

Features

- High Performance, Low Power AVR[®] 8-Bit Microcontroller
- Advanced RISC Architecture
 - 120 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 (ATtiny24/44/84)
Endurance: 10,000 Write/Erase Cycles
 - 128/256/512 Bytes In-System Programmable EEPROM (ATtiny24/44/84)
Endurance: 100,000 Write/Erase Cycles
 - 128/256/512 Bytes Internal SRAM (ATtiny24/44/84)
 - Programming Lock for Self-Programming Flash Program and EEPROM Data Security
- Peripheral Features
 - Two Timer/Counters, 8- and 16-bit counters with two PWM Channels on both
 - 10-bit ADC
 - 8 single-ended channels
 - 12 differential ADC channel pairs with programmable gain (1x, 20x)
 - Temperature Measurement
 - Programmable Watchdog Timer with Separate On-chip Oscillator
 - On-chip Analog Comparator
 - Universal Serial Interface
- Special Microcontroller Features
 - debugWIRE On-chip Debug System
 - In-System Programmable via SPI Port
 - External and Internal Interrupt Sources
 - Pin Change Interrupt on 12 pins
 - 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
 - 14-pin SOIC, PDIP and 20-pin QFN/MLF: Twelve Programmable I/O Lines
- Operating Voltage:
 - 1.8 - 5.5V for ATtiny24V/44V/84V
 - 2.7 - 5.5V for ATtiny24/44/84
- Speed Grade
 - ATtiny24V/44V/84V: 0 - 4 MHz @ 1.8 - 5.5V, 0 - 10 MHz @ 2.7 - 5.5V
 - ATtiny24/44/84: 0 - 10 MHz @ 2.7 - 5.5V, 0 - 20 MHz @ 4.5 - 5.5V
- Industrial Temperature Range
- Low Power Consumption
 - Active Mode:
 - 1 MHz, 1.8V: 380 μ A
 - Power-down Mode:
 - 1.8V: 100 nA



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

ATtiny24/44/84

Preliminary

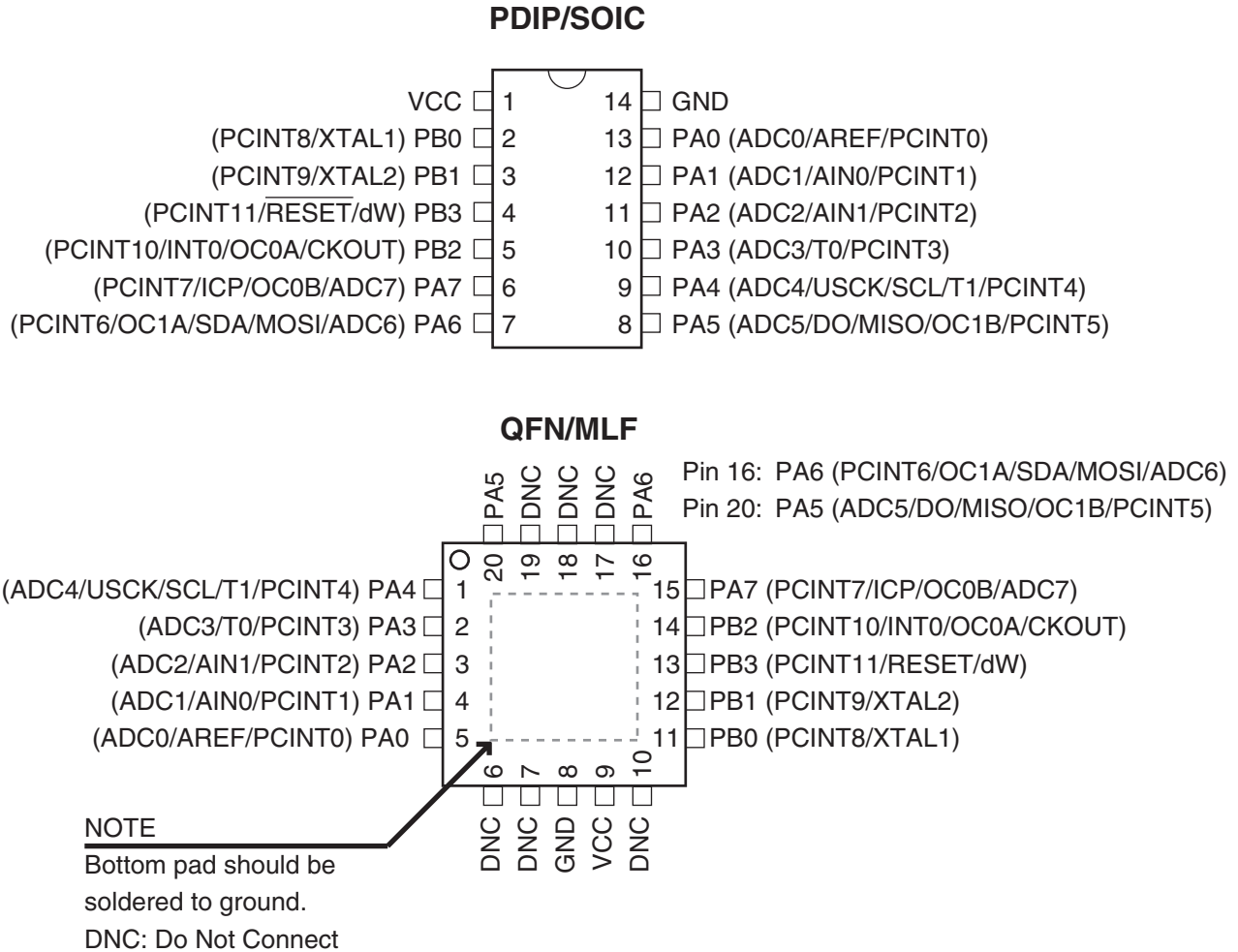
Summary

Rev. 8006DS-AVR-08/06



1. Pin Configurations

Figure 1-1. Pinout ATtiny24/44/84



1.1 Disclaimer

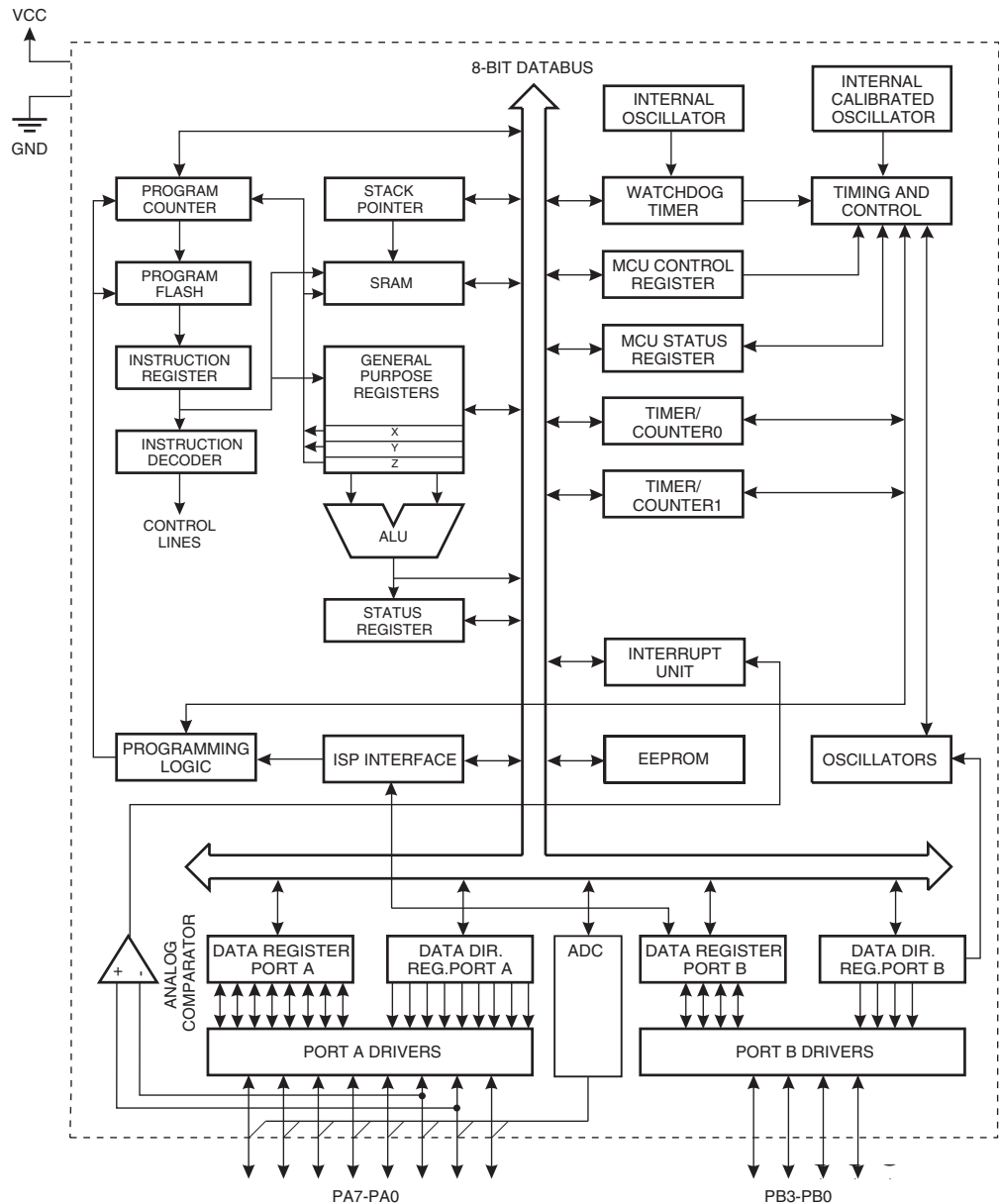
Typical values contained in this data sheet are based on simulations and characterization of other AVR microcontrollers manufactured on the same process technology. Min and Max values will be available after the device is characterized.

2. Overview

The ATtiny24/44/84 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATtiny24/44/84 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 the 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 ATtiny24/44/84 provides the following features: 2/4/8K byte of In-System Programmable Flash, 128/256/512 bytes EEPROM, 128/256/512 bytes SRAM, 12 general purpose I/O lines, 32 general purpose working registers, a 8-bit Timer/Counter with two PWM channels, a 16-bit timer/counter with two PWM channels, Internal and External Interrupts, a 8-channel 10-bit ADC, programmable gain stage (1x, 20x) for 12 differential ADC channel pairs, a programmable Watchdog Timer with internal Oscillator, internal calibrated oscillator, and three software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counter, ADC, Analog Comparator, and Interrupt system to continue functioning. The Power-down mode saves the register contents, disabling all chip functions until the next Interrupt or Hardware Reset. The 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. This allows 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 ATtiny24/44/84 AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

2.2 Pin Descriptions

2.2.1 VCC

Supply voltage.

2.2.2 GND

Ground.

2.2.3 Port B (PB3...PB0)

Port B is a 4-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability except PB3 which has the $\overline{\text{RESET}}$ capability. To use pin PB3 as an I/O pin, instead of RESET pin, program ('0') RSTDISBL fuse. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B 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 ATtiny24/44/84 as listed on [Section 12.3 "Alternate Port Functions" on page 59](#).

2.2.4 $\overline{\text{RESET}}$

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. The minimum pulse length is given in [Table 9-1 on page 38](#). Shorter pulses are not guaranteed to generate a reset.

2.2.5 Port A (PA7...PA0)

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

Port A has an alternate functions as analog inputs for the ADC, analog comparator, timer/counter, SPI and pin change interrupt as described in ["Alternate Port Functions" on page 59](#)

3. Resources

A comprehensive set of development tools, drivers and application notes, and datasheets are available for download on <http://www.atmel.com/avr>.



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 7	
0x3E (0x5E)	SPH	–	–	–	–	–	–	SP9	SP8	Page 10	
0x3D (0x5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	Page 10	
0x3C (0x5C)	OCR0B	Timer/Counter0 – Output Compare Register B									Page 86
0x3B (0x5B)	GIMSK	–	INT0	PCIE1	PCIE0	–	–	–	–	Page 51	
0x3A (0x5A)	GIFR	–	INTF0	PCIF1	PCIF0	–	–	–	–	Page 52	
0x39 (0x59)	TIMSK0	–	–	–	–	–	OCIE0B	OCIE0A	TOIE0	Page 87	
0x38 (0x58)	TIFR0	–	–	–	–	–	OCF0B	OCF0A	TOV0	Page 87	
0x37 (0x57)	SPMCSR	–	–	–	CTPB	RFLB	PGWRT	PGERS	SPMEN	Page 159	
0x36 (0x56)	OCR0A	Timer/Counter0 – Output Compare Register A									Page 86
0x35 (0x55)	MCUCR	–	PUD	SE	SM1	SM0	–	ISC01	ISC00	Page 51	
0x34 (0x54)	MCUSR	–	–	–	–	WDRF	BORF	EXTRF	PORF	Page 41	
0x33 (0x53)	TCCR0B	FOC0A	FOC0B	–	–	WGM02	CS02	CS01	CS00	Page 85	
0x32 (0x52)	TCNT0	Timer/Counter0									Page 86
0x31 (0x51)	OSCCAL	CAL7	CAL6	CAL5	CAL4	CAL3	CAL2	CAL1	CAL0	Page 27	
0x30 (0x50)	TCCR0A	COM0A1	COM0A0	COM0B1	COM0B0	–	–	WGM01	WGM00	Page 82	
0x2F (0x4F)	TCCR1A	COM1A1	COM1A0	COM1B1	COM1B0	–	–	WGM11	WGM10	Page 111	
0x2E (0x4E)	TCCR1B	ICNC1	ICES1	–	WGM13	WGM12	CS12	CS11	CS10	Page 113	
0x2D (0x4D)	TCNT1H	Timer/Counter1 – Counter Register High Byte									Page 115
0x2C (0x4C)	TCNT1L	Timer/Counter1 – Counter Register Low Byte									Page 115
0x2B (0x4B)	OCR1AH	Timer/Counter1 – Compare Register A High Byte									Page 115
0x2A (0x4A)	OCR1AL	Timer/Counter1 – Compare Register A Low Byte									Page 115
0x29 (0x49)	OCR1BH	Timer/Counter1 – Compare Register B High Byte									Page 115
0x28 (0x48)	OCR1BL	Timer/Counter1 – Compare Register B Low Byte									Page 115
0x27 (0x47)	DWDR	DWDR[7:0]									Page 156
0x26 (0x46)	CLKPR	CLKPCE	–	–	–	CLKPS3	CLKPS2	CLKPS1	CLKPS0	Page 29	
0x25 (0x45)	ICR1H	Timer/Counter1 - Input Capture Register High Byte									Page 116
0x24 (0x44)	ICR1L	Timer/Counter1 - Input Capture Register Low Byte									Page 116
0x23 (0x43)	GTCCR	TSM	–	–	–	–	–	–	PSR10	Page 119	
0x22 (0x42)	TCCR1C	FOC1A	FOC1B	–	–	–	–	–	–	Page 114	
0x21 (0x41)	WDTCR	WDIF	WDIE	WDP3	WDCE	WDE	WDP2	WDP1	WDP0	Page 43	
0x20 (0x40)	PCMSK1	–	–	–	–	PCINT11	PCINT10	PCINT9	PCINT8	Page 52	
0x1F (0x3F)	EEARH	–	–	–	–	–	–	–	EEAR8	Page 16	
0x1E (0x3E)	EEARL	EEAR7	EEAR6	EEAR5	EEAR4	EEAR3	EEAR2	EEAR1	EEAR0	Page 17	
0x1D (0x3D)	EEDR	EEPROM Data Register									Page 17
0x1C (0x3C)	EEDR	–	–	EEDR7	EEDR6	EEDR5	EEDR4	EEDR3	EEDR2	Page 17	
0x1B (0x3B)	PORTA	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0	Page 70	
0x1A (0x3A)	DDRA	DDA7	DDA6	DDA5	DDA4	DDA3	DDA2	DDA1	DDA0	Page 70	
0x19 (0x39)	PINA	PINA7	PINA6	PINA5	PINA4	PINA3	PINA2	PINA1	PINA0	Page 70	
0x18 (0x38)	PORTB	–	–	–	–	PORTB3	PORTB2	PORTB1	PORTB0	Page 70	
0x17 (0x37)	DDRB	–	–	–	–	DDB3	DDB2	DDB1	DDB0	Page 70	
0x16 (0x36)	PINB	–	–	–	–	PINB3	PINB2	PINB1	PINB0	Page 70	
0x15 (0x35)	GPOR2	General Purpose I/O Register 2									Page 22
0x14 (0x34)	GPOR1	General Purpose I/O Register 1									Page 22
0x13 (0x33)	GPOR0	General Purpose I/O Register 0									Page 22
0x12 (0x32)	PCMSK0	PCINT7	PCINT6	PCINT5	PCINT4	PCINT3	PCINT2	PCINT1	PCINT0	Page 53	
0x11 (0x31)	Reserved	–									
0x10 (0x30)	USIBR	USI Buffer Register									Page 128
0x0F (0x2F)	USIDR	USI Data Register									Page 128
0x0E (0x2E)	USISR	USISIF	USIOIF	USIPF	USIDC	USICNT3	USICNT2	USICNT1	USICNT0	Page 128	
0x0D (0x2D)	USICR	USISIE	USIOIE	USIWM1	USIWM0	USICS1	USICS0	USICLK	USITC	Page 129	
0x0C (0x2C)	TIMSK1	–	–	ICIE1	–	–	OCIE1B	OCIE1A	TOIE1	Page 116	
0x0B (0x2B)	TIFR1	–	–	ICF1	–	–	OCF1B	OCF1A	TOV1	Page 117	
0x0A (0x2A)	Reserved	–									
0x09 (0x29)	Reserved	–									
0x08 (0x28)	ACSR	ACD	ACBG	ACO	ACI	ACIE	ACIC	ACIS1	ACIS0	Page 134	
0x07 (0x27)	ADMUX	REFS1	REFS0	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	Page 148	
0x06 (0x26)	ADCSRA	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	Page 151	
0x05 (0x25)	ADCH	ADC Data Register High Byte									Page 152
0x04 (0x24)	ADCL	ADC Data Register Low Byte									Page 152
0x03 (0x23)	ADCSRB	BIN	ACME	–	ADLAR	–	ADTS2	ADTS1	ADTS0	Page 153	
0x02 (0x22)	Reserved	–									
0x01 (0x21)	DIDR0	ADC7D	ADC6D	ADC5D	ADC4D	ADC3D	ADC2D	ADC1D	ADC0D	Page 135, Page 154	
0x00 (0x20)	PRR	–	–	–	–	PRTIM1	PRTIM0	PRUSI	PRADC	Page 34	

- 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	$Rd \leftarrow Rd + Rr$	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	Rdl,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	Rdl,K	Subtract Immediate from Word	$Rdh:Rdl \leftarrow Rdh:Rdl - K$	Z,C,N,V,S	2
AND	Rd, Rr	Logical AND Registers	$Rd \leftarrow Rd \cdot Rr$	Z,N,V	1
ANDI	Rd, K	Logical AND Register and Constant	$Rd \leftarrow Rd \cdot K$	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	$Rd \leftarrow Rd \cdot (0xFF - K)$	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	$Rd \leftarrow Rd \cdot Rd$	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
BRANCH INSTRUCTIONS					
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
BIT AND BIT-TEST INSTRUCTIONS					
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

Mnemonics	Operands	Description	Operation	Flags	#Clocks
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
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
DATA TRANSFER INSTRUCTIONS					
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
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 ATtiny24

Speed (MHz)	Power Supply	Ordering Code ⁽¹⁾	Package ⁽²⁾	Operational Range
10	1.8 - 5.5V	ATtiny24V-10SSU ATtiny24V-10PU ATtiny24V-10MU	14S1 14P3 20M1	Industrial (-40°C to 85°C)
20	2.7 - 5.5V	ATtiny24-20SSU ATtiny24-20PU ATtiny24-20MU	14S1 14P3 20M1	Industrial (-40°C to 85°C)

- Notes:
1. This device can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
 2. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.

Package Type	
14S1	14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)
14P3	14-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20M1	20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF)

6.2 ATtiny44

Speed (MHz)	Power Supply	Ordering Code ⁽¹⁾	Package ⁽²⁾	Operational Range
10	1.8 - 5.5V	ATtiny44V-10SSU ATtiny44V-10PU ATtiny44V-10MU	14S1 14P3 20M1	Industrial (-40°C to 85°C)
20	2.7 - 5.5V	ATtiny44-20SSU ATtiny44-20PU ATtiny44-20MU	14S1 14P3 20M1	Industrial (-40°C to 85°C)

- Notes:
1. This device can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
 2. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.

Package Type	
14S1	14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)
14P3	14-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20M1	20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF)



6.3 ATtiny84

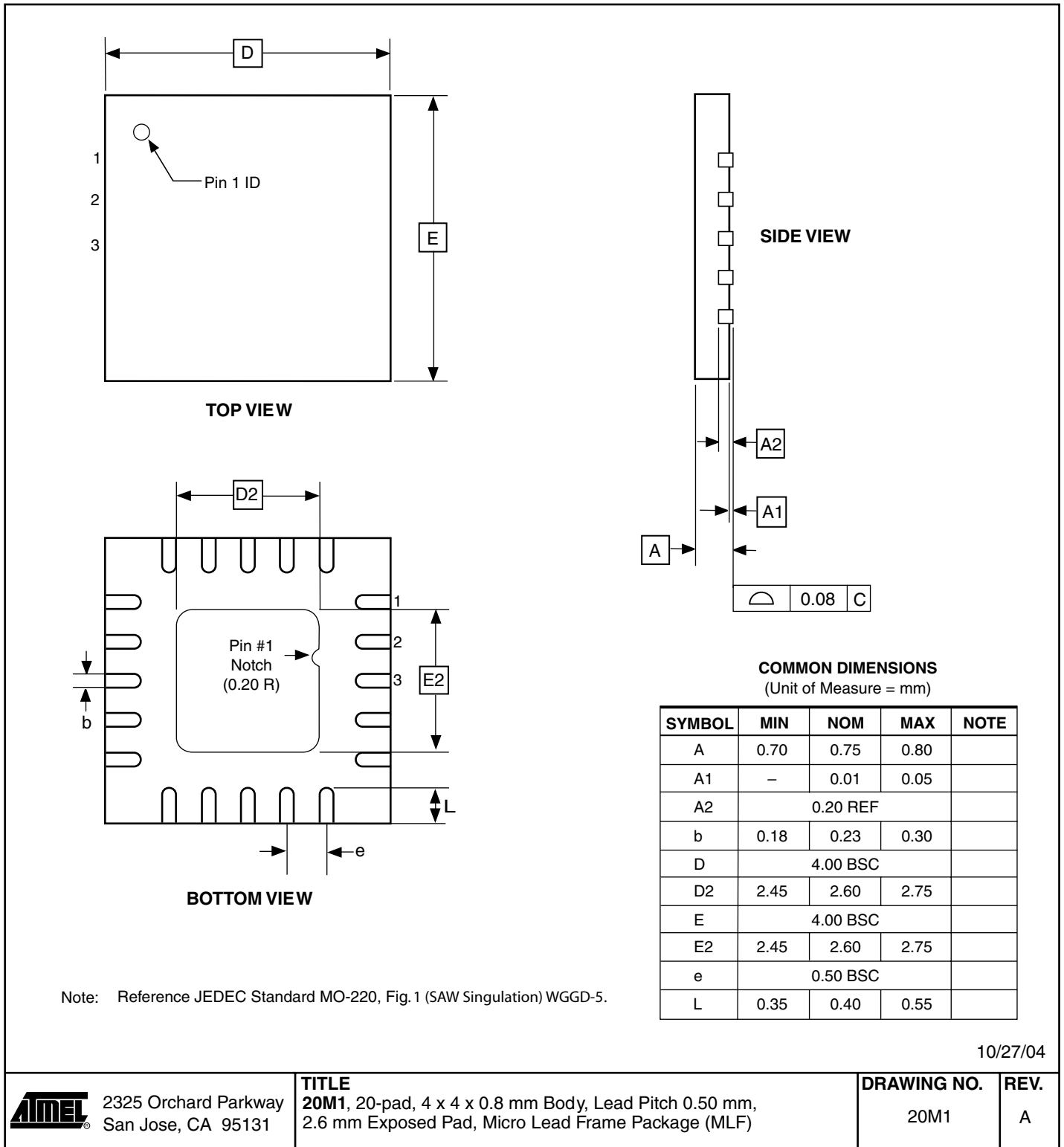
Speed (MHz)	Power Supply	Ordering Code ⁽¹⁾	Package ⁽²⁾	Operational Range
10	1.8 - 5.5V	ATtiny84V-10PU ATtiny84V-10MU	14P3 20M1	Industrial (-40°C to 85°C)
20	2.7 - 5.5V	ATtiny84-20PU ATtiny84-20MU	14P3 20M1	Industrial (-40°C to 85°C)

- Notes:
1. This device can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
 2. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.

Package Type	
14S1	14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)
14P3	14-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20M1	20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF)

7. Packaging Information

7.1 20M1



10/27/04



2325 Orchard Parkway
San Jose, CA 95131

TITLE

20M1, 20-pad, 4 x 4 x 0.8 mm Body, Lead Pitch 0.50 mm,
2.6 mm Exposed Pad, Micro Lead Frame Package (MLF)

DRAWING NO.

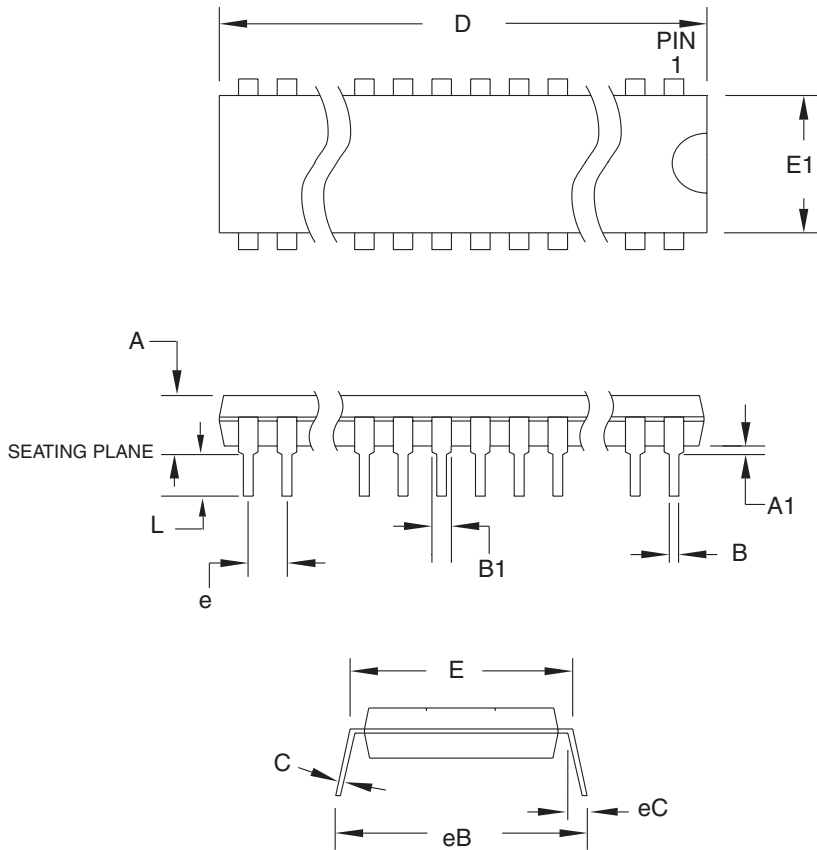
20M1

REV.

A



7.2 14P3



COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	5.334	
A1	0.381	–	–	
D	18.669	–	19.685	Note 2
E	7.620	–	8.255	
E1	6.096	–	7.112	Note 2
B	0.356	–	0.559	
B1	1.143	–	1.778	
L	2.921	–	3.810	
C	0.203	–	0.356	
eB	–	–	10.922	
eC	0.000	–	1.524	
e	2.540 TYP			

- Notes: 1. This package conforms to JEDEC reference MS-001, Variation AA.
2. Dimensions D and E1 do not include mold Flash or Protrusion. Mold Flash or Protrusion shall not exceed 0.25 mm (0.010").

11/02/05



2325 Orchard Parkway
San Jose, CA 95131

TITLE

14P3, 14-lead (0.300"/7.62 mm Wide) Plastic Dual In-line Package (PDIP)

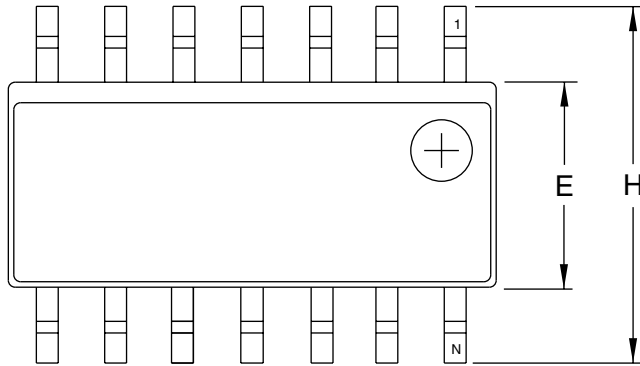
DRAWING NO.

14P3

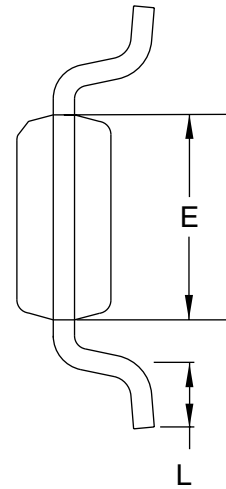
REV.

A

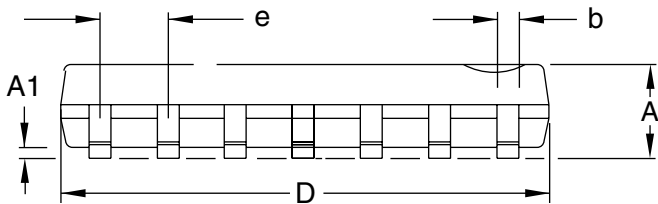
7.3 14S1



Top View



End View



Side View

COMMON DIMENSIONS
(Unit of Measure = mm/inches)

SYMBOL	MIN	NOM	MAX	NOTE
A	1.35/0.0532	–	1.75/0.0688	
A1	0.1/0.0040	–	0.25/0.0098	
b	0.33/0.0130	–	0.5/0.02005	
D	8.55/0.3367	–	8.74/0.3444	2
E	3.8/0.1497	–	3.99/0.1574	3
H	5.8/0.2284	–	6.19/0.2440	
L	0.41/0.0160	–	1.27/0.0500	4
e	1.27/0.050 BSC			

- Notes:
1. This drawing is for general information only; refer to JEDEC Drawing MS-012, Variation AB for additional information.
 2. Dimension D does not include mold Flash, protrusions or gate burrs. Mold Flash, protrusion 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.

2/5/02



2325 Orchard Parkway
San Jose, CA 95131

TITLE

14S1, 14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)

DRAWING NO.

14S1

REV.

A



8. Errata

The revision letter in this section refers to the revision of the ATtiny24/44/84 device.

8.1 ATtiny24

8.1.1 Rev. D

No known errata.

8.1.2 Rev. C

- **Reading EEPROM when system clock frequency is below 900 kHz may not work**

1. **Reading EEPROM when system clock frequency is below 900 kHz may not work**

Reading data from the EEPROM at system clock frequency below 900 kHz may result in wrong data read.

Problem Fix/Work around

Avoid using the EEPROM at clock frequency below 900 kHz.

8.1.3 Rev. B

- **EEPROM read from application code does not work in Lock Bit Mode 3**
- **Reading EEPROM when system clock frequency is below 900 kHz may not work**

1. **EEPROM read from application code does not work in Lock Bit Mode 3**

When the Memory Lock Bits LB2 and LB1 are programmed to mode 3, EEPROM read does not work from the application code.

Problem Fix/Work around

Do not set Lock Bit Protection Mode 3 when the application code needs to read from EEPROM.

2. **Reading EEPROM when system clock frequency is below 900 kHz may not work**

Reading data from the EEPROM at system clock frequency below 900 kHz may result in wrong data read.

Problem Fix/Work around

Avoid using the EEPROM at clock frequency below 900 kHz.

8.1.4 Rev. A

Not sampled.

8.2 ATtiny44**8.2.1 Rev. B**

No known errata.

8.2.2 Rev. A

- **Reading EEPROM when system clock frequency is below 900 kHz may not work**

1. **Reading EEPROM when system clock frequency is below 900 kHz may not work**

Reading data from the EEPROM at system clock frequency below 900 kHz may result in wrong data read.

Problem Fix/Work around

Avoid using the EEPROM at clock frequency below 900 kHz.



8.3 ATtiny84

8.3.1 Rev. A

No known errata.

9. Datasheet Revision History

9.1 Rev D. 08/06

1. Updated "Calibrated Internal RC Oscillator" on page 27.
2. Updated "Oscillator Calibration Register – OSCCAL" on page 27.
3. Added Table 22-4 on page 183.
4. Updated code examples in "SPI Master Operation Example" on page 123.
5. Updated code examples in "SPI Slave Operation Example" on page 124.
6. Updated "Signature Bytes" on page 164.

9.2 Rev C. 07/06

1. Updated Features in "USI – Universal Serial Interface" on page 120.
2. Added "Clock speed considerations" on page 127.
3. Updated Bit description in "ADC Multiplexer Selection Register – ADMUX" on page 148.
4. Added note to Table 20-1 on page 161.

9.3 Rev B. 05/06

1. Updated "Default Clock Source" on page 24
2. Updated "Power Reduction Register" on page 34.
3. Updated Table 9-1 on page 38, Table 9-4 on page 42, Table 18-2 on page 148, Table 21-5 on page 164, Table 21-10 on page 168, Table 21-15 on page 175, Table 22-3 on page 182.
4. Updated Features in "Analog to Digital Converter" on page 136.
5. Updated Operation in "Analog to Digital Converter" on page 136.
6. Updated "Temperature Measurement" on page 154.
7. Updated DC Characteristics in "Electrical Characteristics" on page 178.
8. Updated "Typical Characteristics – Preliminary Data" on page 183.
9. Updated "Errata" on page 216.

9.4 Rev A. 12/05

Initial revision.



Atmel Corporation

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 487-2600

Regional Headquarters

Europe

Atmel Sarl
Route des Arsenalux 41
Case Postale 80
CH-1705 Fribourg
Switzerland
Tel: (41) 26-426-5555
Fax: (41) 26-426-5500

Asia

Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimshatsui
East Kowloon
Hong Kong
Tel: (852) 2721-9778
Fax: (852) 2722-1369

Japan

9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
Tel: (81) 3-3523-3551
Fax: (81) 3-3523-7581

Atmel Operations

Memory

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 436-4314

Microcontrollers

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 436-4314

La Chantrerie
BP 70602
44306 Nantes Cedex 3, France
Tel: (33) 2-40-18-18-18
Fax: (33) 2-40-18-19-60

ASIC/ASSP/Smart Cards

Zone Industrielle
13106 Rousset Cedex, France
Tel: (33) 4-42-53-60-00
Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906, USA
Tel: 1(719) 576-3300
Fax: 1(719) 540-1759

Scottish Enterprise Technology Park
Maxwell Building
East Kilbride G75 0QR, Scotland
Tel: (44) 1355-803-000
Fax: (44) 1355-242-743

RF/Automotive

Theresienstrasse 2
Postfach 3535
74025 Heilbronn, Germany
Tel: (49) 71-31-67-0
Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906, USA
Tel: 1(719) 576-3300
Fax: 1(719) 540-1759

Biometrics/Imaging/Hi-Rel MPU/ High Speed Converters/RF Datacom

Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
Tel: (33) 4-76-58-30-00
Fax: (33) 4-76-58-34-80

Literature Requests

www.atmel.com/literature

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 ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, 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 OF 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 product 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's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© 2006 Atmel Corporation. All rights reserved. ATMEL®, logo and combinations thereof, Everywhere You Are®, AVR®, AVR Studio®, and others, are registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.