

## 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

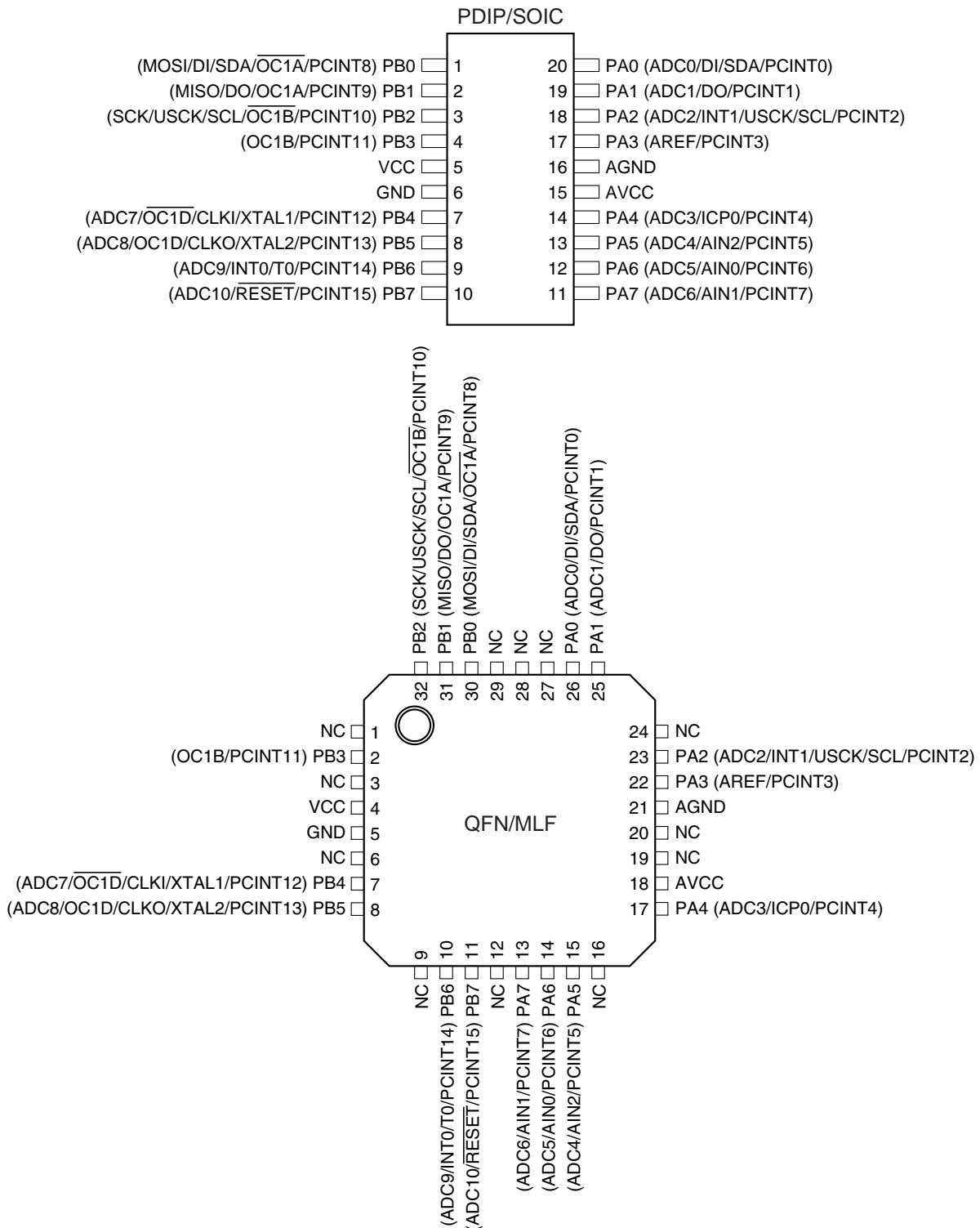
## Summary

\*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 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.

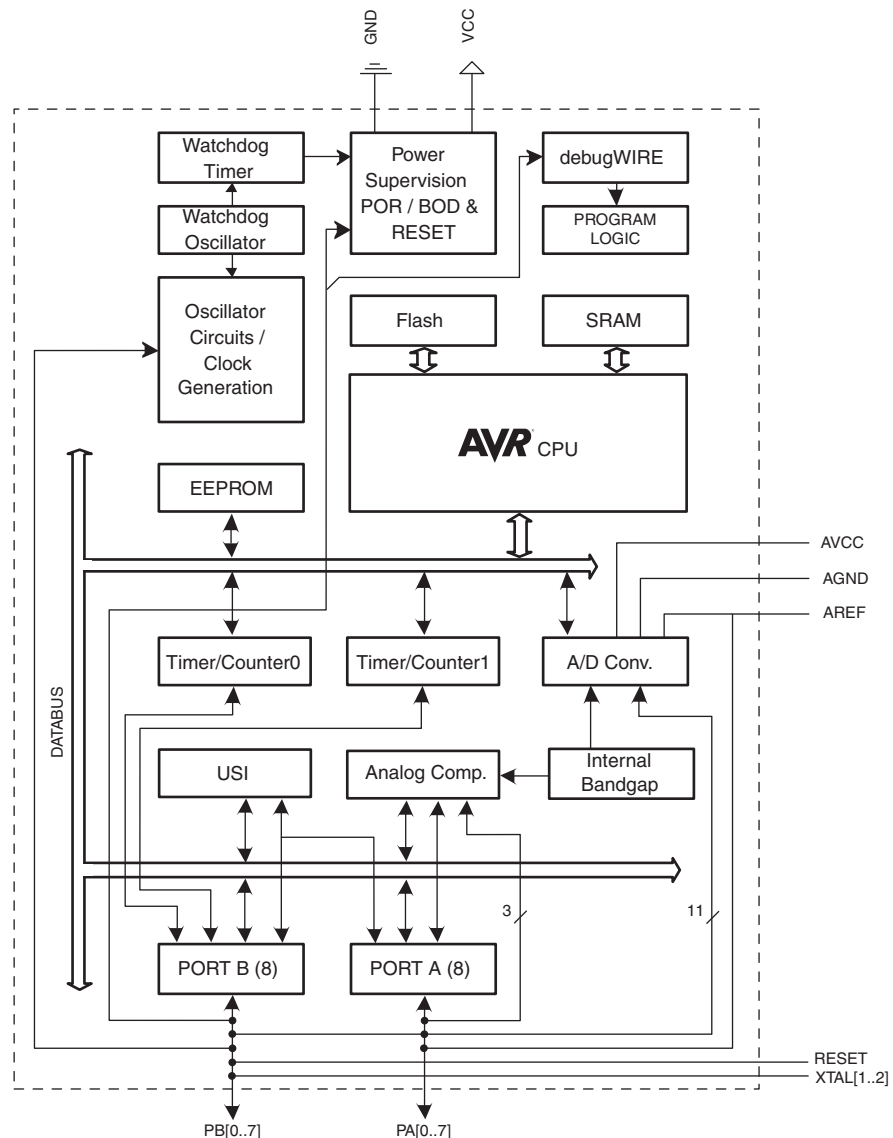
The reset pin can also be used as a (weak) I/O pin.

## 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	FP1E1	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)	EEDR	–	–	EEDR1	EEDR0	EEDR7	EEDR6	EEDR5	EEDR4	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)	GPOR2	General Purpose I/O Register 2								page 22
0x0B (0x2B)	GPOR1	General Purpose I/O Register 1								page 23
0x0A (0x2A)	GPOR0	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
<b>ARITHMETIC AND LOGIC INSTRUCTIONS</b>					
ADD	Rd, Rr	Add two Registers	$Rd \leftarrow Rd + Rr$	Z,C,N,V,H	1
ADC	Rd, Rr	Add with Carry two Registers	$Rd \leftarrow Rd + Rr + C$	Z,C,N,V,H	1
ADIW	Rd,K	Add Immediate to Word	$Rdh:Rdl \leftarrow Rdh:Rdl + K$	Z,C,N,V,S	2
SUB	Rd, Rr	Subtract two Registers	$Rd \leftarrow Rd - Rr$	Z,C,N,V,H	1
SUBI	Rd, K	Subtract Constant from Register	$Rd \leftarrow Rd - K$	Z,C,N,V,H	1
SBC	Rd, Rr	Subtract with Carry two Registers	$Rd \leftarrow Rd - Rr - C$	Z,C,N,V,H	1
SBCI	Rd, K	Subtract with Carry Constant from Reg.	$Rd \leftarrow Rd - K - C$	Z,C,N,V,H	1
SBIW	Rd,K	Subtract Immediate from Word	$Rdh:Rdl \leftarrow Rdh:Rdl - K$	Z,C,N,V,S	2
AND	Rd, Rr	Logical AND Registers	$Rd \leftarrow Rd \bullet Rr$	Z,N,V	1
ANDI	Rd, K	Logical AND Register and Constant	$Rd \leftarrow Rd \bullet K$	Z,N,V	1
OR	Rd, Rr	Logical OR Registers	$Rd \leftarrow Rd \vee Rr$	Z,N,V	1
ORI	Rd, K	Logical OR Register and Constant	$Rd \leftarrow Rd \vee K$	Z,N,V	1
EOR	Rd, Rr	Exclusive OR Registers	$Rd \leftarrow Rd \oplus Rr$	Z,N,V	1
COM	Rd	One's Complement	$Rd \leftarrow 0xFF - Rd$	Z,C,N,V	1
NEG	Rd	Two's Complement	$Rd \leftarrow 0x00 - Rd$	Z,C,N,V,H	1
SBR	Rd,K	Set Bit(s) in Register	$Rd \leftarrow Rd \vee K$	Z,N,V	1
CBR	Rd,K	Clear Bit(s) in Register	$Rd \leftarrow Rd \bullet (0xFF - K)$	Z,N,V	1
INC	Rd	Increment	$Rd \leftarrow Rd + 1$	Z,N,V	1
DEC	Rd	Decrement	$Rd \leftarrow Rd - 1$	Z,N,V	1
TST	Rd	Test for Zero or Minus	$Rd \leftarrow Rd \bullet Rd$	Z,N,V	1
CLR	Rd	Clear Register	$Rd \leftarrow Rd \oplus Rd$	Z,N,V	1
SER	Rd	Set Register	$Rd \leftarrow 0xFF$	None	1
<b>BRANCH INSTRUCTIONS</b>					
RJMP	k	Relative Jump	$PC \leftarrow PC + k + 1$	None	2
IJMP		Indirect Jump to (Z)	$PC \leftarrow Z$	None	2
RCALL	k	Relative Subroutine Call	$PC \leftarrow PC + k + 1$	None	3
ICALL		Indirect Call to (Z)	$PC \leftarrow Z$	None	3
RET		Subroutine Return	$PC \leftarrow STACK$	None	4
RETI		Interrupt Return	$PC \leftarrow STACK$	I	4
CPSE	Rd,Rr	Compare, Skip if Equal	if (Rd = Rr) $PC \leftarrow PC + 2$ 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) $PC \leftarrow PC + 2$ or 3	None	1/2/3
SBRS	Rr, b	Skip if Bit in Register is Set	if (Rr(b)=1) $PC \leftarrow PC + 2$ or 3	None	1/2/3
SBIC	P, b	Skip if Bit in I/O Register Cleared	if (P(b)=0) $PC \leftarrow PC + 2$ or 3	None	1/2/3
SBIS	P, b	Skip if Bit in I/O Register is Set	if (P(b)=1) $PC \leftarrow PC + 2$ or 3	None	1/2/3
BRBS	s, k	Branch if Status Flag Set	if (SREG(s) = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRBC	s, k	Branch if Status Flag Cleared	if (SREG(s) = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BREQ	k	Branch if Equal	if (Z = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRNE	k	Branch if Not Equal	if (Z = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRCS	k	Branch if Carry Set	if (C = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRCC	k	Branch if Carry Cleared	if (C = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRSH	k	Branch if Same or Higher	if (C = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRLO	k	Branch if Lower	if (C = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRMI	k	Branch if Minus	if (N = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRPL	k	Branch if Plus	if (N = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRGE	k	Branch if Greater or Equal, Signed	if (N $\oplus$ V = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRLT	k	Branch if Less Than Zero, Signed	if (N $\oplus$ V = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRHS	k	Branch if Half Carry Flag Set	if (H = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRHC	k	Branch if Half Carry Flag Cleared	if (H = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRTS	k	Branch if T Flag Set	if (T = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRTC	k	Branch if T Flag Cleared	if (T = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRVS	k	Branch if Overflow Flag is Set	if (V = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRVC	k	Branch if Overflow Flag is Cleared	if (V = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BRIE	k	Branch if Interrupt Enabled	if (I = 1) then $PC \leftarrow PC + k + 1$	None	1/2
BRID	k	Branch if Interrupt Disabled	if (I = 0) then $PC \leftarrow PC + k + 1$	None	1/2
<b>BIT AND BIT-TEST INSTRUCTIONS</b>					
SBI	P,b	Set Bit in I/O Register	$I/O(P,b) \leftarrow 1$	None	2
CBI	P,b	Clear Bit in I/O Register	$I/O(P,b) \leftarrow 0$	None	2
LSL	Rd	Logical Shift Left	$Rd(n+1) \leftarrow Rd(n), Rd(0) \leftarrow 0$	Z,C,N,V	1
LSR	Rd	Logical Shift Right	$Rd(n) \leftarrow Rd(n+1), Rd(7) \leftarrow 0$	Z,C,N,V	1
ROL	Rd	Rotate Left Through Carry	$Rd(0) \leftarrow C, Rd(n+1) \leftarrow Rd(n), C \leftarrow Rd(7)$	Z,C,N,V	1
ROR	Rd	Rotate Right Through Carry	$Rd(7) \leftarrow C, Rd(n) \leftarrow Rd(n+1), C \leftarrow Rd(0)$	Z,C,N,V	1

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ASR	Rd	Arithmetic Shift Right	$Rd(n) \leftarrow Rd(n+1), n=0..6$	Z,C,N,V	1
SWAP	Rd	Swap Nibbles	$Rd(3..0) \leftarrow Rd(7..4), Rd(7..4) \leftarrow Rd(3..0)$	None	1
BSET	s	Flag Set	$SREG(s) \leftarrow 1$	SREG(s)	1
BCLR	s	Flag Clear	$SREG(s) \leftarrow 0$	SREG(s)	1
BST	Rr, b	Bit Store from Register to T	$T \leftarrow Rr(b)$	T	1
BLD	Rd, b	Bit load from T to Register	$Rd(b) \leftarrow T$	None	1
SEC		Set Carry	$C \leftarrow 1$	C	1
CLC		Clear Carry	$C \leftarrow 0$	C	1
SEN		Set Negative Flag	$N \leftarrow 1$	N	1
CLN		Clear Negative Flag	$N \leftarrow 0$	N	1
SEZ		Set Zero Flag	$Z \leftarrow 1$	Z	1
CLZ		Clear Zero Flag	$Z \leftarrow 0$	Z	1
SEI		Global Interrupt Enable	$I \leftarrow 1$	I	1
CLI		Global Interrupt Disable	$I \leftarrow 0$	I	1
SES		Set Signed Test Flag	$S \leftarrow 1$	S	1
CLS		Clear Signed Test Flag	$S \leftarrow 0$	S	1
SEV		Set Twos Complement Overflow.	$V \leftarrow 1$	V	1
CLV		Clear Twos Complement Overflow	$V \leftarrow 0$	V	1
SET		Set T in SREG	$T \leftarrow 1$	T	1
CLT		Clear T in SREG	$T \leftarrow 0$	T	1
SEH		Set Half Carry Flag in SREG	$H \leftarrow 1$	H	1
CLH		Clear Half Carry Flag in SREG	$H \leftarrow 0$	H	1
<b>DATA TRANSFER INSTRUCTIONS</b>					
MOV	Rd, Rr	Move Between Registers	$Rd \leftarrow Rr$	None	1
MOVW	Rd, Rr	Copy Register Word	$Rd+1:Rd \leftarrow Rr+1:Rr$	None	1
LDI	Rd, K	Load Immediate	$Rd \leftarrow K$	None	1
LD	Rd, X	Load Indirect	$Rd \leftarrow (X)$	None	2
LD	Rd, X+	Load Indirect and Post-Inc.	$Rd \leftarrow (X), X \leftarrow X + 1$	None	2
LD	Rd, -X	Load Indirect and Pre-Dec.	$X \leftarrow X - 1, Rd \leftarrow (X)$	None	2
LD	Rd, Y	Load Indirect	$Rd \leftarrow (Y)$	None	2
LD	Rd, Y+	Load Indirect and Post-Inc.	$Rd \leftarrow (Y), Y \leftarrow Y + 1$	None	2
LD	Rd, -Y	Load Indirect and Pre-Dec.	$Y \leftarrow Y - 1, Rd \leftarrow (Y)$	None	2
LDD	Rd, Y+q	Load Indirect with Displacement	$Rd \leftarrow (Y + q)$	None	2
LD	Rd, Z	Load Indirect	$Rd \leftarrow (Z)$	None	2
LD	Rd, Z+	Load Indirect and Post-Inc.	$Rd \leftarrow (Z), Z \leftarrow Z + 1$	None	2
LD	Rd, -Z	Load Indirect and Pre-Dec.	$Z \leftarrow Z - 1, Rd \leftarrow (Z)$	None	2
LDD	Rd, Z+q	Load Indirect with Displacement	$Rd \leftarrow (Z + q)$	None	2
LDS	Rd, k	Load Direct from SRAM	$Rd \leftarrow (k)$	None	2
ST	X, Rr	Store Indirect	$(X) \leftarrow Rr$	None	2
ST	X+, Rr	Store Indirect and Post-Inc.	$(X) \leftarrow Rr, X \leftarrow X + 1$	None	2
ST	-X, Rr	Store Indirect and Pre-Dec.	$X \leftarrow X - 1, (X) \leftarrow Rr$	None	2
ST	Y, Rr	Store Indirect	$(Y) \leftarrow Rr$	None	2
ST	Y+, Rr	Store Indirect and Post-Inc.	$(Y) \leftarrow Rr, Y \leftarrow Y + 1$	None	2
ST	-Y, Rr	Store Indirect and Pre-Dec.	$Y \leftarrow Y - 1, (Y) \leftarrow Rr$	None	2
STD	Y+q, Rr	Store Indirect with Displacement	$(Y + q) \leftarrow Rr$	None	2
ST	Z, Rr	Store Indirect	$(Z) \leftarrow Rr$	None	2
ST	Z+, Rr	Store Indirect and Post-Inc.	$(Z) \leftarrow Rr, Z \leftarrow Z + 1$	None	2
ST	-Z, Rr	Store Indirect and Pre-Dec.	$Z \leftarrow Z - 1, (Z) \leftarrow Rr$	None	2
STD	Z+q, Rr	Store Indirect with Displacement	$(Z + q) \leftarrow Rr$	None	2
STS	k, Rr	Store Direct to SRAM	$(k) \leftarrow Rr$	None	2
LPM		Load Program Memory	$R0 \leftarrow (Z)$	None	3
LPM	Rd, Z	Load Program Memory	$Rd \leftarrow (Z)$	None	3
LPM	Rd, Z+	Load Program Memory and Post-Inc	$Rd \leftarrow (Z), Z \leftarrow Z + 1$	None	3
SPM		Store Program Memory	$(z) \leftarrow R1:R0$	None	
IN	Rd, P	In Port	$Rd \leftarrow P$	None	1
OUT	P, Rr	Out Port	$P \leftarrow Rr$	None	1
PUSH	Rr	Push Register on Stack	$STACK \leftarrow Rr$	None	2
POP	Rd	Pop Register from Stack	$Rd \leftarrow STACK$	None	2
<b>MCU CONTROL INSTRUCTIONS</b>					
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) <sup>(3)</sup>	Power Supply (V)	Ordering Code <sup>(4)(5)</sup>	Package <sup>(2)</sup>	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) <sup>(1)</sup>
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) <sup>(1)</sup>

- 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.

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

## 6.2 ATtiny461

Speed (MHz) <sup>(3)</sup>	Power Supply (V)	Ordering Code <sup>(4)</sup>	Package <sup>(2)</sup>	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) <sup>(1)</sup>
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) <sup>(1)</sup>

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

## 6.3 ATtiny861

Speed (MHz) <sup>(3)</sup>	Power Supply (V)	Ordering Code <sup>(4)</sup>	Package <sup>(2)</sup>	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) <sup>(1)</sup>
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) <sup>(1)</sup>

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](#).

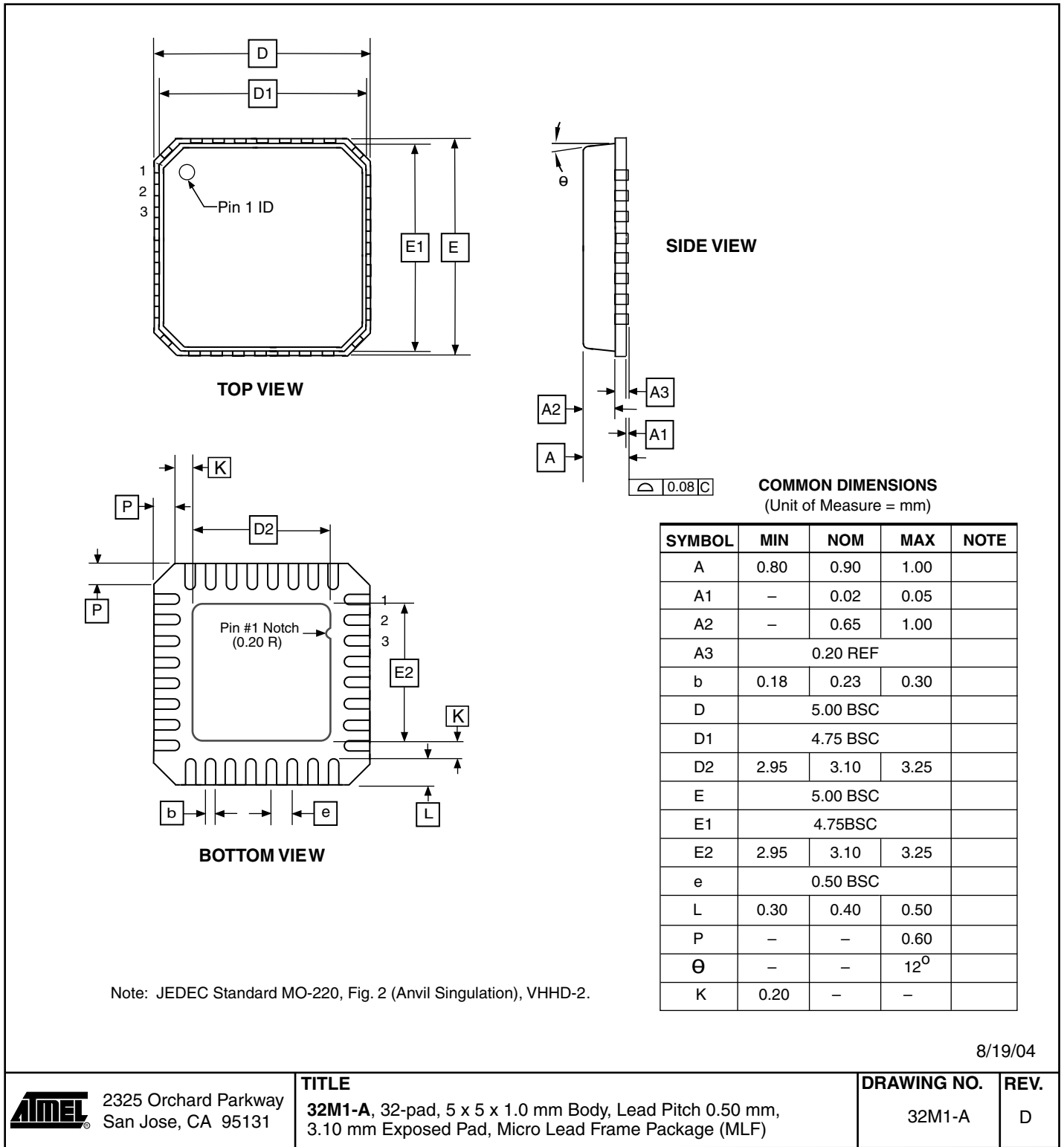
4. Code indicators:

- U: matte tin
- R: tape & reel

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

7. Packaging Information

7.1 32M1-A



8/19/04



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San Jose, CA 95131

**TITLE**  
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)

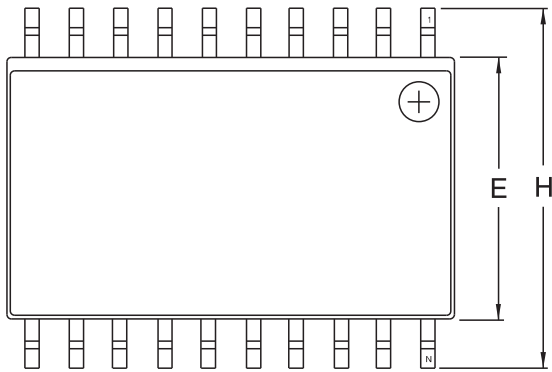
**DRAWING NO.**  
32M1-A

**REV.**  
D

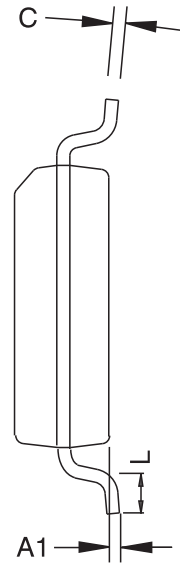
7.2 20P3



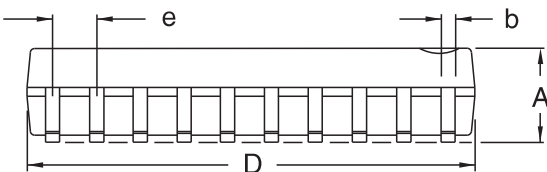
## 7.3 20S2



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.



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**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<sub>A</sub> = -40°C to +85°C, V<sub>CC</sub> = 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 ( $V_{CC}$ ).” 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,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ ,  $V_{CC} = 1.8 - 5.5V$  (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.  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ ,  $V_{CC} = 1.8V$  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.



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