	2		2	6+2	8	Y	Y	2.7-5.5V	16	TQFP64, MLF64	Y	-40°C to +125°C



1.12 Product Selection Guide – AVR32 AP family

Product	Status	SRAM (Bytes)	DSP instr.	Vector mult.	Ethernet MAC	USB Hi speed	LCD	USART	PWM (Channels)	I/O	PDC (Channels)	EBI	Timers 16bit	RTC	SPI	Audio DAC (16bit)	Audio	ISI	PS/2 interf.	SSC	TW (I2C)	WDT	POR	Crystal Osc.	PLL	ECC	MMU	JTAG	Nexus	Vcc (V) Range	Package	Pb-free, Green	Temp. Range
AT32AP7000	P	32K	Y	Y	2	Y	2048x2048 24-bit	4	4	160	15	Y	6	Y	2	Stereo	AC97, 3xI2S	CMOS	Y	3	Y	Y	Y	2	2	Y	MMU	Y	Class 3	1.8+3.3V	CTBGA256	Y	-40°C to +85°C
AT32AP7001	P	32K	Y	Y	Y	Y		4	4	90	15	Y	6	Y	2	Stereo	AC97, 3xI2S	CMOS	Y	3	Y	Y	Y	2	2	Y	MMU	Y	Class 3	1.8+3.3V	QFP208	Y	-40°C to +85°C
AT32AP7002	P	32K	Y	Y	Y	Y	2048x2048 18-bit	4	4	85	15	Y	6	Y	2	Stereo	AC97, 3xI2S	CMOS	Y	3	Y	Y	Y	2	2	Y	MMU	Y	Class 3	1.8+3.3V	CTBGA196	Y	-40°C to +85°C

1.13 Product Selection Guide – AVR32 UC3 family

Product	Status	Flash (KBytes)	SRAM (Bytes)	Ethernet MAC	USB Full speed	USB Host/OTG	USART	PWM (Channels)	I/O	EBI	System Bus Layers	PDC (Channels)	Timers 16bit	RTC	SPI	SSC	TW (I2C)	WDT	POR	Crystal Osc.	Vcc (V) Range	Clock Speed (MHz)	Package	Pb-free, Green	Temp. Range
AT32UC3A0128	I	128	32K	1	Y	Y	4	13	109	Y	6	7	3	Y	1	1	Y	Y	Y	2	3.3V	66	LQFP144	Y	-40°C to +85°C
AT32UC3A0256	I	256	64K	1	Y	Y	4	13	109	Y	6	7	3	Y	1	1	Y	Y	Y	2	3.3V	66	LQFP144	Y	-40°C to +85°C
AT32UC3A0512	I	512	64K	1	Y	Y	4	13	109	Y	6	7	3	Y	1	1	Y	Y	Y	2	3.3V	66	LQFP144	Y	-40°C to +85°C
AT32UC3A1128	I	128	32K	1	Y	Y	4	13	69		6	7	3	Y	1	1	Y	Y	Y	2	3.3V	66	TQFP100	Y	-40°C to +85°C
AT32UC3A1256	I	256	64K	1	Y	Y	4	13	69		6	7	3	Y	1	1	Y	Y	Y	2	3.3V	66	TQFP100	Y	-40°C to +85°C
AT32UC3A1512	I	512	64K	1	Y	Y	4	13	69		6	7	3	Y	1	1	Y	Y	Y	2	3.3V	66	TQFP100	Y	-40°C to +85°C
AT32UC3B064	I	64	16K		Y	Y	3	13	44		5	7	3	Y	1	1	Y	Y	Y	2	3.3V	60	TQFP64, QFN64	Y	-40°C to +85°C
AT32UC3B0128	I	128	32K		Y	Y	3	13	44		5	7	3	Y	1	1	Y	Y	Y	2	3.3V	60	TQFP64, QFN64	Y	-40°C to +85°C
AT32UC3B0256	I	256	32K		Y	Y	3	13	44		5	7	3	Y	1	1	Y	Y	Y	2	3.3V	60	TQFP64, QFN64	Y	-40°C to +85°C
AT32UC3B164	I	64	16K		Y		2	13	28		5	7	3	Y	1		Y	Y	Y	1	3.3V	60	TQFP48, QFN48	Y	-40°C to +85°C
AT32UC3B1128	I	128	32K		Y		2	13	28		5	7	3	Y	1		Y	Y	Y	1	3.3V	60	TQFP48, QFN48	Y	-40°C to +85°C
AT32UC3B1256	I	256	32K		Y		2	13	28		5	7	3	Y	1		Y	Y	Y	1	3.3V	60	TQFP48, QFN48	Y	-40°C to +85°C

- a) Pb-free packaging alternative, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.
- b) 8 pin wide SOIC package, 209 mil wide.
- c) The AVR core has 32 internal registers that can be used as RAM storage.
- d) 8 pin narrow SOIC package, 150 mil wide.
- e) One high speed 8-bit timer/counter.
- f) Two High Frequency, 250kHz, PWM Outputs.
- g) Three High Frequency PWM Outputs for BLDC motor control.
- h) F: Future Device, I: Device under Introduction, P: Product in Full Production. Please contact your local sales contact for details
- i) Only 6 ADC in PDIP packages.
- j) T: -40°C to +85°C, T1: -40°C to +105°C, Z: -40°C to +125°C
- k) S: Software, H: Hardware

2 Application area in Focus : XMEGA – The new 8/16-bit AVR family

The AVR® XMEGA™ family is an important addition to Atmel's successful AVR microcontrollers. The system performance of AVR XMEGA expands the market reach for 8/16-bit microcontrollers. With second generation of picoPower™ technology, XMEGA is the only family of Flash microcontrollers with true 1.6V operation. The ultra low power consumption is combined with fast 12-bit analog functions, a DMA controller, an innovative Event System and a crypto engine. All features free CPU resources which minimize power consumption and increase system performance.

The XMEGA microcontrollers range from 16 to 384 KB of Flash and 44- to 100-pin packages. They operate from 1.6V to 3.6V and achieve up to 32 MIPS at 32 MHz. The XMEGA devices are general purpose microcontrollers well suited for a variety of applications including audio systems, ZigBee®, power tools, medical, board controllers, networking, metering, optical transceivers, motor control, white goods and any battery powered product.



2.1 Ultra Low Power

Atmel's picoPower technology already used in megaAVR® products, is recognized as market leader in low power. With AVR XMEGA, using second generation picoPower, battery life is further increased by additional features like true 1.6V operation and a combined Watchdog Timer- and Brown-Out-Detector current consumption of only 1 uA. True 1.6V operation means all functions including Flash reprogramming, EEPROM write, analog conversions and internal oscillators are operative. In battery powered applications like mobile phones XMEGA devices can be connected to a 1.8V (+/- 10%) regulated power supply to save cost and increase battery life. AVR XMEGA delivers industry leading power consumption numbers. In Power Down mode with RAM retention, current consumption is 100 nA. A Real-Time Clock function using a 32 kHz crystal oscillator has a power consumption of only 650 nA.

2.2 Modern CPU Built for Scalability

The 8/16-bit AVR CPU is designed for high-level languages like C. It has 16- and 32-bit arithmetic support and 16- and 24-bit memory pointers. Single cycle operation and 32 working registers connected to the Arithmetic Logic Unit makes AVR more efficient than other CPUs. Based on the solid AVR CPU platform, Atmel now offers one of the largest families of code compatible devices ranging from 1 KB 8-pin tinyAVR® to 384 KB 100-pin XMEGA. By standardizing on AVR MCUs, customers save investments and shorten time-to-market by reusing development tools, software and hardware design.

2.3 Innovative Event System

Like a reflex in the human body, the innovative XMEGA Event System enables inter-peripheral communication without CPU or DMA usage. This ensures 100% predictable and short response time. Up to 8 simultaneous events or interrupt conditions in the peripherals can automatically start actions in other peripherals. The Event System removes bottlenecks associated with multiple and/or frequently triggering interrupts. There is no software overhead and critical tasks are handled with a guaranteed latency shorter than any interrupt response time.

2.4 Leading Analog Performance

The XMEGA Analog-to-Digital Converter has 12-bit resolution and provides up to 2 million samples per second with hardware support for oversampling to increase resolution to 16 bits without extra cost. Programmable gain stage, differential inputs, temperature sensor, and accurate internal voltage references removes external components and saves cost. AVR XMEGA also includes 12-bit Digital-to-Analog Converters and advanced Analog Comparators.

2.5 Fast Crypto Engine

XMEGA has a hardware crypto engine that supports Advanced Encryption Standard (AES) and Data Encryption Standard (DES). The crypto engine increases encrypted communication speed from 10 kbps to 2 Mbps compared to software solutions. AVR XMEGA is the only solution for high bandwidth encrypted data communication in long life battery powered applications, like toll road tags, wireless sensor nodes and ZigBee.

2.6 Flexible 4-channel DMA controller

The XMEGA features a 4 channel Direct Memory Access (DMA) controller that can move data between any locations in the data memory space. Data can be moved from a peripheral register to internal or external SRAM, between SRAM locations, and even between peripheral registers directly. The four DMA channels have individual priority, source, destination, triggers, addressing modes, and transfer block sizes. The DMA can transmit from 1 byte to 16 Mbytes in a single transfer. The large data transfer size is possible due to the simple linear data memory address space in the AVR, and auto increment/decrement and reload features in the DMA controller. The DMA controller in XMEGA is able to handle data transfer with minimal CPU intervention. It enables both higher performance and lower power consumption than solutions without DMA controller for embedded applications that include data transfer.

2.7 Huge communication bandwidth

XMEGA is equipped with up to eight USARTs, four Serial Peripheral Interfaces (SPIs) and four I2C and SMBus compatible Two Wire Interfaces (TWIs). XMEGA also includes fractional baud rate which allows the designer to use any available clock source to generate standard baud rates for the UART. XMEGA contains an Infrared Communication Module (IRCOM) IrDA 1.4 compatible module for baud rates up to 115.2 kbps. With several communication interfaces, XMEGA gives both flexibility for layout and the right communication support for embedded applications.

2.8 Flexible Timer/Counters

XMEGA has up to eight 16-bit Timer/Counters with time keeping, frequency waveform, Pulse Width Modulation (PWM) and input capture capabilities. The Advanced Waveform Extension (AWeX) provides extra features to the Timer/Counter in Waveform Generation modes. The Hi-Resolution (Hi-Res) Extension is able to increase the resolution of the waveform generation output by 4. Compared to competitor solutions with fewer Timer/Counters, XMEGA makes it easier to have several time bases in the application. Timer/Counter are the most used and most flexible peripherals in a microcontroller.

2.9 Development Tools

AVR XMEGA is supported by the easy-to-use tool chain already existing for AVR devices. The AVR Studio® integrated development environment is available free of charge on Atmel's web site. The STK®600 Starter Kit and JTAGICE mkII on-chip debugger supports every microcontroller in Atmel's AVR and AVR32 UC3 product families.

2.10 Availability and Pricing

The first devices, ATxmega128A1 and ATxmega64A1 are both offered in 100-pin TQFP and BGA packages and are available now. Volume prices for 10k units are US\$3.75 and US\$3.50 respectively. Other devices announced will be available during 2008.

3 AVR Development Tools

Atmel provides a complete range of development tools for the AVR products.

3.1 Tools Reference

Part Number	Description
Software	
AVR Studio	Front end software for AVR development tools
AVR32 Studio	Front end software for AVR32 development tools
Starter Kits	
ATSTK500	Starter Kit and development system for AVR
ATSTK600	Starter Kit and development system for AVR & AVR32
ATSTK501	Expansion of STK500 to support 64-pin megaAVR devices
ATSTK502	Expansion of STK500 for 64-pin LCD AVR devices
ATSTK503	Expansion of STK500 for 100-pin megaAVR devices
ATSTK504	Expansion of STK500 for 100-pin LCD AVR devices
ATSTK505	Expansion of STK500 for 14-pin SOIC and 20-pin PDIP AVR devices
ATSTK520	Expansion of STK500 for 90PWM devices
ATSTK524	Expansion for ATmega32M1, ATmega32C1 products
ATSTK525	Starter Kit for AT90USB646/647/1286/1287
ATSTK526	Starter Kit for AT90USB82/162
ATSTK1000	Starter Kit for AVR32AP7xxx devices
AT90EIT1	AVR Embedded Internet Tool Kit
Evaluation Kits	
AVR Butterfly	ATmega169 Demo Board with LCD and Speaker
RZRAVEN	Evaluation and Starter kit for lowpower wireless applications
ATAVRFBKIT	DALI Dimmable Fluorescent Ballast Kit
AVRRTOS	AVR Real Time Operating System development kit
AT90USBKEY	AVR USB Key Demonstration Kit
ATAVRRZ200	Z-Link Demonstration Kit
ATAVRRZ201	Pack of 5 Radio-Controller Boards
ATAKSTK512-3	Remote Access Control – Unidirectional Kit 315 MHz
ATAKSTK512-4	Remote Access Control – Unidirectional Kit 434 MHz
ADEVK1100	Evaluation kit for AVR32 UC3A series
ADEVK1101	Evaluation kit for AVR32 UC3B series
ADEVK525	AVR USB Mass Storage Evaluation Kit
ATAVRAUTOEK1	AVR Automotive Evaluation Kit
Development Kits	
ATAVRMC100	BLDC Motor Control with AT90PWM3
ATAVRMC200	AC Induction Motor Kit
ATAVRMC201	Induction Motor for ATAVRMC200
ATDVK90CAN1	DVK90CAN1 Development Kit for AT90CAN devices
ATAVRSB100	Smart Battery Development Kit for Atmega406
ATAVRBC100	Reference design/development kit that targets especially battery charging
ATAVRDB101	Display module
ATAVRISP2	AVRISP mkII is an ISP programmer for all AVR ISP devices
ATAVRRZ502	Z-Link RF Accessory Kit
ATAVRRZ541	Z-Link Packet Sniffer Kit
ATAVRDRAGON	AVR Dragon is a starter kit supporting On-Chip Debugging and programming for AVR.



Part Number	Description
ATNGW100	Network Gateway design kit and development board for the AT32AP7000
Emulators	
ATJTAGICE2	JTAGICE mkII On-Chip Debugger supporting all AVR and AVR32 with debugWIRE or JTAG interface
JTAGPROBE	JTAGICE mkII Probe including Flex Cables
<i>AVR ONE!</i>	<i>Development tool for on-chip debugging and programming of all AVR32 devices</i>
ATADAPCAN01	STK500/501 90CAN128 CAN adapter
ATAVRAUTO102	AVR Automotive Debugger

3.2 AVR Studio® Tools and Device Support

AVR Studio 4.13 with the latest Service Pack supports all new Atmel debug platforms and devices. Some of the old devices are not supported. See below for a table of currently supported tools and devices in AVR Studio. This support is in progress, and the table below is not guaranteed to be complete when this is read.

This information can also be found in the AVR Studio online help and on www.atmel.com/avr

The latest AVR Studio SW can be found on:

www.atmel.com/dyn/products/tools_card.asp?tool_id=2725

Device	Simulator/ Assembler	JTAGICE mkII	Starter kit	AVR Dragon	AVRISP mkII
ATtiny11	•		ATSTK500, ATSTK600	• ⁽¹⁾	
ATtiny12	•		ATSTK500, ATSTK600	• ⁽¹⁾	•
ATtiny13	•	•	ATSTK500, ATSTK600	•	•
ATtiny15	•		ATSTK500, ATSTK600	• ⁽¹⁾	•
ATtiny24	•	•	ATSTK500 + ATSTK505, ATSTK600	•	•
ATtiny25	•	•	ATSTK500, ATSTK600	•	•
ATtiny26	•		ATSTK500 (+ATSTK505), ATSTK600	• ⁽¹⁾	•
ATtiny261	•	•	ATSTK500 (+ATSTK505), ATSTK600	•	•
ATtiny28	•		ATSTK500, ATSTK600	• ⁽¹⁾	
ATtiny44	•	•	ATSTK500 + ATSTK505, ATSTK600	•	•
ATtiny45	•	•	ATSTK500, ATSTK600	•	•
ATtiny461	•	•	ATSTK500 (+ATSTK505), ATSTK600	•	•
ATtiny84	•	•	ATSTK500 + ATSTK505, ATSTK600	•	•
ATtiny85	•	•	ATSTK500, ATSTK600	•	•
ATtiny861	•	•	ATSTK500 (+ATSTK505), ATSTK600	•	•
ATtiny2313	•	•	ATSTK500, ATSTK600	•	•
ATmega48	•	•	ATSTK500, ATSTK600	•	•
Atmega48P	•	•	ATSTK500, ATSTK600	•	•
ATmega8	•		ATSTK500, ATSTK600	• ⁽¹⁾	•
ATmega88	•	•	ATSTK500, ATSTK600	•	•
Atmega88P	•	•	ATSTK500, ATSTK600	•	•
ATmega8515	•		ATSTK500, ATSTK600	• ⁽¹⁾	•
ATmega8535	•		ATSTK500, ATSTK600	• ⁽¹⁾	•
ATmega16	•	•	ATSTK500, ATSTK600	•	•
ATmega162	•	•	ATSTK500, ATSTK600	•	•
ATmega164P	•	•	ATSTK500, ATSTK600	•	•



Device	Simulator/ Assembler	JTAGICE mkII	Starter kit	AVR Dragon	AVRISP mkII
ATmega165	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega165P	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega168	•	•	ATSTK500, ATSTK600	•	•
ATmega168P	•	•	ATSTK500, ATSTK600	•	•
ATmega169	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega169P	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega32	•	•	ATSTK500, ATSTK600	•	•
ATmega324P	•	•	ATSTK500, ATSTK600	•	•
ATmega325	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega325P	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega3250	•	•	ATSTK500 + ATSTK504, ATSTK600	•	•
ATmega3250P	•	•	ATSTK500 + ATSTK504, ATSTK600	•	•
ATmega329	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega329P	•	•	ATSTK500 + ATSTK502, ATSTK600	•	•
ATmega3290	•	•	ATSTK500 + ATSTK504, ATSTK600	•	•
ATmega3290P	•	•	ATSTK500 + ATSTK504, ATSTK600	•	•
ATmega64	•	•	ATSTK500 + ATSTK501, ATSTK600	• ⁽¹⁾	•
ATmega640	•	•	ATSTK500 + ATSTK503, ATSTK600	• ⁽¹⁾	•
ATmega644	•	•	ATSTK500, ATSTK600	• ⁽¹⁾	•
ATmega644P	•	•	ATSTK500, ATSTK600	• ⁽¹⁾	•
ATmega645	•	•	ATSTK500 + ATSTK502, ATSTK600	• ⁽¹⁾	•
ATmega6450	•	•	ATSTK500 + ATSTK504, ATSTK600	• ⁽¹⁾	•
ATmega649	•	•	ATSTK500 + ATSTK502, ATSTK600	• ⁽¹⁾	•
ATmega6490	•	•	ATSTK500 + ATSTK504, ATSTK600	• ⁽¹⁾	•
ATmega128	•	•	ATSTK500 + ATSTK501, ATSTK600	• ⁽¹⁾	•
ATmega1280	•	•	ATSTK500 + ATSTK503, ATSTK600	• ⁽¹⁾	•
ATmega1281	•	•	ATSTK500 + ATSTK501, ATSTK600	• ⁽¹⁾	•
ATmega2560	•	•	ATSTK500 + ATSTK503, ATSTK600	• ⁽¹⁾	•
ATmega2561	•	•	ATSTK500 + ATSTK501, ATSTK600	• ⁽¹⁾	•
ATmega406	•	•		•	
ATxmega128A1	•	•	ATSTK600		
AT90CAN32	•	•	ATSTK500 + ATSTK501, ATSTK600, ATADAPCAN1	•	•
AT90CAN64	•	•	ATSTK500 + ATSTK501,	• ⁽¹⁾	•



Device	Simulator/ Assembler	JTAGICE mkII	Starter kit	AVR Dragon	AVRISP mkII
			ATSTK600, ATADAPCAN1		
AT90CAN128	•	•	ATSTK500 + ATSTK501, ATSTK600, ATADAPCAN1	• ⁽¹⁾	•
<i>ATmega32M1</i>	•	•	<i>ATSTK500 + ATSTK524, ATSTK600</i>	•	•
AT90PWM2	•	•	ATSTK500 + ATSTK520, ATSTK600	•	•
AT90PWM3	•	•	ATSTK500 + ATSTK520, ATSTK600	•	•
AT90PWM216	•	•	ATSTK500 + ATSTK520, ATSTK600	•	•
AT90PWM316	•	•	ATSTK500 + ATSTK520, ATSTK600	•	•
AT90USB646	•	•	ATSTK500 + ATSTK525, ATSTK600	• ⁽¹⁾	•
AT90USB647	•	•	ATSTK500 + ATSTK525, ATSTK600	• ⁽¹⁾	•
AT90USB1286	•	•	ATSTK500 + ATSTK525, ATSTK600	• ⁽¹⁾	•
AT90USB1287	•	•	ATSTK500 + ATSTK525, ATSTK600	• ⁽¹⁾	•
AT90USB82	•	•	ATSTK500 + ATSTK526, ATSTK600	• ⁽¹⁾	•
AT90USB162	•	•	ATSTK500 + ATSTK526, ATSTK600	• ⁽¹⁾	•
AT32AP7000		•	ATSTK1000		
AT32AP7001		•	ATSTK1000		
AT32AP7002		•	ATSTK1000		
AT32UC3A0		•	ATSTK600, ATEVK1100		
AT32UC3A1		•	ATEVK1100		
AT32UC3B0		•	ATSTK600, ATEVK1101		
AT32UC3B1		•	ATEVK1101		

⁽¹⁾ Programming only

4 Documentation

All documents listed can be downloaded from Atmel Corporation's web site: <http://www.atmel.com> under the product section. For other documentation, please send your request to avr@atmel.com.

4.1 Datasheets

The datasheets of all AVR devices can be downloaded.
 AVR: http://www.atmel.com/dyn/products/datasheets.asp?family_id=607.
 AVR32: http://www.atmel.com/dyn/products/datasheets.asp?family_id=682

Family	Devices	Language	Preliminary	Summary	Complete	Last Update
Auto AVR	ATtiny25/45/85 Automotive	English	X		X	11/07
Auto AVR	Appendix A - ATtiny45 Automotive specification at 150°C	English	X		X	03/07
Auto AVR	Appendix B - ATtiny25/45/85 Automotive Specification at 1.8V	English	X		X	04/07
Auto AVR	ATtiny24/44/84 Automotive	English	X		X	09/07
Auto AVR	ATtiny261/461/861	English	X		X	11/07
Auto AVR	ATmega48/88/168 Automotive	English			X	10/07
Auto AVR	ATmega88 Automotive - 150°C Specification - Appendix A	English	X			11/07



Family	Devices	Language	Preliminary	Summary	Complete	Last Update
Auto AVR	ATmega164P/324P/644P	English	X		X	04/07
Auto AVR	AT90CAN32/64/128 Automotive	English	X		X	01/07
Auto AVR	ATmega32C1, ATmega32M1, ATmega64C1, ATmega64M1 <i>Automotive Advance Information</i>	English	X		X	02/08
CAN AVR	AT90CAN32/64/128	English	X	X	X	11/07
LCD AVR	ATmega169(V)	English		X	X	07/06
LCD AVR	ATmega169(V)	Chinese	X		X	09/04
LCD AVR	ATmega329/3290/649/6490	English	X	X	X	08/07
Lighting AVR	AT90PWM2(B), AT90PWM3(B)	English	X		X	01/08
Lighting AVR	AT90PWM216/316	English	X		X	01/08
AVR Z-Link	AT86RF230 ZigBee™/IEEE 802.15.4-Transceiver	English	X		X	12/07
megaAVR	ATmega48/88/168	English	X	X	X	09/07
megaAVR	ATmega48/88/168	Chinese	X		X	02/05
megaAVR	ATmega8(L)	English		X	X	08/07
megaAVR	ATmega8(L)	Chinese			X	07/04
megaAVR	ATmega8515(L)	English		X	X	10/06
megaAVR	ATmega8515(L)	Chinese			X	09/04
megaAVR	ATmega8535(L)	English	X	X	X	10/06
megaAVR	ATmega8535(L)	Chinese	X		X	09/04
megaAVR	ATmega16(L)	English		X	X	08/07
megaAVR	ATmega16(L)	Chinese			X	10/04
megaAVR	ATmega162(V)	English		X	X	08/07
megaAVR	ATmega165(V)	English	X	X	X	08/06
megaAVR	ATmega32(L)	English		X	X	08/07
megaAVR	ATmega32(L)	Chinese	X		X	09/04
megaAVR	ATmega325/3250/645/6450	English	X	X	X	08/07
megaAVR	ATmega64(L)	English		X	X	08/07
megaAVR	ATmega64(L)	Chinese	X		X	09/04
megaAVR	ATmega640/1280/1281/2560/2561	English	X	X	X	08/07
megaAVR	ATmega644	English	X	X	X	08/07
megaAVR	ATmega128(L)	English		X	X	08/07
megaAVR	ATmega128(L)	Chinese			X	05/04
picoPower megaAVR	ATmega164P/324P/644P	English	X	X	X	01/08
picoPower megaAVR	ATmega165P(V)	English	X	X	X	08/07
picoPower megaAVR	ATmega325P/3250P	English	X	X	X	08/07
PicoPower megaAVR	ATmega48P/88P/168P	English	X	X	X	01/08
picoPower LCD megaAVR	ATmega169P(V)	English	X	X	X	08/07
picoPower LCD megaAVR	ATmega329P/3290P	English	X	X	X	08/07
Smart Battery AVR	ATmega406	English	X	X	X	07/06
tinyAVR	ATtiny11/12	English		X	X	06/07
tinyAVR	ATtiny13	English	X	X	X	10/07
tinyAVR	ATtiny13	Chinese	X		X	01/07
tinyAVR	ATtiny15L	English		X	X	09/07
tinyAVR	ATtiny2313	English	X	X	X	04/06
tinyAVR	ATtiny2313	Chinese	X		X	07/04
tinyAVR	ATtiny24/44/84	English	X	X	X	01/08
tinyAVR	ATtiny25/45/85	English	X	X	X	01/08
tinyAVR	ATtiny26(L)	English		X	X	06/07
tinyAVR	ATtiny26(L)	Chinese	X		X	12/03



Family	Devices	Language	Preliminary	Summary	Complete	Last Update
tinyAVR	ATtiny261/461/861	English	X	X	X	11/06
tinyAVR	ATtiny28(L)(V)	English		X	X	07/06
USB AVR	AT90USB1287/1286/646/647	English	X		X	01/08
USB AVR	AT90USB82/162	English	X		X	12/07
USB AVR	USB DFU Bootloader Datasheet	English				04/06
XMEGA	ATxmega A Manual Preliminary	English	X		X	02/08
XMEGA	ATxmega64A1/128A1/192A1/256A1 Preliminary	English	X		X	02/08
XMEGA	ATxmega64A3/128A3/192A3/256A3 Advance Information	English			X	02/08
XMEGA	ATmega16A4/32A4/64A4/128A4 Advance Information	English			X	02/08
AVR32	AT32AP7000	English	X	X	X	10/07
AVR32	AT32AP7001	English	X	X	X	01/08
AVR32	AT32AP7002	English	X	X	X	10/07
AVR32	AVR32 Architecture Manual	English	X		X	11/07
AVR32	AVR32 Technical Reference Manual	English	X		X	11/07
AVR32	AVR32 Java Technical Reference Manual	English	X		X	10/06
AVR32	AVR32 UC3 USB DFU Bootloader	English			X	07/07
AVR32	AT32UC3A0512, AT32UC3A0256, AT32UC3A0128, AT32UC3A1512, AT32UC3A1256, AT32UC3A1128	English	X	X	X	10/07
AVR32	AT32UC3B0256, AT32UC3B0128, AT32UC3B064, AT32UC3B1256, AT32UC3B1128, AT32UC3B164	English	X	X	X	12/07

4.2 Application Notes

The application notes for all AVR devices can be downloaded.

AVR: http://www.atmel.com/dyn/products/app_notes.asp?family_id=607

AVR32: http://www.atmel.com/dyn/products/app_notes.asp?family_id=682

Note Number	Description	Last Update
AVR000	Register and Bit-Name Definitions for the AVR Microcontroller	04/98
AVR001	Conditional Assembly and Portability Macros	03/05
AVR030	Getting Started with IAR Embedded Workbench for Atmel AVR	10/04
AVR031	Getting Started with ImageCraft C for AVR	05/02
AVR032	Linker Command Files for the IAR ICCA90 Compiler	05/02
AVR033	Getting Started with the CodeVision AVR C Compiler	05/02
AVR034	Mixing C and Assembly Code with AVR Embedded Workbench for AVR	04/03
AVR035	Efficient C Coding for AVR	01/04
AVR040	EMC Design Considerations	06/06
AVR042	AVR Hardware Design Considerations	06/06
AVR053	Calibration of the Internal RC Oscillator	05/06
AVR054	Run-time calibration of the internal RC oscillator	02/06
AVR055	Using a 32kHz XTAL for run-time calibration of the internal RC	02/06
AVR060	JTAGICE	01/04
AVR061	STK500 Protocol	04/03
AVR063	LCD Driver for the STK@504	04/06
AVR064	STK502 – A Temperature Monitoring System with LCD Output	02/06
AVR065	LCD Driver for the STK502	02/06
AVR067	JTAGICE mkII Communication Protocol	04/06
AVR068	STK500 Communication Protocol	06/06

Note Number	Description	Last Update
AVR069	AVRISP mkII Communication Protocol	02/06
AVR070	Modifying AT90ICEPRO to Support Emulation of AT90	05/02
AVR072	Accessing 16-bit I/O Registers	05/02
AVR073	Accessing 10- and 16-bit registers in ATtiny261/461/861	01/08
AVR074	Upgrading AT90ICEPRO to ICE10	05/02
AVR078	STK524 User's Guide	02/08
AVR080	ATmega103 Replaced by ATmega128	01/04
AVR081	Replacing AT90S4433 by ATmega8	07/03
AVR082	Replacing ATmega161 by ATmega162	01/04
AVR083	Replacing ATmega163 by ATmega16	09/05
AVR084	Replacing ATmega323 by ATmega32	07/03
AVR085	Replacing AT90S8515 by ATmega8515	01/04
AVR086	Replacing AT90S8535 by ATmega8535	07/03
AVR087	Migrating between ATmega8515 and ATmega162	07/03
AVR088	Migrating between ATmega8535 and ATmega16	01/04
AVR089	Migrating between ATmega16 and ATmega32	06/03
AVR090	Migrating between ATmega64 and ATmega128	06/03
AVR091	Replacing AT90S2313 by ATtiny2313	10/03
AVR092	Replacing ATtiny11/12 by ATtiny13	10/03
AVR093	Replacing AT90S1200 by ATtiny2313	10/03
AVR094	Replacing ATmega8 by ATmega88	04/05
AVR095	Migrating between ATmega48, ATmega88 and ATmega168	02/04
AVR096	Migrating from ATmega128 to AT90CAN128	03/04
AVR097	Migration between ATmega128 and ATmega2561	07/06
AVR098	Migration between ATmega169, ATmega329 and ATmega649	02/07
AVR099	Replacing AT90S4433 by ATmega48	07/04
AVR100	Accessing the EEPROM	09/05
AVR101	High Endurance EEPROM Storage	09/02
AVR102	Block Routines	05/02
AVR103	Using the EEPROM Programming Modes	03/05
AVR104	Buffered Interrupt Controlled EEPROM Writes	07/03
AVR105	Power Efficient High Endurance Parameter Storage in Flash Memory	09/03
AVR106	C functions for reading and writing to Flash memory	08/06
AVR107	Interfacing AVR serial memories	03/05
AVR108	Setup and Use of the LPM Instructions	05/02
AVR109	Self-programming	06/04
AVR120	Characterization and Calibration of the ADC on an AVR	02/06
AVR121	Enhancing ADC resolution by oversampling	09/05
AVR122	Calibration of the AVR's internal temperature reference	02/08
AVR128	Setup and Use the Analog Comparator	05/02
AVR130	Setup and use the AVR Timers	02/02
AVR131	Using the AVR's High-speed PWM	09/03
AVR132	Using the Enhanced Watchdog Timer	11/03
AVR133	Long Delay Generation Using the AVR Microcontroller	02/04
AVR134	Real-Time Clock using the Asynchronous Timer	08/06
AVR135	Using Timer Capture to Measure PWM Duty Cycle	10/05
AVR136	Low-jitter Multi-channel Software PWM	05/06
AVR137	Writing Software Compatible for AT90PWM2/3 and AT90PWM2B/3B	12/06
AVR140	ATmega48/88/168 family run-time calibration of the Internal RC oscillator	09/06
AVR151	Setup and use of the SPI	09/05
AVR155	Accessing I2C LCD Display Using the AVR 2-Wire Serial Interface	09/05
AVR180	External Brown-Out Protection	05/02
AVR181	Automotive Grade0 - PCB and Assembly Recommendations	09/07
AVR182	Zero Cross Detector	01/04
AVR191	Anti-Pinch Algorithm for AVR Adaptation Procedure	11/06



Note Number	Description	Last Update
AVR1000	Getting Started Writing C-code for XMEGA	02/08
AVR1001	Getting Started With the XMEGA Event System	02/08
AVR1003	Using the XMEGA Clock System	02/08
AVR1301	Using the XMEGA DAC	02/08
AVR1302	Using the XMEGA Analog Comparator	02/08
AVR1303	Use and configuration of IR communication module	02/08
AVR1304	Using the XMEGA DMA Controller	02/08
AVR1305	XMEGA Interrupts and the Programmable Multi-level Interrupt Controller	02/08
AVR1306	Using the XMEGA Timer/Counter	02/08
AVR1307	Using the XMEGA USART	02/08
AVR1308	Using the XMEGA TWI	02/08
AVR1309	Using the XMEGA SPI	02/08
AVR1312	Using the XMEGA External Bus Interface	02/08
AVR1313	Using the XMEGA IO Pins and External Interrupts	02/08
AVR1314	Using the XMEGA Real Time Counter	02/08
AVR200	Multiply and Divide Routines	05/06
AVR2001	AT86RF230 Software Programmer's Guide	07/07
AVR2005	Design Considerations for the AT86RF230	08/07
AVR2006	Design and characterization of the Radio Controller Boards 2.4 GHz PCB Antenna	08/07
AVR2007	IEEE802.15.4 MAC power consumptions for AT86RF230 and ATmega1281	09/07
AVR2009	AT86RF230 – Software Programming Model	08/07
AVR201	Using the AVR Hardware Multiplier	06/02
AVR202	16-Bit Arithmetic	05/02
AVR204	BCD Arithmetic	01/03
AVR220	Bubble Sort	05/02
AVR221	Discrete PID controller	05/06
AVR222	8-Point Moving Average Filter	05/02
AVR223	Digital Filters with AVR	09/02
AVR230	DES Bootloader	04/05
AVR231	AES Bootloader	08/06
AVR236	CRC Check of Program Memory	05/02
AVR240	4x4 Keypad-Wake Up on Keypress	06/06
AVR241	Direct driving of LCD display using general I/O	05/04
AVR242	8-bit Microcontroller Multiplexing LED Drive & a 4x4 Keypad	05/02
AVR243	Matrix Keyboard Decoder	01/03
AVR244	UART as ANSI Terminal Interface	11/03
AVR245	Code Lock with 4x4 Keypad and I2C™ LCD	10/05
AVR270	USB Mouse Demonstration	02/06
AVR271	USB Keyboard Demonstration	02/06
AVR272	USB CDC Demonstration UART to USB Bridge	04/06
AVR273	USB Mass Storage Implementation	04/06
AVR274	Single-wire Software UART	03/07
AVR276	USB Software Library for AT90USBxxx Microcontrollers	02/07
AVR277	On-The-Go (OTG) add-on to USB Software Library	07/07
AVR280	USB Host CDC Demonstration	09/07
AVR282	USB Firmware Upgrade for AT90USB	01/08
AVR2015	RZRAVEN Quick Start Guide	02/08
AVR2016	RZRAVEN Hardware User's Guide	02/08
AVR301	C Code for Interfacing AVR® to AT17CXX FPGA Configuration Memory	01/04
AVR303	SPI-UART Gateway	03/05
AVR304	Half Duplex Interrupt Driven Software UART	08/97
AVR305	Half Duplex Compact Software UART	09/05
AVR306	Using the AVR UART in C	07/02
AVR307	Half Duplex UART Using the USI Module	10/03



Note Number	Description	Last Update
AVR308	Software LIN Slave	05/02
AVR309	Software Universal Serial Bus (USB)	02/06
AVR310	Using the USI Module as a I2C Master	09/04
AVR311	Using the TWI Module as a I2C Slave	10/04
AVR312	Using the USI Module as a I2C Slave	09/05
AVR313	Interfacing the PCAT Keyboard	09/05
AVR314	DTMF Generator	05/02
AVR315	Using the TWI Module as a I2C Master	10/04
AVR316	SMBus Slave Using the TWI Module	10/05
AVR317	Using the USART on the ATmega48/88/168 as a SPI master	11/04
AVR318	Dallas 1-Wire® Master	10/04
AVR319	Using the USI module for SPI communication	11/04
AVR320	Software SPI Master	09/05
AVR322	LIN v1.3 Protocol Implementation on Atmel AVR Microcontrollers	12/05
AVR323	Interfacing GSM modems	02/06
AVR325	High-Speed Interface to Host EPP Parallel Port	02/02
AVR328	USB Generic HID Implementation	01/06
AVR329	USB Firmware Architecture	02/06
AVR335	Digital Sound Recorder with AVR and Serial Data Flash	04/05
AVR336	ADPCM Decoder	01/05
AVR340	Direct Driving of LCD Using General Purpose IO	09/07
AVR341	Four and five-wire Touch screen Controller	07/07
AVR350	XmodemCRC Receive Utility for AVR	01/08
AVR360	Step Motor Controller	04/03
AVR400	Low Cost A/D Converter	05/02
AVR401	8-Bit Precision A/D Converter	02/03
AVR410	RC5 IR Remote Control Receiver	05/02
AVR411	Secure Rolling Code Algorithm for Wireless Link	04/06
AVR414	User Guide - ATAVRRZ502 - Accessory Kit	12/06
AVR415	RC5 IR Remote Control Transmitter	05/03
AVR433	Power Factor Corrector (PFC) with AT90PWM2 Re-triggable High Speed PSC	03/06
AVR434	PSC Cookbook	10/06
AVR435	BLDC/BLAC Motor Control Using a Sinus Modulated PWM Algorithm	09/06
AVR440	Sensorless Control of Two-Phase Brushless DC Motor	09/05
AVR441	Intelligent BLDC Fan Controller with Temperature Sensor and Serial Interface	09/05
AVR442	PC Fan Control using ATtiny13	09/05
AVR443	Sensor-based control of three phase Brushless DC motor	02/06
AVR444	Sensorless control of 3-phase brushless DC motors	10/05
AVR446	Linear speed control of stepper motor	06/06
AVR447	Sinusoidal driving of three-phase permanent magnet motor using ATmega48/88/168	06/06
AVR448	Control of High Voltage 3-Phase BLDC Motor	05/06
AVR449	Sinusoidal driving of 3-phase permanent magnet motor using ATtiny261/461/861	10/07
AVR450	Battery Charger for SLA, NiCd, NiMH and Li-ion Batteries	09/06
AVR451	BC100 Hardware User's Guide	09/07
AVR452	Sensor-based Control of Three Phase Brushless DC Motors Using CAN128 64 32 or mega128 64 usi	03/06
AVR453	Smart Battery Reference Design	02/06
AVR454	Users Guide – ATAVRSB100 – Smart Battery Development Board	06/06
AVR458	Charging Lithium-Ion Batteries with ATAVRBC100	09/07
AVR460	Embedded Web Server	05/02
AVR461	Quick Start Guide for the Embedded Internet Toolkit	05/02
AVR462	Reducing the Power Consumption of ATEIT1	03/02
AVR463	Charging Nickel-Metal Hydride Batteries with ATAVRBC100	09/07



Note Number	Description	Last Update
AVR465	Energy meter	07/04
AVR480	Anti-Pinch System for Electrical Window	12/06
AVR481	DB101 Hardware User's Guide	09/07
AVR482	DB101 Software User's Guide	09/07
AVR483	DB101 Firmware - Getting Started	02/08
AVR492	Brushless DC Motor Control using AT90PWM3	05/07
AVR493	Sensorless Commutation of Brushless DC Motor (BLDC) using AT90PWM3 and ATAVRMC100	07/06
AVR494	AC Induction Motor Control Using the constant V/f Principle and a Natural PWM Algorithm	12/05
AVR495	AC Induction Motor Control Using the Constant V/f Principle and a Space-vector PWM Algorithm	02/06
AVR500	Migration between Atmega64 and Atmega645	09/04
AVR501	Replacing ATtiny15 with ATtiny25	03/05
AVR502	Migration between Atmega165 and ATmega325	11/04
AVR503	Replacing AT90S/LS2323 or AT90S/LS2343 with ATtiny25	09/05
AVR504	Migrating from ATtiny26 to ATtiny261/461/861	10/06
AVR505	Migration between Atmega16/32 and ATmega164/324/644	06/06
AVR506	Migration from Atmega169 to ATmega169P	02/07
AVR507	Migration from ATmega329 to ATmega329P	11/06
AVR508	Migration from ATmega644 to ATmega644P	07/06
AVR509	Migration between ATmega169P and ATmega329P	11/06
AVR510	Migration between ATmega329/649 and ATmega3290/6490	07/06
AVR511	Migration from ATmega3290 to ATmega3290P	11/06
AVR513	Migration Note from Atmega165 to Atmega165P	03/07
AVR514	Migration Note from Atmega325 to Atmega325P	03/07
AVR515	Migrating from ATmega48/88/168 and ATmega48P/88P/168P/328P to ATtiny48/88	09/07
AVR910	In-System Programming	11/00
AVR911	AVR Open-source Programmer	07/04
AVR914	CAN & UART based Bootloader for AT90CAN32, AT90CAN64, & AT90CAN128	05/06
AVR998	Guide to IEC60730 Class B compliance with AVR Microcontrollers	12/07
AVR32000	Introduction to AVR32 header files	05/06
AVR32003	Build root for AVR32	11/07
AVR32004	AVR32 AP7 How to add software package to Buildroot	02/08
AVR32005	AVR32 AP7 How to add a custom board to Buildroot	02/08
AVR32006	Getting Started with GCC for AVR32	12/07
AVR32007	UC3 C-coding Guidelines for ARM7 Developers	03/08
AVR32008	How to Compile the UC3 Software Framework in AVR32 Studio V1.0	12/07
AVR32015	AVR32 Studio getting started	02/08
AVR32100	Using the AVR32 USART	04/06
AVR32101	Configuring the AVR32 Interrupt Controller	04/06
AVR32102	Using the AVR32 SDRAM Controller	05/06
AVR32105	Master and Slave SPI Driver	05/06
AVR32107	Using TWI as a master on the AVR32	04/06
AVR32108	Peripheral Direct Memory Access Driver	05/06
AVR32110	Using the AVR32 Timer/Counter	05/06
AVR32111	Using the AVR32 PIO Controller	05/06
AVR32113	Configuration and Use of the Memory Management Unit	09/06
AVR32114	Using the AVR32 LCD Controller	01/08
AVR32115	ATA Driver for AVR32	01/08
AVR32119	Getting Started with AVR32 UC3A Microcontrollers	12/07
AVR32120	Using the AVR32 audio bitstream DAC ABDAC	02/08
AVR32401	Interfacing DataFlash in Linux with the AVR32	12/07



Note Number	Description	Last Update
AVR32407	AVR32407: WMA Codec Linux Library	09/07
AVR32408	AVR32 AP7 Linux GPIO driver	02/08
AVR32415	AVR32 AP7 Linux PS/2 keyboard and mouse	02/08
AVR32701	AVR32 AP7 USB Performance	02/08
AVR32705	AVR32 AP7 Networking Performance	02/08
AVR32708	AVR32 UC3A and UC3B Flash JTAG Programming Algorithms	11/07
AVR32714	UC3A Schematic Checklist	02/08
AVR32715	AVR32 UC3B Schematic Checklist	02/08
AVR32718	AT32UC3 Series Software Framework DSPLib	11/07
AVR32722	How to licence audio and video codecs	02/08
AVR32737	AVR32 AP7 Linux Getting Started	02/08
AVR32738	AVR32 AP7 Schematic Checklist	02/08
AVR32739	AVR32 UC3 Low power software design	02/08

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