

# AVR® Microcontrollers Peripheral Integration

## Quick Reference Guide

Product Family	Pin Count	Program Flash Memory (KB)	SRAM (KB)	Supply Voltage	Speed (MHz) Single Cycle Instruction: MHz = MIPS	Peripheral Function Focus																																				
						Intelligent Analog							Waveform Control			Timing and Measurements			Logic, Crypto and Math		Safety and Monitoring			Communications				User Interface		System Flexibility												
						ADC (# of bits)	ADC (# of channels)	Comparators	ADC Gain Stage	DAC (# of bits)	Temperature Sensor	Internal Voltage Reference	Zero Cross Detector (ZCD)	8-bit PWM	16-bit PWM	Quadrature Decoder	Waveform Extension (WeX)	Real-Time Counter	8-bit Timer/Counter	12-bit Timer Counter	16-bit Timer/Counter	CCL	MULT	Crypto (AES/DES)	CRC/SCAN	POR	BOD	WDT	USART	USB	PC	SPI	IRCOM	Serial Number	QTouch® Technology	QTouch Technology with PTC <sup>(2)</sup>	LCD	External Bus Interface	DMA Channels	Event System	SleepWalking	Sleep Modes
ATtiny4/5/9/10	6	0.5-1	0.032	1.8-5.5	12	10 <sup>3</sup>	4 <sup>(6)</sup>	✓								2				✓	✓								✓										4			
ATtiny102/104	8/14	1	0.032	1.8-5.5	12	10	5/8	✓								2				✓	✓			1															4			
ATtiny13A	8-20	1	0.064	1.8-5.5	20	10	4	✓							2					✓	✓	✓	✓						✓									3	✓			
ATtiny20/40	12-20	2/4	0.128/0.256	1.8-5.5	12	10	8/12	✓					✓		2	2				✓	✓	✓	✓			1	1		✓										4			
ATtiny24A/44A/84A	14-20	2-8	Up to 0.512	1.8-5.5	20	10	8	✓	✓			✓	✓	2	2					✓	✓	✓	✓			1	1		✓										4	✓		
ATtiny48/88	28-32	4/8	Up to 0.512	1.8-5.5	16	10	8	✓				✓	✓	1	1					✓	✓	✓	✓			1	1												3	✓		
ATtiny87/167	20-32	8/16	0.512	1.8-5.5	16	10	11	✓				✓	✓	1	2					✓	✓	✓	✓		1 <sup>(6)</sup>		1	2												4		
ATtiny261A/461A/861A	20-32	2-8	Up to 0.512	1.8-5.5	20	10	11	✓	✓			✓	✓	2						✓	✓	✓	✓			1	1		✓											4	✓	
ATtiny20x/40x/80x/160x	8-24	2-16	Up to 1	1.8-5.5	20	10	12	✓				✓	✓			2			✓	✓	✓	✓	✓	1 <sup>(1)</sup>		1	1		✓							✓	✓			3	✓	
ATtiny21x/41x/81x/161x/321x	8-24	2-32	Up to 2	1.8-5.5	20	10	12	✓	8	✓	✓	✓	✓	2				✓	✓	✓	✓	✓	✓	1 <sup>(1)</sup>		1	1		✓	✓ <sup>(4)</sup>				✓	✓	✓			3	✓		
ATtiny441/841	14-20	4/8	Up to 0.512	1.7-5.5	16	10	12	✓	✓			✓	✓	1	2					✓	✓	✓	✓		2		1	1												4	✓	
ATtiny2313A	20	2	0.128	1.8-5.5	20		-	✓				✓	✓	2	2					✓	✓	✓	✓		1	1	2												3	✓		
ATmega8A/16A/32A	28-44	8-32	1-2	2.7-5.5	16	10	8	✓				✓	✓	2	1					✓	✓	✓	✓		1		1	1		✓										5		
ATmega8U2/16U2/32U2	32	8-32	0.5-1	2.7-5.5	16		-	✓				✓	✓	4	6					✓	✓	✓	✓		2	✓	2	2												6		
ATmega16U4/32U4	32	16/32	1/2	2.7-5.5	16	10	12	✓				✓	✓	5						✓	✓	✓	✓		✓															6		
ATmega48PB/88PB/168PB/328PB	32	4-32	0.5-2	1.8-5.5	20	10	8	✓				✓	✓	4	2/6 <sup>(6)</sup>					✓	✓	✓	✓		1/2 <sup>(6)</sup>		1/2 <sup>(6)</sup>	1/2 <sup>(6)</sup>		✓	✓ <sup>(6)</sup>									6		
ATmega80x/160x/320x/480x	28-48	8-48	1-6	1.8-5.5	20	10	16	✓				✓	✓	4	3					✓	✓	✓	✓		4		1	1		✓					✓	✓				3	✓	
ATmega64A/128A	64	64-128	4	2.7-5.5	16	10	8	✓	✓			✓	✓	2	6					✓	✓	✓	✓		2		1	1		✓										6		
ATmega164PA/324PA/644PA/1284P	44	16-128	1-16	1.8-5.5	20	10	8	✓	✓			✓	✓	4	2/2/4					✓	✓	✓	✓		2		1	1		✓										6	✓	
ATmega165PA/325PA/645P	44	16-64	1-4	1.8-5.5	16	10	8	✓				✓	✓	4	6					✓	✓	✓	✓		3		2	2												6	✓	
ATmega169PA/329PA/649P	64	16-64	1-4	1.8-5.5	16	10	8	✓				✓	✓	2	2					✓	✓	✓	✓		1		1	1		✓		✓								5		
ATmega324PB	44	32	2	1.8-5.5	20	10	8	✓				✓	✓	2	2					✓	✓	✓	✓		1		1	1		✓	✓									5		
ATmega640/1280/2560/1281/2561	64-100	64-256	8	1.8-5.5	16	10	8/16	✓	✓			✓	✓	4	6/12					✓	✓	✓	✓		2/4		1	1		✓				✓ <sup>(5)</sup>							6	
ATmega3290PA/6490P	100	32-64	2-4	1.8-5.5	20	10	8	✓	✓			✓	✓	2	2					✓	✓	✓	✓		1		1	1		✓		✓								5		
ATmega3250PA/6450P	100	32-64	2-4	1.8-5.5	20	10	8	✓	✓			✓	✓	2	2					✓	✓	✓	✓		1		1	1		✓										5		
AVR-DA Family	28-64	32-128	4-16	1.8-5.5	24	12	12	✓	10	✓	✓	1-3	9-17	3-6						✓	✓	✓	✓		3-6		1-2	2	✓	✓		✓				✓	✓			3	✓	
ATxmega A1U/A3U/A4U Family	44-100	16-128	2-8	1.6-3.6	32	12	12/16	✓	✓	12	✓	✓		5-8	✓	✓	✓			✓	✓	✓	✓		5-8	✓	2-4	2-4	✓	✓		✓			✓	4	✓			5	✓	
ATxmega B1/B3 Family	64-100	64-128	4-8	1.6-3.6	32	12	8	✓	✓			✓		2/3	✓	✓	✓			✓	✓	✓	✓		1/2	✓	1	1	✓	✓		✓				2	✓			5	✓	
ATxmega C3/D3/C4/D4 Family	44-64	16-384	2-32	1.6-3.6	32	12	12/16	✓	✓			✓	✓	4/5	✓	✓	✓			✓	✓	✓	✓		2/3	✓ <sup>(7)</sup>	2	2	✓	✓		✓					4	✓			5	✓
ATxmega32E5 Family	32	8-32	1-4	1.6-3.6	32	12	16	✓	✓	12	✓	✓		3	✓	✓	✓			✓	✓	✓	✓		2		1	1	✓	✓		✓								5	✓	

1: LIN port also    2: Peripheral Touch Controller    3: Only on the ATtinys/10    4: Not on the ATtiny212/214/412/414/416    5: Only on the ATmega1281/2561    6: Only on the ATmega328PB    7: Only on the C3 and C4    8: UART only LIN Port also

## Terminology

INTELLIGENT ANALOG: Sensor Interfacing and Signal Conditioning	
<b>ADC:</b> Analog-to-Digital Converter	General purpose 10-/12-bit ADC
<b>ADC Gain Stage:</b> Analog-to-Digital Converter Gain Stage	Programmable gain stage, providing amplification steps on the differential input voltage
<b>Comp:</b> Comparator	General purpose rail-to-rail comparator
<b>DAC:</b> Digital-to-Analog Converter	Programmable voltage reference with multiple internal and external connections
<b>VREF:</b> Voltage Reference	Stable fixed voltage reference for use with integrated analog peripherals
<b>ZCD:</b> Zero Cross Detect	AC high-voltage zero-crossing detection for simplifying TRIAC control, synchronised switching control and timing
WAVEFORM CONTROL: PWM Drive and Waveform Generation	
<b>PWM:</b> Pulse Width Modulation	General purpose 10-bit PWM control
<b>16-bit PWM:</b> Standalone 16-bit PWM and 16-bit Timer/Counter	1. High-resolution 16-bit PWM with edge- and center-aligned modes 2. General purpose 16-bit timer/counter
<b>WeX:</b> Waveform Extension	1. Module for more customised and advanced waveform generation 2. Optimised for various types of motor, ballast and power stage control
TIMING AND MEASUREMENTS: Signal Measurement with Timing and Counter Control	
<b>8-/12-/16-bit Timer</b>	General purpose 8-/12-/16-bit timer/counter
LOGIC, CRYPTO AND MATH: Customizable Logic and Math Functions	
<b>CCL:</b> Configurable Custom Logic	1. Integrated combinational and sequential logic 2. Customer interconnection and re-routing of digital peripherals
<b>MULT:</b> Hardware Multiplier	MULTIPLY function of two 8-bit values with 16-bit result
<b>Crypto (AES/DES)</b>	Data encryption and decryption can be easily performed for both internally stored data or for small external data packets
SAFETY AND MONITORING: Hardware Monitoring and Fault Detection	
<b>CRC/SCAN:</b> Cyclical Redundancy Check with Memory Scan	Automatically calculates CRC checksum of Program/DataEE memory for NVM integrity
<b>POR:</b> Power-On Reset	Keeps the device in reset until the voltage is high enough. Ensures a safe start-up of logic and memories
<b>BOD:</b> Brownout Detector	Prevents code execution if voltage drops below a set threshold
<b>WDT:</b> Watchdog Timer	Monitors correct program operation. Constantly running timer with a configurable time-out period

COMMUNICATIONS: General, Industrial, Lighting and Automotive	
<b>UART:</b> Universal Asynchronous Receiver Transmitter	1. General purpose serial communications 2. Support for LIN
<b>USB:</b> Universal Serial Bus	Support for Full-Speed USB 2.0 device profiles
<b>I<sup>2</sup>C:</b> Inter-Integrated Circuit	General purpose 2-wire serial communications
<b>SPI:</b> Serial Peripheral Interface	General purpose 4-wire serial communications
<b>IRCOM:</b> Infrared Communication Module	Encodes and decodes data according to the IrDA communication protocol
<b>Serial Number</b>	Factory programmed unique ID useful in wired and wireless communications
USER INTERFACE: Capacitive Touch Sensing and LCD Control	
<b>LCD:</b> Liquid Crystal Display	Highly integrated segmented LCD controller
<b>QTouch<sup>®</sup>:</b> Microchip Proprietary Touch Technology	Provides a simple-to-use solution to realize touch-sensitive interfaces
<b>QTouch with PTC:</b> QTouch with Peripheral Touch Controller	Provides a simple-to-use solution to realize touch-sensitive interfaces with a Peripheral Touch Controller
LOW POWER AND SYSTEM FLEXIBILITY: Low-Power Technology, Peripheral and Interconnects	
<b>DMA:</b> Direct Memory Access	Moves data between memories and peripherals without CPU overhead, improving overall system performance and efficiency
<b>Event System</b>	Flexible routing of peripheral events, ability to control peripheral independent from the CPU
<b>External Bus Interface</b>	Highly flexible module for interfacing external memories and memory-addressable peripherals
<b>picoPower<sup>®</sup> Technology</b>	Low-power technology
<b>Sleep Modes</b>	Low-power saving modes, IDLE, power-down, power-save, standby and extended standby
<b>SleepWalking</b>	Ability to put the CPU core to sleep until a relevant event occurs