



# ATMEL CORPORATION

## AVR Flash Microcontroller: Product Line Reference

November 2005 Customer Edition

### Table of Contents

<b>1</b>	<b>AVR Product Family .....</b>	<b>2</b>
1.1	PRODUCT SELECTION GUIDE .....	2
1.2	PRODUCT SELECTION GUIDE CONT'D .....	3
1.3	APPLICATION AREA IN FOCUS: CONTROL OF BRUSHLESS DC MOTORS .....	4
1.3.1	AVR BLDC motor control design wins.....	4
1.3.2	AVR benefits for motor control.....	5
1.3.3	Two-phase BLDC motor Application notes .....	5
1.3.4	Three-phase BLDC motor Application notes .....	5
1.3.5	Development Kits available.....	5
1.3.6	Find more information .....	5
<b>2</b>	<b>AVR Development Tools .....</b>	<b>6</b>
2.1	TOOL REFERENCE .....	6
2.2	AVR STUDIO 4.12 TOOLS AND DEVICES SUPPORT .....	7
<b>3</b>	<b>Documentation.....</b>	<b>8</b>
3.1	DATA SHEET .....	8
3.2	APPLICATION NOTES .....	9

# 1 AVR Product Family

## 1.1 Product Selection Guide

	FLASH (KB)	EEPROM(Bytes)	RAM(Bytes)	I/O Pins	SPI	UART	TWI	USI*	Hardware Multiplier	PWM	8-bit Timer	16-bit Timer	10-bit A/D Channels	JTAG Interface	debugWIRE	LCD Interface	CAN Interface	In System Prog. (I) + Self-Prog.(S)	Vcc(V)	Clock speed(MHz)	Package (Pin)
tiny11L	1	-	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2.7-5.5	0-2	8 P/S
tiny11	1	-	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	-	4.5-5.5	0-6	8 P/S
tiny12V	1	64	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	I	1.8-5.5	0-1	8 P/S
tiny12L	1	64	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	I	2.7-5.5	0-4	8 P/S
tiny12	1	64	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	I	4.5-5.5	0-8	8 P/S
tiny13V	1	64	64	6	-	-	-	-	-	2	1	-	4	-	Y	-	-	S	1.8-5.5	0-10	8 P/S/SS, 20 M
tiny13	1	64	64	6	-	-	-	-	-	2	1	-	4	-	Y	-	-	S	2.7-5.5	0-20	8 P/S/SS, 20 M
tiny15L	1	64	-	6	-	-	-	-	-	1	2	-	4	-	-	-	-	I	2.7-5.5	1,6	8 P/S
tiny2313V	2	128	128	18	-	1	-	1	-	4	1	1	-	-	Y	-	-	S	1.8-5.5	0-10	20 M/P/S
tiny2313	2	128	128	18	-	1	-	1	-	4	1	1	-	-	Y	-	-	S	2.7-5.5	0-20	20 M/P/S
tiny24V	2	128	128	12	-	-	-	1	-	4	1	1	8	-	Y	-	-	S	1.8-5.5	0-10	14 X, 20 M
tiny24	2	128	128	12	-	-	-	1	-	4	1	1	8	-	Y	-	-	S	2.7-5.5	0-20	14 X, 20 M
tiny25V	2	128	128	6	-	-	-	1	-	4	2	-	4	-	Y	-	-	S	1.8-5.5	0-10	8 P/S, 20 M
tiny25	2	128	128	6	-	-	-	1	-	4	2	-	4	-	Y	-	-	S	2.7-5.5	0-20	8 P/S, 20 M
tiny26L	2	128	128	16	-	-	-	1	-	2	2	-	11	-	-	-	-	I	2.7-5.5	0-8	20 P/S, 32 M
tiny26	2	128	128	16	-	-	-	1	-	2	2	-	11	-	-	-	-	I	4.5-5.5	0-16	20 P/S, 32 M
tiny261V	2	128	128	16	-	-	-	1	-	5	1	1	11	-	Y	-	-	S	1.8-5.5	0-10	20 P/S, 32 M
tiny261	2	128	128	16	-	-	-	1	-	5	1	1	11	-	Y	-	-	S	2.7-5.5	0-20	20 P/S, 32 M
tiny28V	2	-	-	20	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1.8-5.5	0-1	28 P, 32 A/M
tiny28L	2	-	-	20	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2.7-5.5	0-4	28 P, 32 A/M
tiny44V	4	256	256	12	-	-	-	1	-	4	1	1	8	-	Y	-	-	S	1.8-5.5	0-10	14 X, 20 M
tiny44	4	256	256	12	-	-	-	1	-	4	1	1	8	-	Y	-	-	S	2.7-5.5	0-20	14 X, 20 M
tiny45V	4	256	256	6	-	-	-	1	-	4	2	-	4	-	Y	-	-	S	1.8-5.5	0-10	8 P/S, 20 M
tiny45	4	256	256	6	-	-	-	1	-	4	2	-	4	-	Y	-	-	S	2.7-5.5	0-20	8 P/S, 20 M
tiny461V	4	256	256	16	-	-	-	1	-	5	1	1	11	-	Y	-	-	S	1.8-5.5	0-10	20 P/S, 32 M
tiny461	4	256	256	16	-	-	-	1	-	5	1	1	11	-	Y	-	-	S	2.7-5.5	0-20	20 P/S, 32 M
tiny84V	8	512	512	12	-	-	-	1	-	4	1	1	8	-	Y	-	-	S	1.8-5.5	0-10	14 X, 20 M
tiny84	8	512	512	12	-	-	-	1	-	4	1	1	8	-	Y	-	-	S	2.7-5.5	0-20	14 X, 20 M
tiny85V	8	512	512	6	-	-	-	1	-	4	2	-	4	-	Y	-	-	S	1.8-5.5	0-10	8 P/S, 20 M
tiny85	8	512	512	6	-	-	-	1	-	4	2	-	4	-	Y	-	-	S	2.7-5.5	0-20	8 P/S, 20 M
tiny861V	8	512	512	16	-	-	-	1	-	5	1	1	11	-	Y	-	-	S	1.8-5.5	0-10	20 P/S, 32 M
tiny861	8	512	512	16	-	-	-	1	-	5	1	1	11	-	Y	-	-	S	2.7-5.5	0-20	20 P/S, 32 M
mega48V	4	256	512	23	1	1	1	-	Y	6	2	1	8	-	Y	-	-	S	1.8-5.5	0-10	28 P, 32 A/M
mega48	4	256	512	23	1	1	1	-	Y	6	2	1	8	-	Y	-	-	S	2.7-5.5	0-20	28 P, 32 A/M
mega8L	8	512	1K	23	1	1	1	-	Y	3	2	1	8	-	-	-	-	S	2.7-5.5	0-8	28 P, 32 A/M
mega8	8	512	1K	23	1	1	1	-	Y	3	2	1	8	-	-	-	-	S	4.5-5.5	0-16	28 P, 32 A/M
mega88V	8	512	1K	23	1	1	1	-	Y	6	2	1	8	-	Y	-	-	S	1.8-5.5	0-10	28 P, 32 A/M
mega88	8	512	1K	23	1	1	1	-	Y	6	2	1	8	-	Y	-	-	S	2.7-5.5	0-20	28 P, 32 A/M
mega8515L	8	512	512	35	1	1	1	-	Y	3	1	1	-	-	-	-	-	S	2.7-5.5	0-8	40 P, 44 A/J/M
mega8515	8	512	512	35	1	1	1	-	Y	3	1	1	-	-	-	-	-	S	4.5-5.5	0-16	40 P, 44 A/J/M
mega8535L	8	512	512	32	1	1	1	-	Y	4	2	1	8	-	-	-	-	S	2.7-5.5	0-8	40 P, 44 A/J/M
mega8535	8	512	512	32	1	1	1	-	Y	4	2	1	8	-	-	-	-	S	4.5-5.5	0-16	40 P, 44 A/J/M
PWM2	8	512	512	19	1	1	1	-	Y	2	1	1	8	-	Y	-	-	S	2.7-5.5	0-16	24 S
PWM3	8	512	512	27	1	1	1	-	Y	3	1	1	11	-	Y	-	-	S	2.7-5.5	0-16	32 M/S
mega162V	16	512	1K	35	1	2	-	-	Y	6	2	2	-	Y	-	-	-	S	1.8-5.5	0-8	40 P, 44 A/M
mega162	16	512	1K	35	1	2	-	-	Y	6	2	2	-	Y	-	-	-	S	2.7-5.5	0-16	40 P, 44 A/M
mega16L	16	512	1K	32	1	1	1	-	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-8	40 P, 44 A/M
mega16	16	512	1K	32	1	1	1	-	Y	4	2	1	8	Y	-	-	-	S	4.5-5.5	0-16	40 P, 44 A/M

Package Options: A=TQFP; J=PLCC; M=QFN/MLF; P=PDIP; S=SOIC; X=TSSOP

Note: USI can be configured to SPI, UART or TWI.

Note: Fully Green Option is available.

Note: Fully Green Only.

1.2 Product Selection Guide cont'd

	FLASH (KB)	EEPROM(Bytes)	RAM(Bytes)	I/O Pins	SPI	UART/USART	TWI	US*	Hardware Multiplier	PWM	8-bit Timer	16-bit Timer	A/D Channels	JTAG Interface	debugWIRE	LCD Interface	CAN Interface	In System Prog. (I) + Self-Prog. (S)	Vcc(V)	Clock speed(MHz)	Packages (Pin)
mega164VP	16	512	1K	32	1	2	1	-	Y	6	2	1	8	Y	-	-	-	S	1.8-5.5	0-10	40 P, 44 A/M
mega164P	16	512	1K	32	1	2	1	-	Y	6	2	1	8	Y	-	-	-	S	2.7-5.5	0-20	40 P, 44 A/M
mega165VP	16	512	1K	53	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	1.8-5.5	0-8	64 A/M
mega165P	16	512	1K	53	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-16	64 A/M
mega168V	16	512	1K	23	1	1	1	-	Y	6	2	1	8	-	Y	-	-	S	1.8-5.5	0-10	28 P, 32 A/M
mega168	16	512	1K	23	1	1	1	-	Y	6	2	1	8	-	Y	-	-	S	2.7-5.5	0-20	28 P, 32 A/M
mega169VP	16	512	1K	53	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	1.8-5.5	0-8	64 A/M
mega169P	16	512	1K	53	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	2.7-5.5	0-16	64 A/M
mega32L	32	1K	2K	32	1	1	1	-	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-8	40 P, 44 A/M
mega32	32	1K	2K	32	1	1	1	-	Y	4	2	1	8	Y	-	-	-	S	4.5-5.5	0-16	40 P, 44 A/M
mega324VP	32	1K	2K	32	1	2	1	-	Y	6	2	1	8	Y	-	-	-	S	1.8-5.5	0-10	40 P, 44 A/M
mega324P	32	1K	2K	32	1	2	1	-	Y	6	2	1	8	Y	-	-	-	S	2.7-5.5	0-20	40 P, 44 A/M
mega325V	32	1K	2K	53	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	1.8-5.5	0-8	64 A/M
mega325	32	1K	2K	53	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-16	64 A/M
mega3250V	32	1K	2K	68	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	1.8-5.5	0-8	100 A
mega3250	32	1K	2K	68	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-16	100 A
mega329V	32	1K	2K	53	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	1.8-5.5	0-8	64 A/M
mega329	32	1K	2K	53	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	2.7-5.5	0-16	64 A/M
mega3290V	32	1K	2K	68	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	1.8-5.5	0-8	100 A
mega3290	32	1K	2K	68	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	2.7-5.5	0-16	100 A
mega406	40	512	2K	48	-	-	1	-	Y	1	1	1	8	Y	-	-	-	S	4-25	0-1	48 A
mega64L	64	2K	4K	53	1	2	1	-	Y	2+6	2	2	8	Y	-	-	-	S	2.7-5.5	0-8	64 A/M
mega64	64	2K	4K	53	1	2	1	-	Y	2+6	2	2	8	Y	-	-	-	S	4.5-5.5	0-16	64 A/M
mega640V	64	4K	8K	86	1	4	1	-	Y	4+12	2	4	16	Y	-	-	-	S	1.8-5.5	0-8	100 A
mega640	64	4K	8K	86	1	4	1	-	Y	4+12	2	4	16	Y	-	-	-	S	2.7-5.5	0-16	100 A
mega644V	64	2K	4K	32	1	1	1	-	Y	6	2	1	8	Y	-	-	-	S	1.8-5.5	0-10	40 P, 44 A/M
mega644	64	2K	4K	32	1	1	1	-	Y	6	2	1	8	Y	-	-	-	S	2.7-5.5	0-20	40 P, 44 A/M
mega645V	64	2K	4K	53	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	1.8-5.5	0-8	64 A/M
mega645	64	2K	4K	53	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-16	64 A/M
mega6450V	64	2K	4K	68	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	1.8-5.5	0-8	100 A
mega6450	64	2K	4K	68	1	1	-	1	Y	4	2	1	8	Y	-	-	-	S	2.7-5.5	0-16	100 A
mega649V	64	2K	4K	53	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	1.8-5.5	0-8	64 A/M
mega649	64	2K	4K	53	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	2.7-5.5	0-16	64 A/M
mega6490V	64	2K	4K	68	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	1.8-5.5	0-8	100 A
mega6490	64	2K	4K	68	1	1	-	1	Y	4	2	1	8	Y	-	Y	-	S	2.7-5.5	0-16	100 A
mega128L	128	4K	4K	53	1	2	1	-	Y	2+6	2	2	8	Y	-	-	-	S	2.7-5.5	0-8	64 A/M
mega128	128	4K	4K	53	1	2	1	-	Y	2+6	2	2	8	Y	-	-	-	S	4.5-5.5	0-16	64 A/M
mega1280V	128	4K	8K	86	1	4	1	-	Y	4+12	2	4	16	Y	-	-	-	S	1.8-5.5	0-8	100 A
mega1280	128	4K	8K	86	1	4	1	-	Y	4+12	2	4	16	Y	-	-	-	S	2.7-5.5	0-16	100 A
mega1281V	128	4K	8K	51	1	2	1	-	Y	4+6	2	4	8	Y	-	-	-	S	1.8-5.5	0-8	64 A/M
mega1281	128	4K	8K	51	1	2	1	-	Y	4+6	2	4	8	Y	-	-	-	S	2.7-5.5	0-16	64 A/M
mega2560V	256	4K	8K	86	1	4	1	-	Y	4+12	2	4	16	Y	-	-	-	S	1.8-5.5	0-8	100 A
mega2560	256	4K	8K	86	1	4	1	-	Y	4+12	2	4	16	Y	-	-	-	S	2.7-5.5	0-16	100 A
mega2561V	256	4K	8K	51	1	2	1	-	Y	4+6	2	4	8	Y	-	-	-	S	1.8-5.5	0-8	64 A/M
mega2561	256	4K	8K	51	1	2	1	-	Y	4+6	2	4	8	Y	-	-	-	S	2.7-5.5	0-16	64 A/M
90CAN128	128	4K	4K	53	1	2	1	-	Y	3	2	2	8	Y	-	-	Y	S	2.7-5.5	0-16	64 A/M

Package Options: A=TQFP; J=PLCC; M=QFN/MLF; P=PDIP; S=SOIC; X=TSSOP

Note: USI can be configured to SPI, UART or TWI.

Note: Fully Green Option is available.

Note: Fully Green Only.

### 1.3 Application area in focus: Control of Brushless DC Motors

By Jacob Lunn Lassen, R&D Manager, Applications Group, AVR Products.

There is a clear trend towards replacing conventional brushed DC motors and to some extent also AC induction motors by Brushless DC (BLDC) motors. This is due to the excellent characteristics of the BLDC motors: High power efficiency, high starting torque, high power-to-weight ratio and minimal need for maintenance.

Single and two-phase BLDC motors are mainly used in cooling fans e.g. for power supplies, CPU and GPU, and high performance embedded applications. Three-phase BLDC motors are used in many different applications, such as toys, power tools, white goods, automotive, computer peripherals; the list is long... The figure below shows some typical applications for brushless DC motors.



#### 1.3.1 AVR BLDC motor control design wins

Atmel's competitors are of the impression that it takes specialized microcontrollers to do motor control. This is not the case! The AVR is very well suited for controlling BLDC motors, which has been proven through a significant number of high volume design wins in the following application areas:

- Server cooling, single and two-phase fans (tiny13 and tiny45)
- Automotive three-phase fan (mega48)
- Automotive seat control (mega48)
- Office automation - printer and copy machines (tiny461)
- Washing machines (mega48 and tiny24)

The designs have been won based on the preliminary information from the series of application notes released lately.

### 1.3.2 AVR benefits for motor control

To control the speed of a BLDC motor a number of PWM channels are required, depending on the motor and the method used. AVR is equipped with sufficient PWM channels to do the job well. The PWM is connected to the power stage of the motor and by varying the duty cycle of the PWM the voltage and current through the coils can be controlled.

One of the features that make the AVR very suitable for motor control is the possibility to trigger ADC sampling from the PWM. This, combined with the dual-slope PWM timer mode, ensures that signals, such as current flow can be measured when the PWM switching does not occur. This ensures that switching noise does not contaminate the signals.

*Devices of special interest for single and two-phase fans and key benefits:*

- Tiny13 (hardware PWM, ADC and pin-change interrupt)
- Tiny25/45/85 (tiny13 + TWI and internal temperature sensor)

*Devices of special interest for three-phase motor control:*

- Tiny261/461/861 (6 channel high-speed PWM with dead-band, hardware fault protection, ADC and TWI/SPI/UART)
- Mega48/88/168 (Automotive grade, ADC and TWI/SPI/UART)
- 90PWM1/2/3 (High speed PWM with dead-band, hardware fault protect, fast ADC)

### 1.3.3 Two-phase BLDC motor Application notes

- AVR440: Sensorless Control of Two-Phase Brushless DC Motor
- AVR441: Intelligent BLDC Fan Controller with Temperature Sensor and Serial Interface
- AVR442: PC fan control using ATtiny13

### 1.3.4 Three-phase BLDC motor Application notes

- AVR443: Sensor-based control of three phase Brushless DC motor
- AVR444: Sensorless control of 3-phase brushless DC motors
- AVR448: Control of High Voltage 3-Phase BLDC Motor
- AVR492: Brushless DC Motor control using AT90PWM3

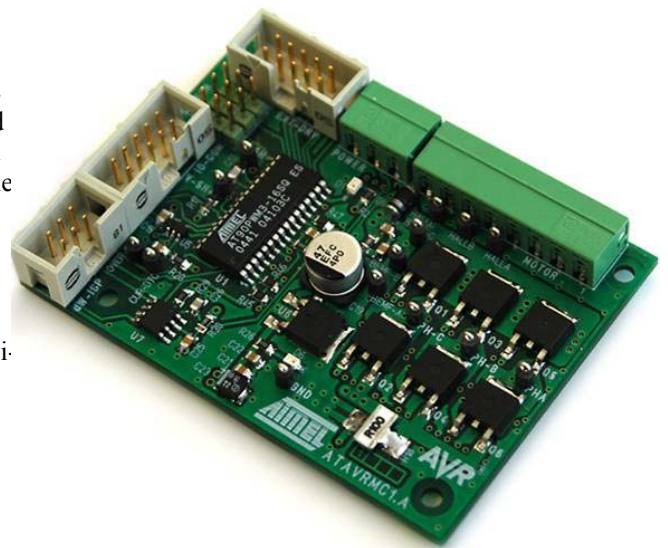
### 1.3.5 Development Kits available

To get a flying start working with three-phase BLDC motors the development kit ATAVRMC100 can be used. This board demonstrate how the driver stage can be designed and uses a 90PWM3 to drive the motor, which is included in the kit. The board can be used for other devices as well as all relevant signals are available on a pin header.

### 1.3.6 Find more information

Find more information on the motor control application specific pages on the Atmel web site:

<http://www.atmel.com/products/AVR/mc/>





## 2 AVR Development Tools

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

### 2.1 Tool Reference

Part Number	Description
<b>Software</b>	
AVR Studio 4.12	Front end software for AVR development tools
<b>Starter Kits</b>	
STK500	AVR Starter Kit with AVR Studio Interface
STK501	Expansion of STK500 to support 64-pin megaAVR devices
STK502	Expansion of STK500 for 64-pin LCD AVR devices
STK503	Expansion of STK500 for 100-pin megaAVR devices
STK504	Expansion of STK500 for 100-pin LCD AVR devices
STK505	Expansion of STK500 for 14-pin SOIC and 20-pin PDIP AVR devices
STK520	Expansion of STK500 for 90PWM devices
AVRISP	ISP programmer for all AVR ISP devices
<b>Evaluation Kits</b>	
90EIT1	AVR Embedded Internet Tool Kit
AVRBFLY	ATmega169 Demo Board with LCD and Speaker
<b>Development Kits</b>	
DVK90CAN1	DVK90CAN1 Development Kit for AT90CAN devices
SB100	Smart Battery Development Kit for Atmega406
<b>Emulators</b>	
ICE50	AVR In-Circuit Emulator for all megaAVR and new tinyAVR devices.
JTAGICE2	JTAGICE mkII low cost In-Circuit Emulator supporting all AVR with debugWIRE or JTAG interface
JTAGPROBE	JTAGICE mkII Probe including Flex Cables
ADAPTEST	ICE50 Test Adapter
ADAPMEGA8	ICE50 Mega8 PDIP personality adapter
ADAPMEGA32	ICE50 Mega8535/16/32 PDIP personality adapter
ADAP128_TOP	ICE50 Mega64/128 TQFP personality adapter (top module); requires one AT64PSKT_BOT as the bottom module
ADAP169_TOP	ICE50 Mega169 TQFP personality adapter (top module); requires one AT64PSKT_BOT as the bottom module
ADAPMEGA162	ICE50 Mega8515/162 PDIP personality adapter
ADAPTINY26	ICE50 Tiny26 PDIP personality adapter
ADAPTINY13	ICE50 Tiny13 PDIP personality adapter
ADAPT2313	ICE50 Tiny2313 PDIP personality adapter
ATADAPCAN01	STK500/501 90CAN128 CAN adapter
ICE50MEM	ICE50 memory extension card for mega2560/2561
ICE50PROBE	ICE40/50 Probe including Flex Cables
ICE50POD	ICE40 and ICE50 POD replacement kit



## 2.2 AVR Studio 4.12 Tools and Devices Support

AVR Studio 4.12 supports all new Atmel debug platforms and devices. Some of the old devices are not yet supported. See below for a table of supported tools and devices in AVR Studio 4.12. This support is in progress, and the table below is not guaranteed to be complete when this is read.

	Simulator	ICE40	ICE50	JTAGICE mkII	JTAGICE	STK500	Assembler
tiny11	•					•	•
tiny12	•					•	•
tiny13	•	•	•	•		•	•
tiny15	•					•	•
tiny24	•			•		• STK505	•
tiny26	•	•	•			• (STK505)	•
tiny28	•					•	•
tiny2313	•		•	•		•	•
tiny45	•			•		•	•
mega48	•		•	•		•	•
mega8	•	•	•			•	•
mega88	•		•	•		•	•
mega168	•		•	•		•	•
mega8515	•		•			•	•
mega8535	•		•			•	•
mega16	•		•	•	•	•	•
mega162	•		•	•	•	•	•
mega32	•		•	•	•	•	•
mega165	•		•	•		• STK502	•
mega169	•		•	•	•	• STK502	•
mega325	•		•	•		• STK502	•
mega3250	•			•		• STK504	•
mega329	•		•	•		• STK502	•
mega3290	•			•		• STK504	•
mega64	•		•	•	•	• STK501	•
mega640	•			•		• STK503	•
mega644	•		•	•		•	•
mega645	•		•	•		• STK502	•
mega6450	•			•		• STK504	•
mega649	•		•	•		• STK502	•
mega6490	•			•		• STK504	•
mega128	•		•	•	•	• STK501	•
mega1280	•			•		• STK503	•
mega1281	•		•	•		• STK501	•
mega2560	•			•		• STK503	•
mega2561	•		•	•		• STK501	•
mega406				•			•
90CAN128	•		•	•		• STK501	•
90PWM2	•			•		• STK520	•
90PWM3	•			•		• STK520	•



### 3 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](mailto:avr@atmel.com).

#### 3.1 Data Sheet

The data sheets of all AVR devices can be downloaded at [http://www.atmel.com/dyn/products/datasheets.asp?family\\_id=607](http://www.atmel.com/dyn/products/datasheets.asp?family_id=607).

Family	Devices	Languages	Preliminary	Summary	Complete	Last Update
Auto AVR	ATmega48/88/168 Automotive	English	X		X	08/05
Auto AVR	AT90CAN128 Automotive	English	X		X	09/05
CAN AVR	<a href="#">AT90CAN32/64</a>	<a href="#">English</a>	<a href="#">X</a>	<a href="#">X</a>	<a href="#">X</a>	<a href="#">09/05</a>
CAN AVR	AT90CAN128	English		X	X	09/05
LCD AVR	ATmega169(V), Rev.F and onwards	English	X	X	X	05/05
LCD AVR	ATmega169(V), Rev.A to E	English		X	X	03/05
LCD AVR	ATmega169(V)	Chinese	X		X	9/04
LCD AVR	ATmega329/3290/649/6490	English	X	X	X	05/05
Lighting AVR	AT90PWM2, AT90PWM3	English	X		X	07/05
Lighting AVR	AT90PWM2/3 Errata	English				3/05
megaAVR	ATmega48/88/168	English	X	X	X	06/05
megaAVR	ATmega48/88/168 Automotive	English	X		X	08/05
megaAVR	ATmega48/88/168	Chinese	X		X	2/05
megaAVR	ATmega8(L)	English		X	X	10/04
megaAVR	ATmega8(L)	Chinese			X	7/04
megaAVR	ATmega8515(L)	English		X	X	03/05
megaAVR	ATmega8515(L)	Chinese			X	9/04
megaAVR	ATmega8535(L)	English	X	X	X	04/05
megaAVR	ATmega8535(L)	Chinese	X		X	9/04
megaAVR	ATmega16(L)	English		X	X	06/05
megaAVR	ATmega16(L)	Chinese			X	10/04
megaAVR	ATmega162(V)	English		X	X	03/05
megaAVR	ATmega164/324/644 Advance Information	English	X	X	X	06/05
megaAVR	ATmega165(V)	English	X	X	X	03/05
megaAVR	ATmega32(L)	English		X	X	03/05
megaAVR	ATmega32(L)	Chinese	X		X	9/04
megaAVR	ATmega325/3250/645/6450	English	X	X	X	05/05
megaAVR	ATmega64(L)	English		X	X	03/05
megaAVR	ATmega64(L)	Chinese	X		X	9/04
megaAVR	ATmega640/1280/1281/2560/2561 Advance Information	English	X	X	X	09/05
megaAVR	ATmega128(L)	English		X	X	11/04
megaAVR	ATmega128(L)	Chinese			X	05/04
Smart Battery AVR	ATmega406	English	X	X	X	06/05
tinyAVR	ATtiny11/12	English		X	X	07/03
tinyAVR	ATtiny13	English	X	X	X	10/04
tinyAVR	ATtiny13	Chinese	X		X	04/04



Family	Devices	Languages	Preliminary	Summary	Complete	Last Update
tinyAVR	ATtiny15L	English		X	X	06/05
tinyAVR	ATtiny2313	English	X	X	X	02/05
tinyAVR	ATtiny2313	Chinese	X		X	07/04
tinyAVR	ATtiny25/45/85	English	X	X	X	06/05
tinyAVR	ATtiny26(L)	English		X	X	03/05
tinyAVR	ATtiny26(L)	Chinese	X		X	12/03
tinyAVR	ATtiny28(L)(V)	English		X	X	03/05

### 3.2 Application Notes

All application notes for AVR product family can be downloaded at [http://www.atmel.com/dyn/products/app\\_notes.asp?family\\_id=607](http://www.atmel.com/dyn/products/app_notes.asp?family_id=607).

Note Number	Description	Last Update
AVR000	Register and Bit-Name Definitions for the AVR Microcontroller	4/98
AVR001	Conditional Assembly and Portability Macros	3/05
AVR030	Getting Started with IAR Embedded Workbench for Atmel AVR	10/04
AVR031	Getting Started with ImageCraft C for AVR	5/02
AVR032	Linker Command Files for the IAR ICCA90 Compiler	5/02
AVR033	Getting Start with the CodeVision AVR C Compiler	5/02
AVR034	Mixing C and Assembly Code with AVR Embedded Workbench for AVR	4/03
AVR035	Efficient C Coding for AVR	1/04
AVR040	EMC Design Considerations	1/04
AVR042	AVR Hardware Design Considerations	09/05
AVR053	Calibration of the Internal RC Oscillator	09/05
AVR054	Run-time calibration of the internal RC oscillator	9/04
AVR055	Using a 32kHz XTAL for run-time calibration of the internal RC	09/05
AVR060	JTAGICE	01/04
AVR061	STK500 Protocol	4/03
AVR064	STK502 – A Temperature Monitoring System with LCD Output	2/03
AVR065	LCD Driver for the STK502	01/04
AVR067	JTAGICE mkII Communication Protocol	3/05
AVR068	STK500 Communication Protocol	3/05
AVR070	Modifying AT90ICEPRO to Support Emulation of AT90	5/02
AVR072	Accessing 16-bit I/O Registers	5/02
AVR074	Upgrading AT90ICEPRO to ICE10	5/02
AVR080	ATmega103 Replaced by ATmega128	01/04
AVR081	Replacing AT90S4433 by ATmega8	7/03
AVR082	Replacing ATmega161 by ATmega162	01/04
AVR083	Replacing ATmega163 by ATmega16	09/05
AVR084	Replacing ATmega323 by ATmega32	7/03
AVR085	Replacing AT90S8515 by ATmega8515	1/04
AVR086	Replacing AT90S8535 by ATmega8535	7/03
AVR087	Migrating between ATmega8515 and ATmega162	7/03
AVR088	Migrating between ATmega8535 and ATmega16	1/04
AVR089	Migrating between ATmega16 and ATmega32	6/03
AVR090	Migrating between ATmega64 and ATmega128	6/03
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	4/05
AVR095	Migrating between ATmega48, ATmega88 and ATmega168	2/04
AVR096	Migrating from ATmega128 to AT90CAN128	3/04



Note Number	Description	Last Update
AVR097	Migration between ATmega128 and ATmega2561	09/05
AVR098	Migration between ATmega169 and ATmega329	11/04
AVR099	Replacing AT90S4433 by ATmega48	9/04
AVR100	Accessing the EEPROM	09/05
AVR101	High Endurance EEPROM Storage	9/02
AVR102	Block Routines	5/02
AVR103	Using the EEPROM Programming Modes	3/05
AVR104	Buffered Interrupt Controlled EEPROM Writes	7/03
AVR105	Power Efficient High Endurance Parameter Storage in Flash Memory	9/03
AVR106	C functions for reading and writing to Flash memory	9/04
AVR107	Interfacing AVR serial memories	3/05
AVR108	Setup and Use of the LPM Instructions	5/02
AVR109	Self-programming	6/04
AVR120	Characterization and Calibration of the ADC on an AVR	5/04
AVR121	Enhancing ADC resolution by oversampling	09/05
AVR128	Setup and Use the Analog Comparator	5/02
AVR130	Setup and use the AVR Timers	2/02
AVR131	Using the AVR's High-speed PWM	9/03
AVR132	Using the Enhanced Watchdog Timer	11/03
AVR133	Long Delay Generation Using the AVR Microcontroller	2/04
AVR134	Real-Time Clock using the Asynchronous Timer	09/05
<i>AVR135</i>	<i>Using Timer Capture to Measure PWM Duty Cycle</i>	<i>10/31/2005</i>
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	5/02
AVR182	Zero Cross Detector	1/04
AVR200	Multiply and Divide Routines	10/98
AVR201	Using the AVR Hardware Multiplier	6/02
AVR202	16-Bit Arithmetic	5/02
AVR204	BCD Arithmetic	1/03
AVR220	Bubble Sort	5/02
AVR222	8-Point Moving Average Filter	5/02
AVR223	Digital Filters with AVR	9/02
AVR230	DES Bootloader	4/05
AVR231	AES Bootloader	3/05
AVR236	CRC Check of Program Memory	5/02
AVR240	4x4 Keypad-Wake Up on Keypress	8/03
AVR241	Direct driving of LCD display using general I/O	5/04
AVR242	8-bit Microcontroller Multiplexing LED Drive & a 4x4 Keypad	5/02
AVR243	Matrix Keyboard Decoder	1/03
AVR244	UART as ANSI Terminal Interface	11/03
<i>AVR245</i>	<i>Code Lock with 4x4 Keypad and I2C™ LCD</i>	<i>10/31/2005</i>
AVR301	C Code for Interfacing AVR® to AT17CXX FPGA Configuration Memory	1/04
AVR303	SPI-UART Gateway	3/05
AVR304	Half Duplex Interrupt Driven Software UART	8/97
AVR305	Half Duplex Compact Software UART	09/05
AVR306	Using the AVR UART in C	7/02
AVR307	Half Duplex UART Using the USI Module	10/03
AVR308	Software LIN Slave	5/02
AVR309	Software Universal Serial Bus (USB)	7/05
AVR310	Using the USI Module as a I2C Master	9/04
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	5/02



Note Number	Description	Last Update
<a href="#">AVR315</a>	<a href="#">Using the TWI Module as a I2C Master</a>	10/04
AVR316	SMBus Slave Using the TWI Module	10/31/2005
AVR317	Using the USART on the ATmega48/88/168 as a SPI master	11/04
AVR318	Dallas 1-Wire <sup>®</sup> Master	10/04
AVR319	Using the USI module for SPI communication	11/04
AVR320	Software SPI Master	09/05
AVR325	High-Speed Interface to Host EPP Parallel Port	2/02
AVR335	Digital Sound Recorder with AVR and Serial Data Flash	4/05
AVR336	ADPCM Decoder	1/05
AVR350	XmodemCRC Receive Utility for AVR	09/05
AVR360	Step Motor Controller	4/03
AVR400	Low Cost A/D Converter	5/02
AVR401	8-Bit Precision A/D Converter	2/03
AVR410	RC5 IR Remote Control Receiver	5/02
AVR415	RC5 IR Remote Control Transmitter	5/03
AVR440	Sensorless Control of Two-Phase Brushless DC Motor	09/05
AVR441	Intelligent BLDC Fan Controller with Temperature Sensor and Serial Interface	9/05
AVR442	PC Fan Control using ATtiny13	9/05
AVR443	Sensor-based control of three phase Brushless DC motor	6/05
<a href="#">AVR444</a>	<a href="#">Sensorless control of 3-phase brushless DC motors</a>	10/31/2005
AVR448	Control of High Voltage 3-Phase BLDC Motro	7/05
AVR450	Battery Charger for SLA, NiCd, NiMH and Li-ion Batteries	11/02
AVR453	Smart Battery Reference Design	8/05
AVR454	Users Guide – ATAVRSB100 – Smart Battery Development Board	7/05
AVR460	Embedded Web Server	5/02
AVR461	Quick Start Guide for the Embedded Internet Toolkit	5/02
AVR462	Reducing the Power Consumption of ATEIT1	3/02
AVR465	Energy meter	7/04
AVR492	Brushless DC Motor Control using AT90PWM3	7/05
AVR500	Migration between ATmega64 and Atmega645	9/04
AVR501	Replacing ATtiny15 with ATtiny25	3/05
AVR502	Migration between ATmega165 and ATmega325	11/04
AVR503	Replacing AT90S/LS2323 or AT90S/LS2343 with ATtiny25	09/05
AVR505	Migration between ATmega16/32 and ATmega164/324/644	09/05
AVR910	In-System Programming	11/00
AVR911	AVR Open-source Programmer	7/04