Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 123 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
- Non-volatile Program and Data Memories
  - 2/4/8K Byte of In-System Programmable Program Memory Flash
    - Endurance: 10,000 Write/Erase Cycles
  - 128/256/512 Bytes In-System Programmable EEPROM
    - Endurance: 100,000 Write/Erase Cycles
  - 128/256/512 Bytes Internal SRAM
  - Data retention: 20 years at 85°C / 100 years at 25°C
  - Programming Lock for Self-Programming Flash Program & EEPROM Data Security
- Peripheral Features
  - 8/16-bit Timer/Counter with Prescaler
  - 8/10-bit High Speed Timer/Counter with Separate Prescaler
    - 3 High Frequency PWM Outputs with Separate Output Compare Registers
    - Programmable Dead Time Generator
  - 10-bit ADC
    - 11 Single-Ended Channels
    - 16 Differential ADC Channel Pairs
    - 15 Differential ADC Channel Pairs with Programmable Gain (1x, 8x, 20x, 32x)
  - On-chip Analog Comparator
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - Universal Serial Interface with Start Condition Detector
- Special Microcontroller Features
  - debugWIRE On-chip Debug System
  - In-System Programmable via SPI Port
  - External and Internal Interrupt Sources
  - Low Power Idle, ADC Noise Reduction, Standby and Power-Down Modes
  - Enhanced Power-on Reset Circuit
  - Programmable Brown-out Detection Circuit
  - Internal Calibrated Oscillator
  - On-chip Temperature Sensor
- I/O and Packages
  - 16 Programmable I/O Lines
  - Available in 20-pin PDIP, 20-pin SOIC and 32-pad MLF
- Operating Voltage:
  - 1.8 – 5.5V for ATtiny261V/461V/861V
  - 2.7 – 5.5V for ATtiny261/461/861
- Speed Grade:
  - ATtiny261V/461V/861V: 0 – 4 MHz @ 1.8 – 5.5V, 0 – 10 MHz @ 2.7 – 5.5V
  - ATtiny261/461/861: 0 – 10 MHz @ 2.7 – 5.5V, 0 – 20 MHz @ 4.5 – 5.5V
- Industrial Temperature Range
- Low Power Consumption
  - Active Mode (1 MHz System Clock): 300 µA @ 1.8V
  - Power-Down Mode: 0.1 µA at 1.8V

8-bit AVR® Microcontroller with 2/4/8K Bytes In-System Programmable Flash

ATtiny261/V*
ATtiny461/V
ATtiny861/V

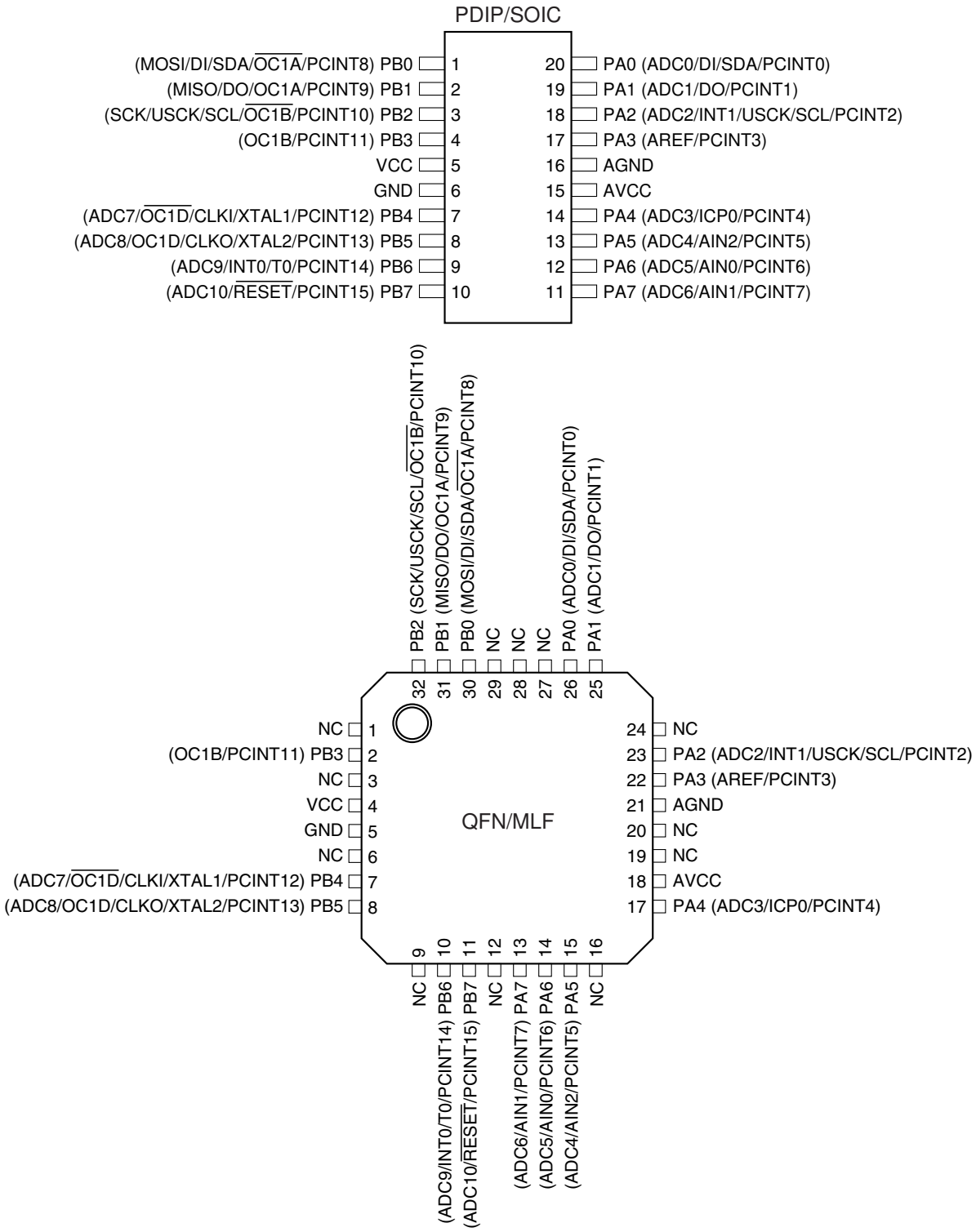
Summary

*Mature

2588FS–AVR–06/2013

1. Pin Configurations

Figure 1-1. Pinout ATtiny261/461/861 and ATtiny261V/461V/861V



Note: To ensure mechanical stability the center pad underneath the QFN/MLF package should be soldered to ground on the board.

1.1 Pin Descriptions

1.1.1 VCC

Supply voltage.

1.1.2 GND

Ground.

1.1.3 AVCC

Analog supply voltage. This is the supply voltage pin for the Analog-to-digital Converter (ADC), the analog comparator, the Brown-Out Detector (BOD), the internal voltage reference and Port A. It should be externally connected to VCC, even if some peripherals such as the ADC are not used. If the ADC is used AVCC should be connected to VCC through a low-pass filter.

1.1.4 AGND

Analog ground.

1.1.5 Port A (PA7:PA0)

An 8-bit, bi-directional I/O port with internal pull-up resistors, individually selectable for each bit. Output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, port pins that are externally pulled low will source current if pull-up resistors have been activated. Port pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port A also serves the functions of various special features of the device, as listed on page 63.

1.1.6 Port B (PB7:PB0)

An 8-bit, bi-directional I/O port with internal pull-up resistors, individually selectable for each bit. Output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, port pins that are externally pulled low will source current if pull-up resistors have been activated. Port pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B also serves the functions of various special features of the device, as listed on page 66.

1.1.7 $\overline{\text{RESET}}$

Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running and provided the reset pin has not been disabled. The minimum pulse length is given in Table 19-4 on page 190. Shorter pulses are not guaranteed to generate a reset.

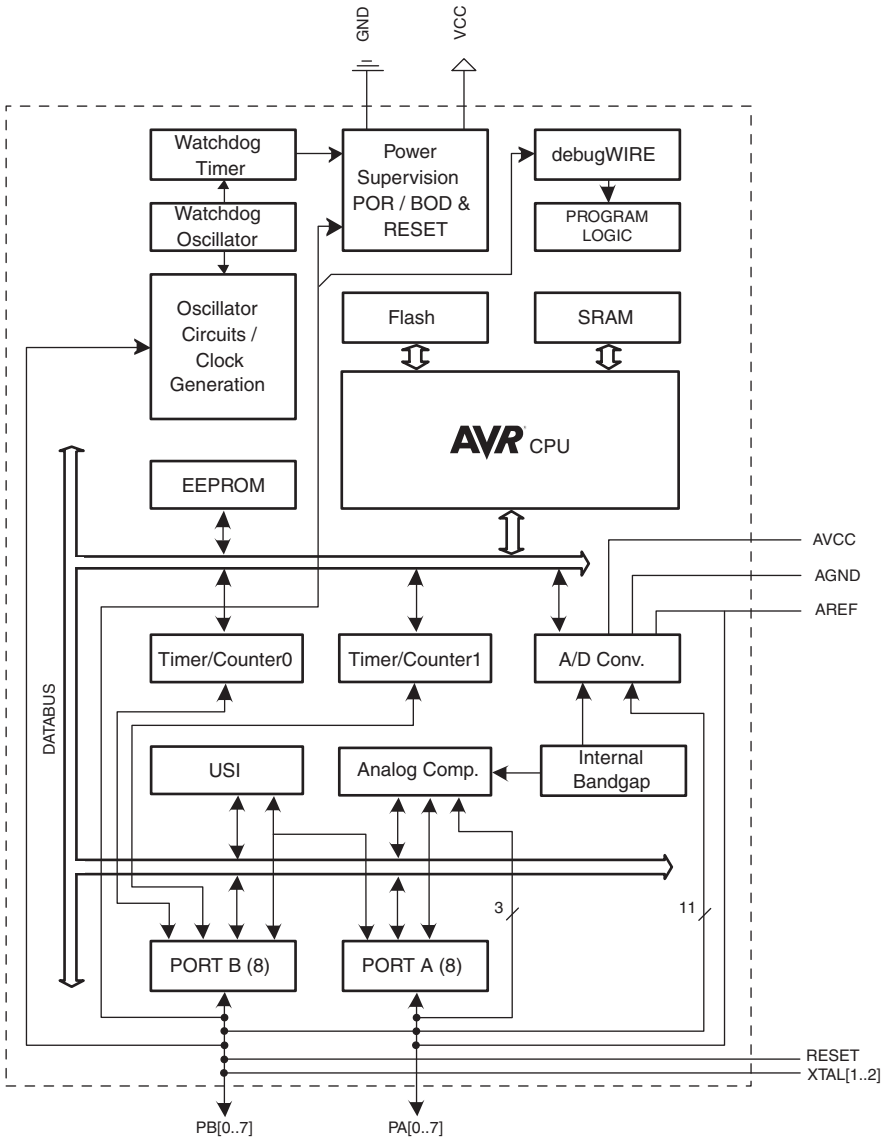
The reset pin can also be used as a (weak) I/O pin.

2. Overview

ATtiny261/461/861 are low-power CMOS 8-bit microcontrollers based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATtiny261/461/861 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

2.1 Block Diagram

Figure 2-1. Block Diagram



The AVR core combines a rich instruction set with 32 general purpose working registers. All 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATtiny261/461/861 provides the following features: 2/4/8K byte of In-System Programmable Flash, 128/256/512 bytes EEPROM, 128/256/512 bytes SRAM, 16 general purpose I/O lines, 32 general purpose working registers, an 8-bit Timer/Counter with compare modes, an 8-bit high speed Timer/Counter, a Universal Serial Interface, Internal and External Interrupts, an 11-channel, 10-bit ADC, a programmable Watchdog Timer with internal oscillator, and four software selectable power saving modes. Idle mode stops the CPU while allowing the SRAM, Timer/Counter, ADC, Analog Comparator, and Interrupt system to continue functioning. Power-down mode saves the register contents, disabling all chip functions until the next Interrupt or Hardware Reset. ADC Noise Reduction mode stops the CPU and all I/O modules except ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping, allowing very fast start-up combined with low power consumption.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the Program memory to be re-programmed In-System through an SPI serial interface, by a conventional non-volatile memory programmer or by an On-chip boot code running on the AVR core.

The ATtiny261/461/861 AVR is supported by a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, and Evaluation kits.

3. About

3.1 Resources

A comprehensive set of drivers, application notes, data sheets and descriptions on development tools are available for download at http://www.atmel.com/avr.

3.2 Code Examples

This documentation contains simple code examples that briefly show how to use various parts of the device. These code examples assume that the part specific header file is included before compilation. Be aware that not all C compiler vendors include bit definitions in the header files and interrupt handling in C is compiler dependent. Please confirm with the C compiler documentation for more details.

For I/O Registers located in the extended I/O map, “IN”, “OUT”, “SBIS”, “SBIC”, “CBI”, and “SBI” instructions must be replaced with instructions that allow access to extended I/O. Typically, this means “LDS” and “STS” combined with “SBRS”, “SBRC”, “SBR”, and “CBR”. Note that not all AVR devices include an extended I/O map.

3.3 Data Retention

Reliability Qualification results show that the projected data retention failure rate is much less than 1 PPM over 20 years at 85°C or 100 years at 25°C.

3.4 Disclaimer

Typical values contained in this data sheet are based on simulations and characterization of other AVR microcontrollers manufactured on the same process technology.

4. Register Summary

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
0x3F (0x5F)	SREG	I	T	H	S	V	N	Z	C	page 8
0x3E (0x5E)	SPH	–	–	–	–	–	SP10	SP9	SP8	page 11
0x3D (0x5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	page 11
0x3C (0x5C)	Reserved	–								
0x3B (0x5B)	GIMSK	INT1	INT0	PCIE1	PCIE0	–	–	–	–	page 52
0x3A (0x5A)	GIFR	INTF1	INTF0	PCIF	–	–	–	–	–	page 53
0x39 (0x59)	TIMSK	OCIE1D	OCIE1A	OCIE1B	OCIE0A	OCIE0B	TOIE1	TOIE0	TICIE0	page 86, page 123
0x38 (0x58)	TIFR	OCF1D	OCF1A	OCF1B	OCF0A	OCF0B	TOV1	TOV0	ICF0	page 87, page 123
0x37 (0x57)	SPMCSR	–	–	–	CTPB	RFLB	PGWRT	PGERS	SPMEN	page 169
0x36 (0x56)	PRR					PRTIM1	PRTIM0	PRUSI	PRADC	page 37
0x35 (0x55)	MCUCR	–	PUD	SE	SM1	SM0	–	ISC01	ISC00	page 39, page 69, page 52
0x34 (0x54)	MCUSR	–	–	–	–	WDRF	BORF	EXTRF	PORF	page 47,
0x33 (0x53)	TCCR0B	–	–	–	TSM	PSR0	CS02	CS01	CS00	page 85
0x32 (0x52)	TCNT0L	Timer/Counter0 Counter Register Low Byte								page 85
0x31 (0x51)	OSCCAL	Oscillator Calibration Register								page 32
0x30 (0x50)	TCCR1A	COM1A1	COM1A0	COM1B1	COM1B0	FOC1A	FOC1B	PWM1A	PWM1B	page 112
0x2F (0x4F)	TCCR1B	PWM1X	PSR1	DTPS11	DTPS10	CS13	CS12	CS11	CS10	page 169
0x2E (0x4E)	TCNT1	Timer/Counter1 Counter Register								page 121
0x2D (0x4D)	OCR1A	Timer/Counter1 Output Compare Register A								page 121
0x2C (0x4C)	OCR1B	Timer/Counter1 Output Compare Register B								page 122
0x2B (0x4B)	OCR1C	Timer/Counter1 Output Compare Register C								page 122
0x2A (0x4A)	OCR1D	Timer/Counter1 Output Compare Register D								page 122
0x29 (0x49)	PLLCSR	LSM					PCKE	PLLE	PLOCK	page 120
0x28 (0x48)	CLKPR	CLKPCE				CLKPS3	CLKPS2	CLKPS1	CLKPS0	page 32
0x27 (0x47)	TCCR1C	COM1A1S	COM1A0S	COM1B1S	COM1B0S	COM1D1	COM1D0	FOC1D	PWM1D	page 117
0x26 (0x46)	TCCR1D	FPIE1	FPEN1	FPNC1	FPES1	FPAC1	FPF1	WGM11	WGM10	page 118
0x25 (0x45)	TC1H							TC19	TC18	page 121
0x24 (0x44)	DT1	DT1H3	DT1H2	DT1H1	DT1H0	DT1L3	DT1L2	DT1L1	DT1L0	page 124
0x23 (0x43)	PCMSK0	PCINT7	PCINT6	PCINT5	PCINT4	PCINT3	PCINT2	PCINT1	PCINT0	page 54
0x22 (0x42)	PCMSK1	PCINT15	PCINT14	PCINT13	PCINT12	PCINT11	PCINT10	PCINT9	PCINT8	page 54
0x21 (0x41)	WDTCR	WDIF	WDIE	WDP3	WDCE	WDE	WDP2	WDP1	WDP0	page 47
0x20 (0x40)	DWDR	DWDR[7:0]								page 37
0x1F (0x3F)	EEARH								EEAR8	page 20
0x1E (0x3E)	EEARL	EEAR7	EEAR6	EEAR5	EEAR4	EEAR3	EEAR2	EEAR1	EEAR0	page 21
0x1D (0x3D)	EEDR	EEPROM Data Register								page 21
0x1C (0x3C)	EECR	–	–	EEPM1	EEPM0	EERIE	EEMPE	EEPE	EERE	page 21
0x1B (0x3B)	PORTA	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0	page 69
0x1A (0x3A)	DDRA	DDA7	DDA6	DDA5	DDA4	DDA3	DDA2	DDA1	DDA0	page 69
0x19 (0x39)	PINA	PINA7	PINA6	PINA5	PINA4	PINA3	PINA2	PINA1	PINA0	page 70
0x18 (0x38)	PORTB	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0	page 70
0x17 (0x37)	DDRB	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	page 70
0x16 (0x36)	PINB	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	page 70
0x15 (0x35)	TCCR0A	TCW0	ICEN0	ICNC0	ICES0	ACIC0			CTC0	page 84
0x14 (0x34)	TCNT0H	Timer/Counter0 Counter Register High Byte								page 86
0x13 (0x33)	OCR0A	Timer/Counter0 Output Compare Register A								page 86
0x12 (0x32)	OCR0B	Timer/Counter0 Output Compare Register B								page 86
0x11 (0x31)	USIPP								USIPOS	page 136
0x10 (0x30)	USIBR	USI Buffer Register								page 133
0x0F (0x2F)	USIDR	USI Data Register								page 132
0x0E (0x2E)	USISR	USISIF	USIOIF	USIPF	USIDC	USICNT3	USICNT2	USICNT1	USICNT0	page 133
0x0D (0x2D)	USICR	USISIE	USIOIE	USIWM1	USIWM0	USICS1	USICS0	USICLK	USITC	page 134
0x0C (0x2C)	GPIOR2	General Purpose I/O Register 2								page 22
0x0B (0x2B)	GPIOR1	General Purpose I/O Register 1								page 23
0x0A (0x2A)	GPIOR0	General Purpose I/O Register 0								page 23
0x09 (0x29)	ACSRB	HSEL	HLEV				ACM2	ACM1	ACM0	page 140
0x08 (0x28)	ACSRA	ACD	ACBG	ACO	ACI	ACIE	ACME	ACIS1	ACIS0	page 139
0x07 (0x27)	ADMUX	REFS1	REFS0	ADLAR	MUX4	MUX3	MUX2	MUX1	MUX0	page 155
0x06 (0x26)	ADCSRA	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	page 159
0x05 (0x25)	ADCH	ADC Data Register High Byte								page 160
0x04 (0x24)	ADCL	ADC Data Register Low Byte								page 160
0x03 (0x23)	ADCSRB	BIN	GSEL		REFS2	MUX5	ADTS2	ADTS1	ADTS0	page 161
0x02 (0x22)	DIDR1	ADC10D	ADC9D	ADC8D	ADC7D					page 162
0x01 (0x21)	DIDR0	ADC6D	ADC5D	ADC4D	ADC3D	AREFD	ADC2D	ADC1D	ADC0D	page 162
0x00 (0x20)	TCCR1E	–	-	OC1OE5	OC1OE4	OC1OE3	OC1OE2	OC1OE1	OC1OE0	page 119

Note:
1. For compatibility with future devices, reserved bits should be written to zero if accessed. Reserved I/O memory addresses should never be written.
2. I/O Registers within the address range 0x00 - 0x1F are directly bit-accessible using the SBI and CBI instructions. In these registers, the value of single bits can be checked by using the SBIS and SBIC instructions.
3. Some of the Status Flags are cleared by writing a logical one to them. Note that, unlike most other AVRs, the CBI and SBI instructions will only operation the specified bit, and can therefore be used on registers containing such Status Flags. The CBI and SBI instructions work with registers 0x00 to 0x1F only.

5. Instruction Set Summary

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ARITHMETIC AND LOGIC INSTRUCTIONS					
ADD	Rd, Rr	Add two Registers	Rd ← Rd + Rr	Z,C,N,V,H	1
ADC	Rd, Rr	Add with Carry two Registers	Rd ← Rd + Rr + C	Z,C,N,V,H	1
ADIW	Rdl,K	Add Immediate to Word	Rdh:Rdl ← Rdh:Rdl + K	Z,C,N,V,S	2
SUB	Rd, Rr	Subtract two Registers	Rd ← Rd - Rr	Z,C,N,V,H	1
SUBI	Rd, K	Subtract Constant from Register	Rd ← Rd - K	Z,C,N,V,H	1
SBC	Rd, Rr	Subtract with Carry two Registers	Rd ← Rd - Rr - C	Z,C,N,V,H	1
SBCI	Rd, K	Subtract with Carry Constant from Reg.	Rd ← Rd - K - C	Z,C,N,V,H	1
SBIW	Rdl,K	Subtract Immediate from Word	Rdh:Rdl ← Rdh:Rdl - K	Z,C,N,V,S	2
AND	Rd, Rr	Logical AND Registers	Rd ← Rd • Rr	Z,N,V	1
ANDI	Rd, K	Logical AND Register and Constant	Rd ← Rd • K	Z,N,V	1
OR	Rd, Rr	Logical OR Registers	Rd ← Rd v Rr	Z,N,V	1
ORI	Rd, K	Logical OR Register and Constant	Rd ← Rd v K	Z,N,V	1
EOR	Rd, Rr	Exclusive OR Registers	Rd ← Rd ⊕ Rr	Z,N,V	1
COM	Rd	One's Complement	Rd ← 0xFF – Rd	Z,C,N,V	1
NEG	Rd	Two's Complement	Rd ← 0x00 – Rd	Z,C,N,V,H	1
SBR	Rd,K	Set Bit(s) in Register	Rd ← Rd v K	Z,N,V	1
CBR	Rd,K	Clear Bit(s) in Register	Rd ← Rd • (0xFF - K)	Z,N,V	1
INC	Rd	Increment	Rd ← Rd + 1	Z,N,V	1
DEC	Rd	Decrement	Rd ← Rd – 1	Z,N,V	1
TST	Rd	Test for Zero or Minus	Rd ← Rd • Rd	Z,N,V	1
CLR	Rd	Clear Register	Rd ← Rd ⊕ Rd	Z,N,V	1
SER	Rd	Set Register	Rd ← 0xFF	None	1
BRANCH INSTRUCTIONS					
RJMP	k	Relative Jump	PC ← PC + k + 1	None	2
IJMP		Indirect Jump to (Z)	PC ← Z	None	2
RCALL	k	Relative Subroutine Call	PC ← PC + k + 1	None	3
ICALL		Indirect Call to (Z)	PC ← Z	None	3
RET		Subroutine Return	PC ← STACK	None	4
RETI		Interrupt Return	PC ← STACK	I	4
CPSE	Rd,Rr	Compare, Skip if Equal	if (Rd = Rr) PC ← PC + 2 or 3	None	1/2/3
CP	Rd,Rr	Compare	Rd – Rr	Z, N,V,C,H	1
CPC	Rd,Rr	Compare with Carry	Rd – Rr – C	Z, N,V,C,H	1
CPI	Rd,K	Compare Register with Immediate	Rd – K	Z, N,V,C,H	1
SBRC	Rr, b	Skip if Bit in Register Cleared	if (Rr(b)=0) PC ← PC + 2 or 3	None	1/2/3
SBRS	Rr, b	Skip if Bit in Register is Set	if (Rr(b)=1) PC ← PC + 2 or 3	None	1/2/3
SBIC	P, b	Skip if Bit in I/O Register Cleared	if (P(b)=0) PC ← PC + 2 or 3	None	1/2/3
SBIS	P, b	Skip if Bit in I/O Register is Set	if (P(b)=1) PC ← PC + 2 or 3	None	1/2/3
BRBS	s, k	Branch if Status Flag Set	if (SREG(s) = 1) then PC←PC+k + 1	None	1/2
BRBC	s, k	Branch if Status Flag Cleared	if (SREG(s) = 0) then PC←PC+k + 1	None	1/2
BREQ	k	Branch if Equal	if (Z = 1) then PC ← PC + k + 1	None	1/2
BRNE	k	Branch if Not Equal	if (Z = 0) then PC ← PC + k + 1	None	1/2
BRCS	k	Branch if Carry Set	if (C = 1) then PC ← PC + k + 1	None	1/2
BRCC	k	Branch if Carry Cleared	if (C = 0) then PC ← PC + k + 1	None	1/2
BRSH	k	Branch if Same or Higher	if (C = 0) then PC ← PC + k + 1	None	1/2
BRLO	k	Branch if Lower	if (C = 1) then PC ← PC + k + 1	None	1/2
BRMI	k	Branch if Minus	if (N = 1) then PC ← PC + k + 1	None	1/2
BRPL	k	Branch if Plus	if (N = 0) then PC ← PC + k + 1	None	1/2
BRGE	k	Branch if Greater or Equal, Signed	if (N ⊕ V= 0) then PC ← PC + k + 1	None	1/2
BRLT	k	Branch if Less Than Zero, Signed	if (N ⊕ V= 1) then PC ← PC + k + 1	None	1/2
BRHS	k	Branch if Half Carry Flag Set	if (H = 1) then PC ← PC + k + 1	None	1/2
BRHC	k	Branch if Half Carry Flag Cleared	if (H = 0) then PC ← PC + k + 1	None	1/2
BRTS	k	Branch if T Flag Set	if (T = 1) then PC ← PC + k + 1	None	1/2
BRTC	k	Branch if T Flag Cleared	if (T = 0) then PC ← PC + k + 1	None	1/2
BRVS	k	Branch if Overflow Flag is Set	if (V = 1) then PC ← PC + k + 1	None	1/2
BRVC	k	Branch if Overflow Flag is Cleared	if (V = 0) then PC ← PC + k + 1	None	1/2
BRIE	k	Branch if Interrupt Enabled	if (I = 1) then PC ← PC + k + 1	None	1/2
BRID	k	Branch if Interrupt Disabled	if (I = 0) then PC ← PC + k + 1	None	1/2
BIT AND BIT-TEST INSTRUCTIONS					
SBI	P,b	Set Bit in I/O Register	I/O(P,b) ← 1	None	2
CBI	P,b	Clear Bit in I/O Register	I/O(P,b) ← 0	None	2
LSL	Rd	Logical Shift Left	Rd(n+1) ← Rd(n), Rd(0) ← 0	Z,C,N,V	1
LSR	Rd	Logical Shift Right	Rd(n) ← Rd(n+1), Rd(7) ← 0	Z,C,N,V	1
ROL	Rd	Rotate Left Through Carry	Rd(0)←C,Rd(n+1)← Rd(n),C←Rd(7)	Z,C,N,V	1
ROR	Rd	Rotate Right Through Carry	Rd(7)←C,Rd(n)← Rd(n+1),C←Rd(0)	Z,C,N,V	1

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ASR	Rd	Arithmetic Shift Right	Rd(n) ← Rd(n+1), n=0..6	Z,C,N,V	1
SWAP	Rd	Swap Nibbles	Rd(3..0)←Rd(7..4),Rd(7..4)←Rd(3..0)	None	1
BSET	s	Flag Set	SREG(s) ← 1	SREG(s)	1
BCLR	s	Flag Clear	SREG(s) ← 0	SREG(s)	1
BST	Rr, b	Bit Store from Register to T	T ← Rr(b)	T	1
BLD	Rd, b	Bit load from T to Register	Rd(b) ← T	None	1
SEC		Set Carry	C ← 1	C	1
CLC		Clear Carry	C ← 0	C	1
SEN		Set Negative Flag	N ← 1	N	1
CLN		Clear Negative Flag	N ← 0	N	1
SEZ		Set Zero Flag	Z ← 1	Z	1
CLZ		Clear Zero Flag	Z ← 0	Z	1
SEI		Global Interrupt Enable	I ← 1	I	1
CLI		Global Interrupt Disable	I ← 0	I	1
SES		Set Signed Test Flag	S ← 1	S	1
CLS		Clear Signed Test Flag	S ← 0	S	1
SEV		Set Twos Complement Overflow.	V ← 1	V	1
CLV		Clear Twos Complement Overflow	V ← 0	V	1
SET		Set T in SREG	T ← 1	T	1
CLT		Clear T in SREG	T ← 0	T	1
SEH		Set Half Carry Flag in SREG	H ← 1	H	1
CLH		Clear Half Carry Flag in SREG	H ← 0	H	1
DATA TRANSFER INSTRUCTIONS					
MOV	Rd, Rr	Move Between Registers	Rd ← Rr	None	1
MOVW	Rd, Rr	Copy Register Word	Rd+1:Rd ← Rr+1:Rr	None	1
LDI	Rd, K	Load Immediate	Rd ← K	None	1
LD	Rd, X	Load Indirect	Rd ← (X)	None	2
LD	Rd, X+	Load Indirect and Post-Inc.	Rd ← (X), X ← X + 1	None	2
LD	Rd, - X	Load Indirect and Pre-Dec.	X ← X - 1, Rd ← (X)	None	2
LD	Rd, Y	Load Indirect	Rd ← (Y)	None	2
LD	Rd, Y+	Load Indirect and Post-Inc.	Rd ← (Y), Y ← Y + 1	None	2
LD	Rd, - Y	Load Indirect and Pre-Dec.	Y ← Y - 1, Rd ← (Y)	None	2
LDD	Rd,Y+q	Load Indirect with Displacement	Rd ← (Y + q)	None	2
LD	Rd, Z	Load Indirect	Rd ← (Z)	None	2
LD	Rd, Z+	Load Indirect and Post-Inc.	Rd ← (Z), Z ← Z+1	None	2
LD	Rd, -Z	Load Indirect and Pre-Dec.	Z ← Z - 1, Rd ← (Z)	None	2
LDD	Rd, Z+q	Load Indirect with Displacement	Rd ← (Z + q)	None	2
LDS	Rd, k	Load Direct from SRAM	Rd ← (k)	None	2
ST	X, Rr	Store Indirect	(X) ← Rr	None	2
ST	X+, Rr	Store Indirect and Post-Inc.	(X) ← Rr, X ← X + 1	None	2
ST	- X, Rr	Store Indirect and Pre-Dec.	X ← X - 1, (X) ← Rr	None	2
ST	Y, Rr	Store Indirect	(Y) ← Rr	None	2
ST	Y+, Rr	Store Indirect and Post-Inc.	(Y) ← Rr, Y ← Y + 1	None	2
ST	- Y, Rr	Store Indirect and Pre-Dec.	Y ← Y - 1, (Y) ← Rr	None	2
STD	Y+q,Rr	Store Indirect with Displacement	(Y + q) ← Rr	None	2
ST	Z, Rr	Store Indirect	(Z) ← Rr	None	2
ST	Z+, Rr	Store Indirect and Post-Inc.	(Z) ← Rr, Z ← Z + 1	None	2
ST	-Z, Rr	Store Indirect and Pre-Dec.	Z ← Z - 1, (Z) ← Rr	None	2
STD	Z+q,Rr	Store Indirect with Displacement	(Z + q) ← Rr	None	2
STS	k, Rr	Store Direct to SRAM	(k) ← Rr	None	2
LPM		Load Program Memory	R0 ← (Z)	None	3
LPM	Rd, Z	Load Program Memory	Rd ← (Z)	None	3
LPM	Rd, Z+	Load Program Memory and Post-Inc	Rd ← (Z), Z ← Z+1	None	3
SPM		Store Program Memory	(z) ← R1:R0	None	
IN	Rd, P	In Port	Rd ← P	None	1
OUT	P, Rr	Out Port	P ← Rr	None	1
PUSH	Rr	Push Register on Stack	STACK ← Rr	None	2
POP	Rd	Pop Register from Stack	Rd ← STACK	None	2
MCU CONTROL INSTRUCTIONS					
NOP		No Operation		None	1
SLEEP		Sleep	(see specific descr. for Sleep function)	None	1
WDR		Watchdog Reset	(see specific descr. for WDR/Timer)	None	1
BREAK		Break	For On-chip Debug Only	None	N/A

6. Ordering Information

6.1 ATtiny261 - Mature

Speed (MHz)[3]	Power Supply (V)	Ordering Code[4][5]	Package[2]	Operational Range
10	1.8 - 5.5	ATtiny261V-10MU ATtiny261V-10MUR ATtiny261V-10PU ATtiny261V-10SU ATtiny261V-10SUR	32M1-A 32M1-A 20P3 20S2 20S2	Industrial (-40°C to +85°C)[1]
20	2.7 - 5.5	ATtiny261-20MU ATtiny261-20MUR ATtiny261-20PU ATtiny261-20SU ATtiny261-20SUR	32M1-A 32M1-A 20P3 20S2 20S2	Industrial (-40°C to +85°C)[1]

Notes:
1. These devices can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
2. All packages are Pb-free, halide-free and fully green and they comply with the European directive for Restriction of Hazardous Substances (RoHS).
3. For Speed vs. V_{CC}, see Figure 19.3 on page 188.
4. Code indicators:
   - U: matte tin
   - R: tape & reel
5. Mature devices, replaced by ATtiny261A.

Package Type	
32M1-A	32-pad, 5 x 5 x 1.0 mm Body, Lead Pitch 0.50 mm, Micro Lead Frame Package (MLF)
20P3	20-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20S2	20-lead, 0.300" Wide, Plastic Gull Wing Smal Outline Package (SOIC)

6.2 ATtiny461

Speed (MHz)[3]	Power Supply (V)	Ordering Code[4]	Package[2]	Operational Range
10	1.8 - 5.5	ATtiny461V-10MU ATtiny461V-10MUR ATtiny461V-10PU ATtiny461V-10SU ATtiny461V-10SUR	32M1-A 32M1-A 20P3 20S2 20S2	Industrial (-40°C to +85°C)[1]
20	2.7 - 5.5	ATtiny461-20MU ATtiny461-20MUR ATtiny461-20PU ATtiny461-20SU ATtiny461-20SUR	32M1-A 32M1-A 20P3 20S2 20S2	Industrial (-40°C to +85°C)[1]

Notes:
1. These devices can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
2. All packages are Pb-free, halide-free and fully green and they comply with the European directive for Restriction of Hazardous Substances (RoHS).
3. For Speed vs. V_{CC}, see Figure 19.3 on page 188.
4. Code indicators:
   - U: matte tin
   - R: tape & reel

Package Type	
32M1-A	32-pad, 5 x 5 x 1.0 mm Body, Lead Pitch 0.50 mm, Micro Lead Frame Package (MLF)
20P3	20-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20S2	20-lead, 0.300" Wide, Plastic Gull Wing Smal Outline Package (SOIC)

6.3 ATtiny861

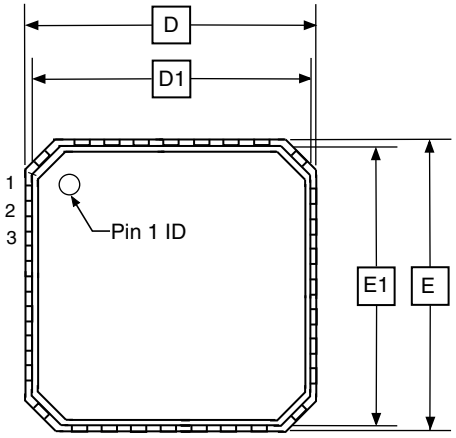
Speed (MHz)[3]	Power Supply (V)	Ordering Code[4]	Package[2]	Operational Range
10	1.8 - 5.5	ATtiny861V-10MU ATtiny861V-10MUR ATtiny861V-10PU ATtiny861V-10SU ATtiny861V-10SUR	32M1-A 32M1-A 20P3 20S2 20S2	Industrial (-40°C to +85°C)[1]
20	2.7 - 5.5	ATtiny861-20MU ATtiny861-20MUR ATtiny861-20PU ATtiny861-20SU ATtiny861-20SUR	32M1-A 32M1-A 20P3 20S2 20S2	Industrial (-40°C to +85°C)[1]

Notes:
1. These devices can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
2. All packages are Pb-free, halide-free and fully green and they comply with the European directive for Restriction of Hazardous Substances (RoHS).
3. For Speed vs. V_{CC}, see Figure 19.3 on page 188.
4. Code indicators:
   - U: matte tin
   - R: tape & reel

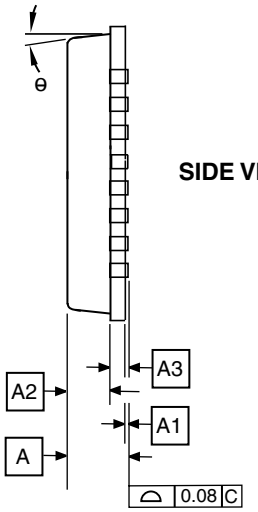
Package Type	
32M1-A	32-pad, 5 x 5 x 1.0 mm Body, Lead Pitch 0.50 mm, Micro Lead Frame Package (MLF)
20P3	20-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20S2	20-lead, 0.300" Wide, Plastic Gull Wing Smal Outline Package (SOIC)

7. Packaging Information

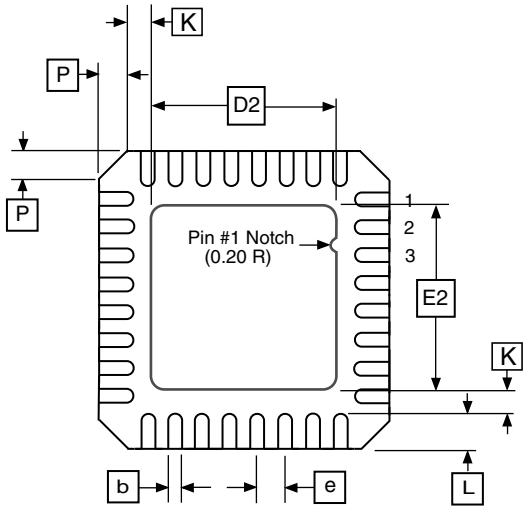
7.1 32M1-A



TOP VIEW



SIDE VIEW



BOTTOM VIEW

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.80	0.90	1.00	
A1	–	0.02	0.05	
A2	–	0.65	1.00	
A3		0.20 REF		
b	0.18	0.23	0.30	
D		5.00 BSC		
D1		4.75 BSC		
D2	2.95	3.10	3.25	
E		5.00 BSC		
E1		4.75BSC		
E2	2.95	3.10	3.25	
e		0.50 BSC		
L	0.30	0.40	0.50	
P	–	–	0.60	
θ	–	–	12^{o}	
K	0.20	–	–	

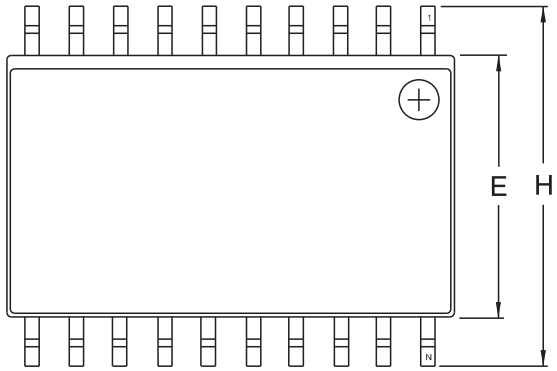
Note: JEDEC Standard MO-220, Fig. 2 (Anvil Singulation), VHHD-2.

8/19/04

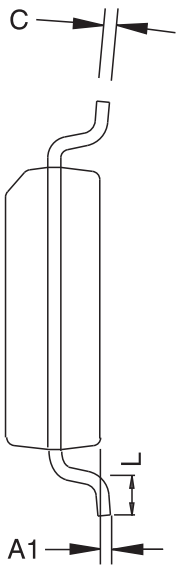
	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**32M1-A**, 32-pad, 5 x 5 x 1.0 mm Body, Lead Pitch 0.50 mm, 3.10 mm Exposed Pad, Micro Lead Frame Package (MLF)	32M1-A	D

7.2 20P3

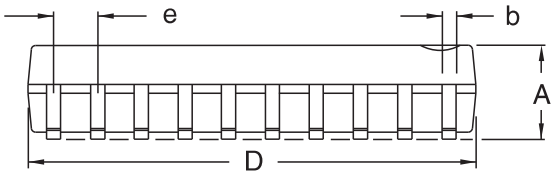
7.3 20S2



Top View



End View



Side View

COMMON DIMENSIONS
(Unit of Measure – mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	2.35		2.65	
A1	0.10		0.30	
b	0.33		0.51	4
C	0.23		0.32	
D	12.60		13.00	1
E	7.40		7.60	2
H	10.00		10.65	
L	0.40		1.27	3
e	1.27 BSC			

Notes.
1. This drawing is for general information only; refer to JEDEC Drawing MS-013, Variation AC for additional information.
2. Dimension 'D' does not include mold Flash, protrusions or gate burrs. Mold Flash, protrusions and gate burrs shall not exceed 0.15 mm (0.006') per side.
3. Dimension 'E' does not include inter-lead Flash or protrusion. Inter-lead Flash and protrusions shall not exceed 0.25 mm (0.010') per side.
4. 'L' is the length of the terminal for soldering to a substrate.
5. The lead width 'b', as measured 0.36 mm (0.014') or greater above the seating plane, shall not exceed a maximum value of 0.61 mm (0.024') per side.

11/6/06

2325 Orchard Parkway San Jose, CA 95131	**TITLE** **20S2**, 20-lead, 0.300' Wide Body, Plastic Gull Wing Small Outline Package (SOIC)	**DRAWING NO.** 20S2	**REV.** B

8. Errata

8.1 Errata ATtiny261

The revision letter in this section refers to the revision of the ATtiny261 device.

8.1.1 Rev A

No known errata.

8.2 Errata ATtiny461

The revision letter in this section refers to the revision of the ATtiny461 device.

8.2.1 Rev B

Yield improvement. No known errata.

8.2.2 Rev A

No known errata.

8.3 Errata ATtiny861

The revision letter in this section refers to the revision of the ATtiny861 device.

8.3.1 Rev B

No known errata.

8.3.2 Rev A

Not sampled.

9. Datasheet Revision History

Please note that the referring page numbers in this section refer to the complete document.

9.1 Rev. 2588F – 06/13

1. ATtiny261 changed status to “Mature”.

9.2 Rev. 2588E – 08/10

1. Added tape and reel in “Ordering Information” on page 11.
2. Clarified Section 6.4 “Clock Output Buffer” on page 32.
3. Removed text "Not recommended for new designs" from cover page.

9.3 Rev. 2588D – 06/10

1. Removed “Preliminary” from cover page.
2. Added clarification before Table 6-10, “Capacitance for Low-Frequency Crystal Oscillator,” on page 29.
3. Updated Figure 15-1 “Analog to Digital Converter Block Schematic” on page 143, changed INTERNAL 1.18V REFERENCE to 1.1V.
4. Updated Table 18-8, “No. of Words in a Page and No. of Pages in the EEPROM,” on page 173, No. of Pages from 64 to 32 for ATtiny261.
5. Adjusted notes in Table 19-1, “DC Characteristics. T_A = -40°C to +85°C, V_{CC} = 1.8V to 5.5V (unless otherwise noted).,” on page 187.

9.4 Rev. 2588C – 10/09

1. Updated document template. Re-arranged some sections.
2. Changed device status to "Not Recommended for New Designs".
3. Added Sections:
   – “Data Retention” on page 6
   – “Clock Sources” on page 25
   – “Low Level Interrupt” on page 51
   – “Prescaling and Conversion Timing” on page 145
   – “Clock speed considerations” on page 131
4. Updated Sections:
   – “Code Examples” on page 6
   – “High-Frequency PLL Clock” on page 26
   – “Normal Mode” on page 99
   – “Features” on page 142
   – “Temperature Measurement” on page 154
   – “Limitations of debugWIRE” on page 164
   – Step 1. on page 174
   – “Programming the Flash” on page 180
   – “System and Reset Characteristics” on page 190
5. Added Figures:
   – “Flash Programming Waveforms” on page 182

- "Reset Pin Output Voltage vs. Sink Current (V_{CC} = 3V)" on page 209
- "Reset Pin Output Voltage vs. Sink Current (V_{CC} = 3V)" on page 209
- "Reset Pin Output Voltage vs. Sink Current (V_{CC} = 3V)" on page 209
- "Reset Pin Output Voltage vs. Sink Current (V_{CC} = 3V)" on page 209
- "Bandgap Voltage vs. Supply Voltage (VCC)." on page 216

6. Updated Figures:
   - "Block Diagram" on page 4
   - "Clock Distribution" on page 24
7. Added Table:
   - "Capacitance for Low-Frequency Crystal Oscillator" on page 29
8. Updated Tables:
   - "Start-up Times for the Internal Calibrated RC Oscillator Clock Selection" on page 28
   - "Start-up Times for the 128 kHz Internal Oscillator" on page 29
   - "Active Clock Domains and Wake-up Sources in Different Sleep Modes" on page 36
   - "Serial Programming Characteristics, T_A = -40°C to +85°C, V_{CC} = 1.8 - 5.5V (Unless Otherwise Noted)" on page 193
9. Updated Register Descriptions:
   - "TCCR1A – Timer/Counter1 Control Register A" on page 112
   - "TCCR1C – Timer/Counter1 Control Register C" on page 117
   - "ADMUX – ADC Multiplexer Selection Register" on page 155
10. Updated assembly program example in section "Write" on page 17.
11. Updated "DC Characteristics. T_A = -40°C to +85°C, V_{CC} = 1.8V to 5.5V (unless otherwise noted)." on page 187.

9.5 Rev. 2588B – 11/06

1. Updated "Ordering Information" on page 11.
2. Updated "Packaging Information" on page 15.

9.6 Rev. 2588A – 10/06

1. Initial Revision.

Atmel | Enabling Unlimited Possibilities®

Atmel Corporation
1600 Technology Drive
San Jose, CA 95110
USA
Tel: (+1) (408) 441-0311
Fax: (+1) (408) 487-2600
www.atmel.com

Atmel Asia Limited
Unit 01-5 & 16, 19F
BEA Tower, Millennium City 5
418 Kwun Tong Roa
Kwun Tong, Kowloon
HONG KONG
Tel: (+852) 2245-6100
Fax: (+852) 2722-1369

Atmel Munich GmbH
Business Campus
Parkring 4
D-85748 Garching b. Munich
GERMANY
Tel: (+49) 89-31970-0
Fax: (+49) 89-3194621

Atmel Japan G.K.
16F Shin-Osaki Kangyo Bldg
1-6-4 Osaki, Shinagawa-ku
Tokyo 141-0032
JAPAN
Tel: (+81) (3) 6417-0300
Fax: (+81) (3) 6417-0370

© 2013 Atmel Corporation. All rights reserved. / Rev.: 2588FS–AVR–06/2013

Atmel®, Atmel logo and combinations thereof, Enabling Unlimited Possibilities®, AVR® and others are registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.

Disclaimer: The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. EXCEPT AS SET FORTH IN THE ATMEL TERMS AND CONDITIONS OF SALES LOCATED ON THE ATMEL WEBSITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS AND PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and products descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.