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
- High Endurance, Non-volatile Memory Segments
  - 2K/4K/8K Bytes of In-System, Self-programmable Flash Program Memory
    - Endurance: 10,000 Write/Erase Cycles
  - 128/256/512 Bytes of In-System Programmable EEPROM
    - Endurance: 100,000 Write/Erase Cycles
  - 128/256/512 Bytes of Internal SRAM
  - Data Retention: 20 years at 85°C / 100 years at 25°C
  - Programming Lock for Self-programming Flash & EEPROM Data Security
- Peripheral Features
  - One 8-bit and One 16-bit Timer/Counter with Two PWM Channels, Each
  - 10-bit ADC
    - 8 Single-ended Channels
    - 12 Differential ADC Channel Pairs with Programmable Gain (1x / 20x)
  - 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
  - Internal and External 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 with Software Disable Function
  - Internal Calibrated Oscillator
  - On-chip Temperature Sensor
- I/O and Packages
  - Available in 20-pin QFN/MLF/VQFN, 14-pin SOIC, 14-pin PDIP and 15-ball UFBGA
  - Twelve Programmable I/O Lines
- Operating Voltage:
  - 1.8 – 5.5V
- Speed Grade:
  - 0 – 4 MHz @ 1.8 – 5.5V
  - 0 – 10 MHz @ 2.7 – 5.5V
  - 0 – 20 MHz @ 4.5 – 5.5V
- Industrial Temperature Range: -40°C to +85°C
- Low Power Consumption
  - Active Mode:
    - 210 µA at 1.8V and 1 MHz
  - Idle Mode:
    - 33 µA at 1.8V and 1 MHz
  - Power-down Mode:
    - 0.1 µA at 1.8V and 25°C

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

ATtiny24A
ATtiny44A
ATtiny84A

Summary

Rev. 8183FS–AVR–06/12

1. Pin Configurations

Figure 1-1. Pinout of ATtiny24A/44A/84A

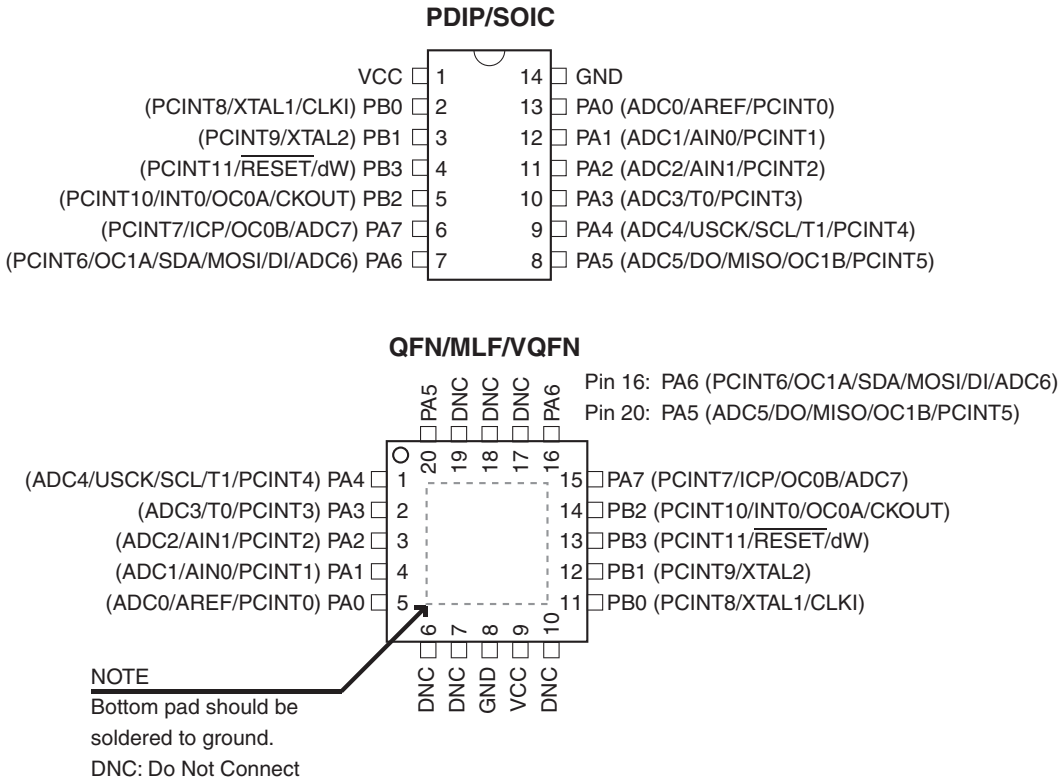


Table 1-1. UFBGA - Pinout ATtiny24A/44A/84A (top view)

	1	2	3	4
A		PA5	PA6	PB2
B	PA4	PA7	PB1	PB3
C	PA3	PA2	PA1	PB0
D	PA0	GND	GND	VCC

1.1 Pin Descriptions

1.1.1 VCC

Supply voltage.

1.1.2 GND

Ground.

1.1.3 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 ATtiny24A/44A/84A as listed in Section 10.2 “Alternate Port Functions” on page 58.

1.1.4 $\overline{\text{RESET}}$

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 and provided the reset pin has not been disabled. The minimum pulse length is given in Table 20-4 on page 176. Shorter pulses are not guaranteed to generate a reset.

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

1.1.5 Port A (PA7:PA0)

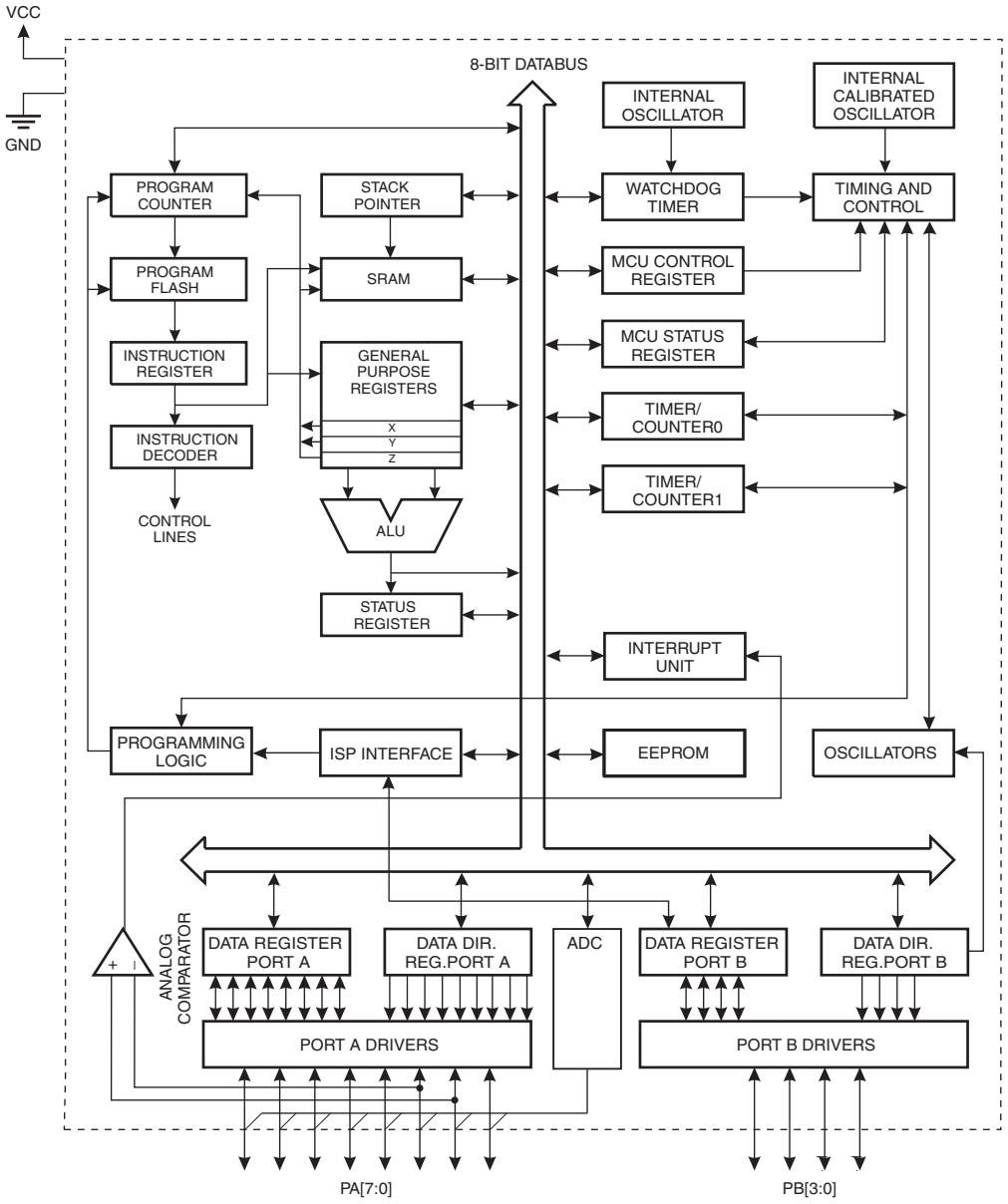
Port A is a 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port A pins that are externally pulled low will source current if the pull-up resistors 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 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 58.

2. Overview

ATtiny24A/44A/84A are low-power CMOS 8-bit microcontrollers based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATtiny24A/44A/84A achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

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 ATtiny24A/44A/84A provides the following features: 2K/4K/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, an 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 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. ADC Noise Reduction mode minimizes switching noise during ADC conversions by stopping the CPU and all I/O modules except the ADC. In Power-down mode registers keep their contents and all chip functions are disbaled until the next interrupt or hardware reset. 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 ATtiny24A/44A/84A AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators and Evaluation kits.

3. General Information

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 Capacitive Touch Sensing

Atmel QTouch Library provides a simple to use solution for touch sensitive interfaces on Atmel AVR microcontrollers. The QTouch Library includes support for QTouch® and QMatrix® acquisition methods.

Touch sensing is easily added to any application by linking the QTouch Library and using the Application Programming Interface (API) of the library to define the touch channels and sensors. The application then calls the API to retrieve channel information and determine the state of the touch sensor.

The QTouch Library is free and can be downloaded from the Atmel website. For more information and details of implementation, refer to the QTouch Library User Guide – also available from the Atmel website.

3.4 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.

3.5 Disclaimer

Typical values contained in this datasheet 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 has been characterized.

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 14
0x3E (0x5E)	SPH	–	–	–	–	–	–	SP9	SP8	Page 13
0x3D (0x5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	Page 13
0x3C (0x5C)	OCR0B	Timer/Counter0 – Output Compare Register B								Page 83
0x3B (0x5B)	GIMSK	–	INT0	PCIE1	PCIE0	–	–	–	–	Page 50
0x3A (0x5A)	GIFR	–	INTF0	PCIF1	PCIF0	–	–	–	–	Page 51
0x39 (0x59)	TIMSK0	–	–	–	–	–	OCIE0B	OCIE0A	TOIE0	Page 83
0x38 (0x58)	TIFR0	–	–	–	–	–	OCF0B	OCF0A	TOV0	Page 84
0x37 (0x57)	SPMCSR	–	–	RSIG	CTPB	RFLB	PGWRT	PGERS	SPMEN	Page 156
0x36 (0x56)	OCR0A	Timer/Counter0 – Output Compare Register A								Page 83
0x35 (0x55)	MCUCR	BODS	PUD	SE	SM1	SM0	BODSE	ISC01	ISC00	Pages 36, 50, 66
0x34 (0x54)	MCUSR	–	–	–	–	WDRF	BORF	EXTRF	PORF	Page 44
0x33 (0x53)	TCCR0B	FOC0A	FOC0B	–	–	WGM02	CS02	CS01	CS00	Page 82
0x32 (0x52)	TCNT0	Timer/Counter0								Page 83
0x31 (0x51)	OSCCAL	CAL7	CAL6	CAL5	CAL4	CAL3	CAL2	CAL1	CAL0	Page 31
0x30 (0x50)	TCCR0A	COM0A1	COM0A0	COM0B1	COM0B0	–	–	WGM01	WGM00	Page 79
0x2F (0x4F)	TCCR1A	COM1A1	COM1A0	COM1B1	COM1B0	–	–	WGM11	WGM10	Page 106
0x2E (0x4E)	TCCR1B	ICNC1	ICES1	–	WGM13	WGM12	CS12	CS11	CS10	Page 108
0x2D (0x4D)	TCNT1H	Timer/Counter1 – Counter Register High Byte								Page 110
0x2C (0x4C)	TCNT1L	Timer/Counter1 – Counter Register Low Byte								Page 110
0x2B (0x4B)	OCR1AH	Timer/Counter1 – Compare Register A High Byte								Page 110
0x2A (0x4A)	OCR1AL	Timer/Counter1 – Compare Register A Low Byte								Page 110
0x29 (0x49)	OCR1BH	Timer/Counter1 – Compare Register B High Byte								Page 110
0x28 (0x48)	OCR1BL	Timer/Counter1 – Compare Register B Low Byte								Page 110
0x27 (0x47)	DWDR	DWDR[7:0]								Page 151
0x26 (0x46)	CLKPR	CLKPCE	–	–	–	CLKPS3	CLKPS2	CLKPS1	CLKPS0	Page 31
0x25 (0x45)	ICR1H	Timer/Counter1 - Input Capture Register High Byte								Page 111
0x24 (0x44)	ICR1L	Timer/Counter1 - Input Capture Register Low Byte								Page 111
0x23 (0x43)	GTCCR	TSM	–	–	–	–	–	–	PSR10	Page 114
0x22 (0x42)	TCCR1C	FOC1A	FOC1B	–	–	–	–	–	–	Page 109
0x21 (0x41)	WDTCSR	WDIF	WDIE	WDP3	WDCE	WDE	WDP2	WDP1	WDP0	Page 44
0x20 (0x40)	PCMSK1	–	–	–	–	PCINT11	PCINT10	PCINT9	PCINT8	Page 51
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 23
0x1B (0x3B)	PORTA	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0	Page 66
0x1A (0x3A)	DDRA	DDA7	DDA6	DDA5	DDA4	DDA3	DDA2	DDA1	DDA0	Page 66
0x19 (0x39)	PINA	PINA7	PINA6	PINA5	PINA4	PINA3	PINA2	PINA1	PINA0	Page 67
0x18 (0x38)	PORTB	–	–	–	–	PORTB3	PORTB2	PORTB1	PORTB0	Page 67
0x17 (0x37)	DDRB	–	–	–	–	DDB3	DDB2	DDB1	DDB0	Page 67
0x16 (0x36)	PINB	–	–	–	–	PINB3	PINB2	PINB1	PINB0	Page 67
0x15 (0x35)	GPIOR2	General Purpose I/O Register 2								Page 22
0x14 (0x34)	GPIOR1	General Purpose I/O Register 1								Page 23
0x13 (0x33)	GPIOR0	General Purpose I/O Register 0								Page 23
0x12 (0x32)	PCMSK0	PCINT7	PCINT6	PCINT5	PCINT4	PCINT3	PCINT2	PCINT1	PCINT0	Page 52
0x11 (0x31))	Reserved	–								
0x10 (0x30)	USIBR	USI Buffer Register								Page 127
0x0F (0x2F)	USIDR	USI Data Register								Page 126
0x0E (0x2E)	USISR	USISIF	USIOIF	USIPF	USIDC	USICNT3	USICNT2	USICNT1	USICNT0	Page 125
0x0D (0x2D)	USICR	USISIE	USIOIE	USIWM1	USIWM0	USICS1	USICS0	USICLK	USITC	Page 123
0x0C (0x2C)	TIMSK1	–	–	ICIE1	–	–	OCIE1B	OCIE1A	TOIE1	Page 111
0x0B (0x2B)	TIFR1	–	–	ICF1	–	–	OCF1B	OCF1A	TOV1	Page 112
0x0A (0x2A)	Reserved	–								
0x09 (0x29)	Reserved	–								
0x08 (0x28)	ACSR	ACD	ACBG	ACO	ACI	ACIE	ACIC	ACIS1	ACIS0	Page 129
0x07 (0x27)	ADMUX	REFS1	REFS0	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	Page 144
0x06 (0x26)	ADCSRA	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	Page 146
0x05 (0x25)	ADCH	ADC Data Register High Byte								Page 148
0x04 (0x24)	ADCL	ADC Data Register Low Byte								Page 148
0x03 (0x23)	ADCSRB	BIN	ACME	–	ADLAR	–	ADTS2	ADTS1	ADTS0	Pages 130, 148
0x02 (0x22)	Reserved	–								
0x01 (0x21)	DIDR0	ADC7D	ADC6D	ADC5D	ADC4D	ADC3D	ADC2D	ADC1D	ADC0D	Pages 131, 149
0x00 (0x20)	PRR	–	–	–	–	PRTIM1	PRTIM0	PRUSI	PRADC	Page 37

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

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ROR	Rd	Rotate Right Through Carry	Rd(7)←C,Rd(n)← Rd(n+1),C←Rd(0)	Z,C,N,V	1
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 ATtiny24A

Speed (MHz) [1]	Supply Voltage (V)	Temperature Range	Package [2]	Ordering Code [3]
20	1.8 – 5.5V	Industrial (-40°C to +85°C) [5]	14S1	ATtiny24A-SSU
				ATtiny24A-SSUR
			14P3	ATtiny24A-PU
			15CC1	ATtiny24A-CCU
				ATtiny24A-CCUR
			20M1	ATtiny24A-MU
				ATtiny24A-MUR
			20M2	ATtiny24A-MMH [4]
				ATtiny24A-MMHR [4]
		Industrial (-40°C to +105°C) [6]	14S1	ATtiny24A-SSN
				ATtiny24A-SSNR
		Industrial (-40°C to +125°C) [7]	14S1	ATtiny24A-SSF
				ATtiny24A-SSFR
			20M1	ATtiny24A-MF
				ATtiny24A-MFR
			20M2	ATtiny24A-MM8
				ATtiny24A-MM8R

Notes:
1. For speed vs. supply voltage, see section 20.3 “Speed” on page 174.
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. Code indicators:
   - H: NiPdAu lead finish
   - F, N, U: matte tin
   - R: tape & reel
4. Topside marking for ATtiny24A: T24 / Axx / manufacturing data
5. Also supplied in wafer form. Contact your local Atmel sales office for ordering information and minimum quantities.
6. For typical and electrical characteristics, see “Appendix A – ATtiny24A/44A Specification at 105°C”.
7. For typical and electrical characteristics, see “Appendix B – ATtiny24A/44A/84A Specification at 125°C”.

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)
15CC1	15-ball (4 x 4 Array), 0.65 mm Pitch, 3.0 x 3.0 x 0.6 mm, Ultra Thin, Fine-Pitch Ball Grid Array Package (UFBGA)
20M1	20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No Lead / Micro Lead Frame Package (QFN/MLF)
20M2	20-pad, 3 x 3 x 0.85 mm Body, Very Thin Quad Flat No Lead Package (VQFN)

6.2 ATtiny44A

Speed (MHz) [1]	Supply Voltage (V)	Temperature Range	Package [2]	Ordering Code [3]
20	1.8 – 5.5V	Industrial (-40°C to +85°C) [5]	14S1	ATtiny44A-SSU
				ATtiny44A-SSUR
			14P3	ATtiny44A-PU
			15CC1	ATtiny44A-CCU
				ATtiny44A-CCUR
			20M1	ATtiny44A-MU
				ATtiny44A-MUR
			20M2	ATtiny44A-MMH [4]
				ATtiny44A-MMHR [4]
		Industrial (-40°C to +105°C) [6]	14S1	ATtiny44A-SSN
				ATtiny44A-SSNR
		Industrial (-40°C to +125°C) [7]	14S1	ATtiny44A-SSF
				ATtiny44A-SSFR
			20M1	ATtiny44A-MF
				ATtiny44A-MFR

Notes:
1. For speed vs. supply voltage, see section 20.3 “Speed” on page 174.
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. Code indicators:
   - H: NiPdAu lead finish
   - F, N, U: matte tin
   - R: tape & reel
4. Topside marking for ATtiny44A:
   - 1st Line: T44
   - 2nd Line: Axx
   - 3rd Line: manufacturing data
5. These devices can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
6. For typical and electrical characteristics, see “Appendix A – ATtiny24A/44A Specification at 105°C”.
7. For typical and electrical characteristics, see “Appendix B – ATtiny24A/44A/84A Specification at 125°C”.

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)
15CC1	15-ball (4 x 4 Array), 0.65 mm Pitch, 3.0 x 3.0 x 0.6 mm, Ultra Thin, Fine-Pitch Ball Grid Array Package (UFBGA)
20M1	20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No Lead / Micro Lead Frame Package (QFN/MLF)
20M2	20-pad, 3 x 3 x 0.85 mm Body, Very Thin Quad Flat No Lead Package (VQFN)

6.3 ATtiny84A

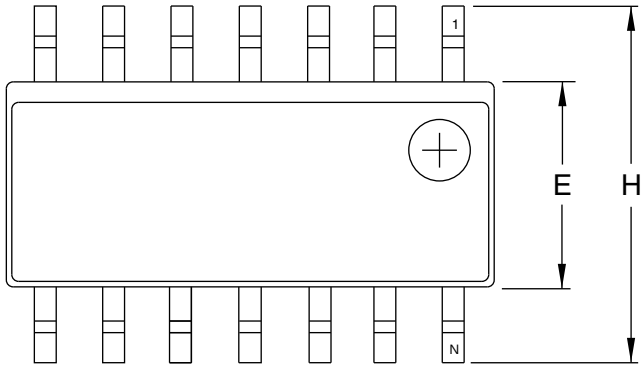
Speed (MHz) [1]	Supply Voltage (V)	Temperature Range	Package [2]	Ordering Code [3]
20	1.8 – 5.5V	Industrial (-40°C to +85°C) [5]	14S1	ATtiny84A-SSU
				ATtiny84A-SSUR
			14P3	ATtiny84A-PU
			15CC1	ATtiny84A-CCU
				ATtiny84A-CCUR
			20M1	ATtiny84A-MU
				ATtiny84A-MUR
			20M2	ATtiny84A-MMH [4]
				ATtiny84A-MMHR [4]
		Industrial (-40°C to +125°C) [7]	14S1	ATtiny84A-SSF
				ATtiny84A-SSFR

Notes:
1. For speed vs. supply voltage, see section 20.3 “Speed” on page 174.
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. Code indicators:
   - H: NiPdAu lead finish
   - F, N, U: matte tin
   - R: tape & reel
4. Topside marking for ATtiny84A:
   - 1st Line: T84
   - 2nd Line: Axx
   - 3rd Line: manufacturing data
5. These devices can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
6. For typical and electrical characteristics, see “Appendix A – ATtiny24A/44A Specification at 105°C”.
7. For typical and electrical characteristics, see “Appendix B – ATtiny24A/44A/84A Specification at 125°C”.

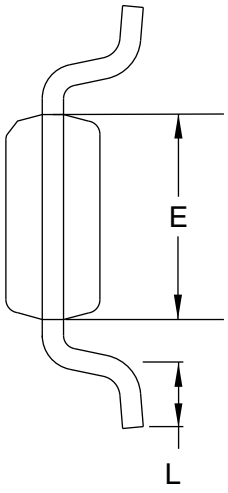
Package Type	
14S1	14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)
14P3	14-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
15CC1	15-ball (4 x 4 Array), 0.65 mm Pitch, 3.0 x 3.0 x 0.6 mm, Ultra Thin, Fine-Pitch Ball Grid Array Package (UFBGA)
20M1	20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No Lead / Micro Lead Frame Package (QFN/MLF)
20M2	20-pad, 3 x 3 x 0.85 mm Body, Very Thin Quad Flat No Lead Package (VQFN)

7. Packaging Information

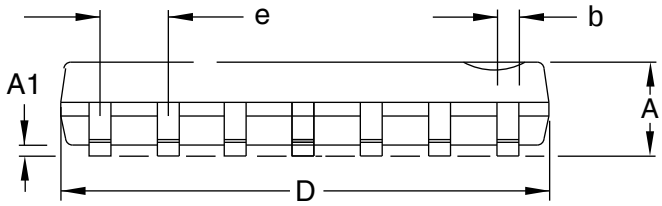
7.1 14S1



Top View



End View



Side View

COMMON DIMENSIONS
(Unit of Measure = mm/inches)

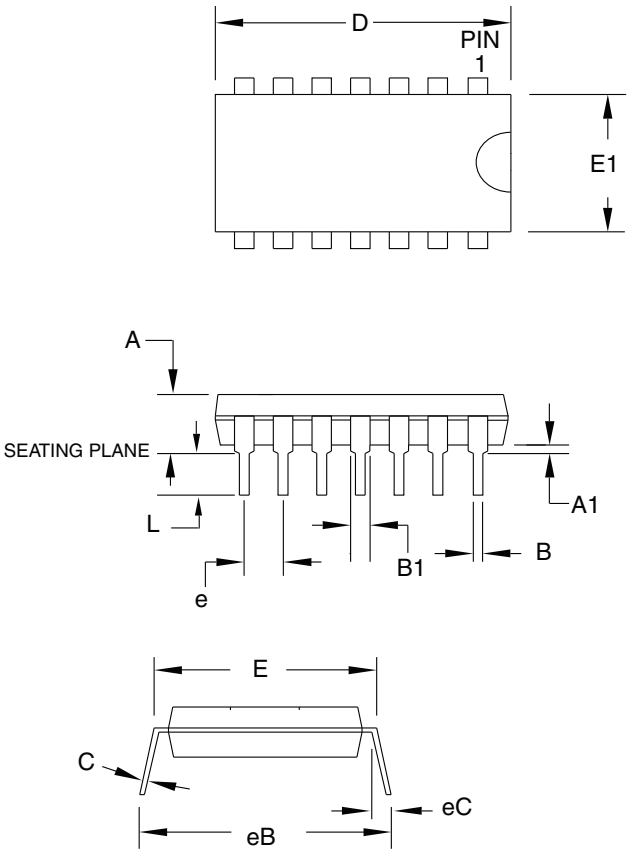
SYMBOL	MIN	NOM	MAX	NOTE
A	1.35/0.0532	–	1.75/0.0688	
A1	0.1/.0040	–	0.25/0.0098	
b	0.33/0.0130	–	0.5/0.0200 5	
D	8.55/0.3367	–	8.74/0.3444	2
E	3.8/0.1497	–	3.99/0.1574	3
H	5.8/0.2284	–	6.19/0.2440	
L	0.41/0.0160	–	1.27/0.0500	4
e	1.27/0.050 BSC			

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

	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**14S1**, 14-lead, 0.150" Wide Body, Plastic Gull Wing Small Outline Package (SOIC)	14S1	A

7.2 14P3



COMMON DIMENSIONS
(Unit of Measure = mm)

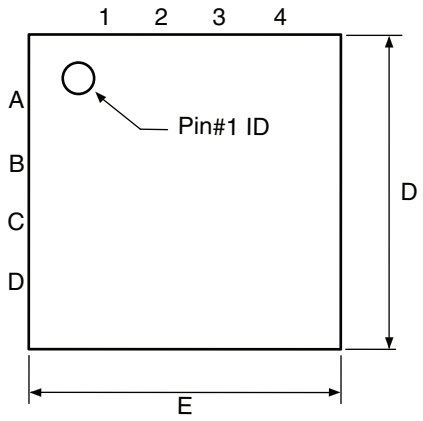
SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	5.334	
A1	0.381	–	–	
D	18.669	–	19.685	Note 2
E	7.620	–	8.255	
E1	6.096	–	7.112	Note 2
B	0.356	–	0.559	
B1	1.143	–	1.778	
L	2.921	–	3.810	
C	0.203	–	0.356	
eB	–	–	10.922	
eC	0.000	–	1.524	
e	2.540 TYP			

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").

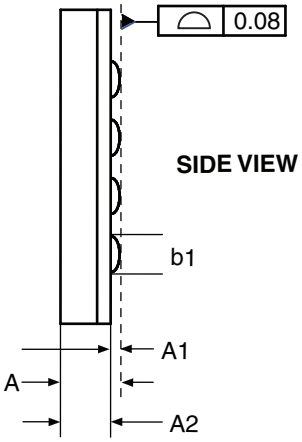
2010-10-20

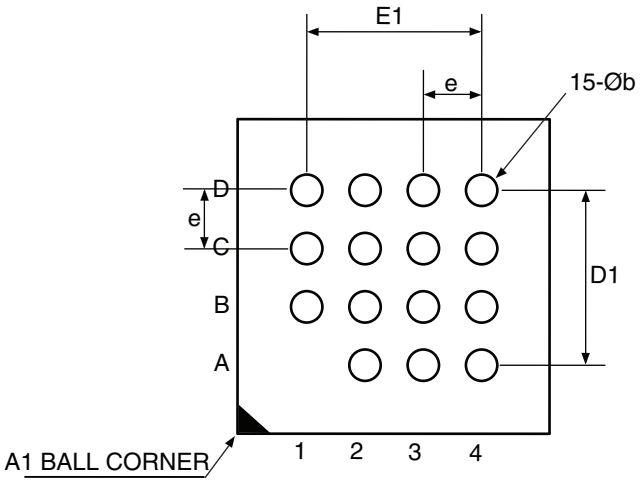
	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**14P3**, 14-lead (0.300"/7.62 mm Wide) Plastic Dual Inline Package (PDIP)	14P3	B

7.3 15CC1



TOP VIEW





BOTTOM VIEW

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	0.60	
A1	0.12	–	–	
A2		0.38 REF		
b	0.25	0.30	0.35	1
b1	0.25	–	–	2
D	2.90	3.00	3.10	
D1		1.95 BSC		
E	2.90	3.00	3.10	
E1		1.95 BSC		
e		0.65 BSC		

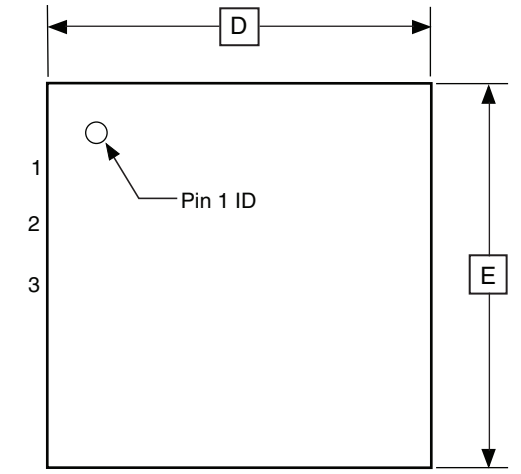
Note1: Dimension "b" is measured at the maximum ball dia. in a plane parallel to the seating plane.

Note2: Dimension "b1" is the solderable surface defined by the opening of the solder resist layer.

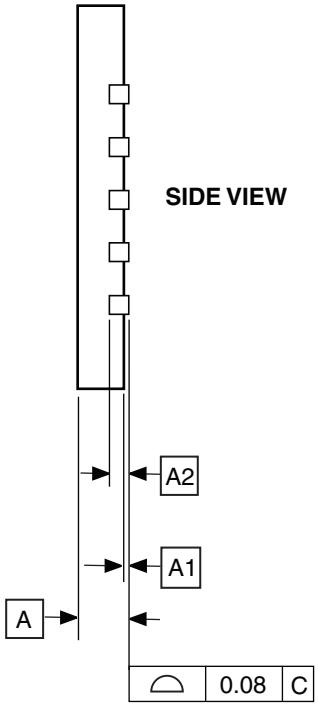
07/06/10

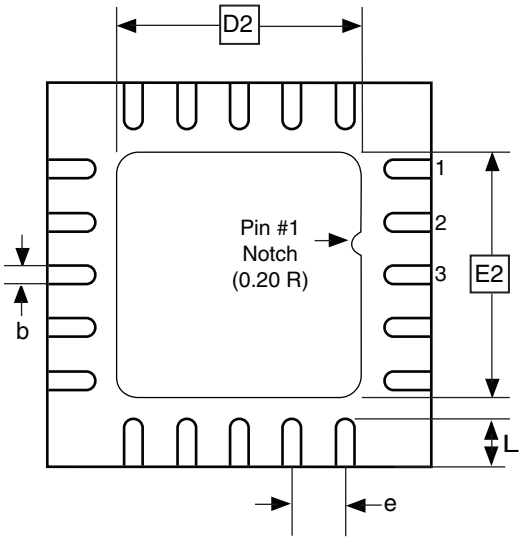
	TITLE	GPC	DRAWING NO.	REV.
Package Drawing Contact: packagedrawings@atmel.com	**15CC1,** 15-ball (4 x 4 Array), 3.0 x 3.0 x 0.6 mm package, ball pitch 0.65 mm, Ultra thin, Fine-Pitch Ball Grid Array Package (UFBGA)	CBC	15CC1	C

7.4 20M1



TOP VIEW





BOTTOM VIEW

Note: Reference JEDEC Standard MO-220, Fig. 1 (SAW Singulation) WGGD-5.

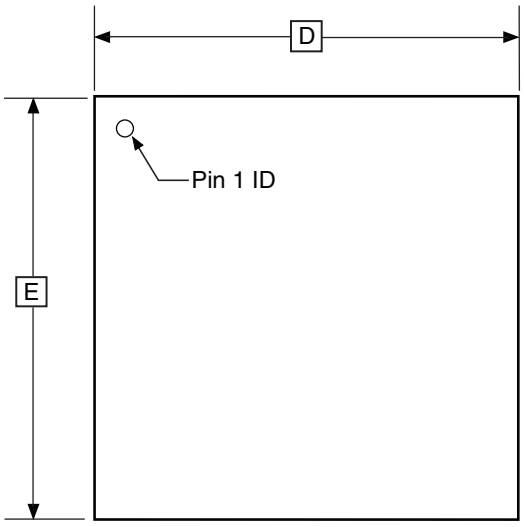
COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.70	0.75	0.80	
A1	–	0.01	0.05	
A2		0.20 REF		
b	0.18	0.23	0.30	
D		4.00 BSC		
D2	2.45	2.60	2.75	
E		4.00 BSC		
E2	2.45	2.60	2.75	
e		0.50 BSC		
L	0.35	0.40	0.55	

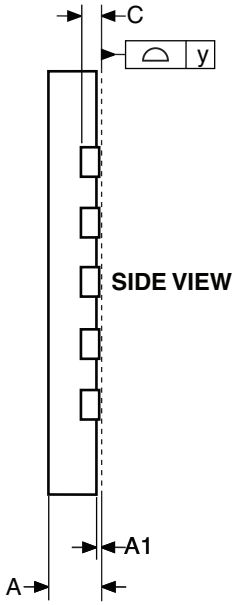
10/27/04

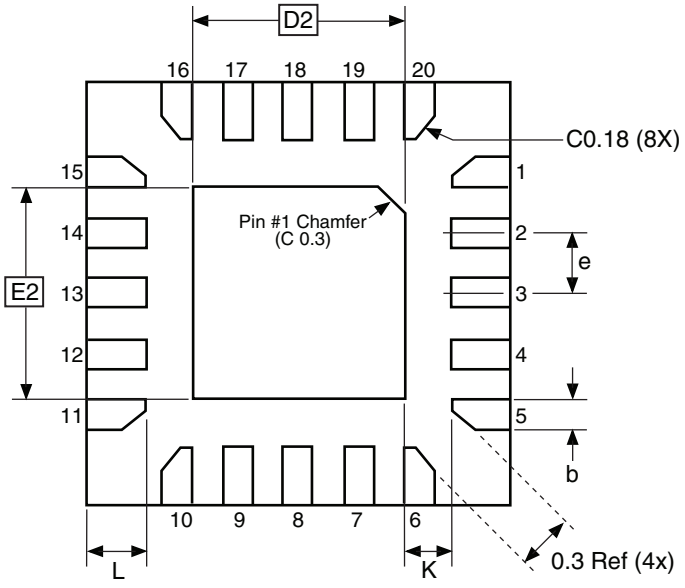
	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**20M1**, 20-pad, 4 x 4 x 0.8 mm Body, Lead Pitch 0.50 mm, 2.6 mm Exposed Pad, Micro Lead Frame Package (MLF)	20M1	B

7.5 20M2



TOP VIEW





BOTTOM VIEW

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.75	0.80	0.85	
A1	0.00	0.02	0.05	
b	0.17	0.22	0.27	
C		0.152		
D	2.90	3.00	3.10	
D2	1.40	1.55	1.70	
E	2.90	3.00	3.10	
E2	1.40	1.55	1.70	
e	–	0.45	–	
L	0.35	0.40	0.45	
K	0.20	–	–	
y	0.00	–	0.08	

10/24/08

	TITLE	GPC	DRAWING NO.	REV.
Package Drawing Contact: packagedrawings@atmel.com	**20M2,** 20-pad, 3 x 3 x 0.85 mm Body, Lead Pitch 0.45 mm, 1.55 x 1.55 mm Exposed Pad, Thermally Enhanced Plastic Very Thin Quad Flat No Lead Package (VQFN)	ZFC	20M2	B

8. Errata

The revision letters in this section refer to the revision of the corresponding ATtiny24A/44A/84A device.

8.1 ATtiny24A

8.1.1 Rev. H

No known errata.

8.1.2 Rev. G

Not sampled.

8.1.3 Rev. F

Not sampled.

8.2 ATtiny44A

8.2.1 Rev. G

No known errata. Yield improvement.

8.2.2 Rev. F

No known errata.

8.2.3 Rev. E

Not sampled.

8.3 ATtiny84A

8.3.1 Rev. C

No known errata.

9. Datasheet Revision History

9.1 Rev. 8183F – 06/12

1. Updated:
   – Table 16-1 on page 138
   – Figure 16-7 on page 137
   – “Ordering Information” on page 11

9.2 Rev. 8183E – 01/12

1. Updated:
   – Production status for ATtiny24A and ATtiny84A
   – “Start Condition Detector” on page 122
   – “Ordering Information” on page 11, 12, and 13

9.3 Rev. 8183D – 04/11

1. Added errata for ATtiny44A rev. G in Section 8. “Errata” on page 19

9.4 Rev. 8183C – 03/11

1. Added:
   – ATtiny84A, including typical characteristics plots
   – Section 3.3 “Capacitive Touch Sensing” on page 6
   – Table 6-8, “Capacitance of Low-Frequency Crystal Oscillator,” on page 28
   – Analog Comparator Offset plots for ATtiny24A (Figure 21.2.10 on page 208) and ATtiny44A (Figure 21.3.11 on page 236)
   – Extended temperature part numbers in Section 6. “Ordering Information” on page 11
2. Updated:
   – Bit syntax throughout the datasheet, e.g. from CS02:0 to CS0[2:0]
   – Section 6.4 “Clock Output Buffer” on page 30, changed CLKO to CKOUT
   – Table 16-4, “Single-Ended Input channel Selections,” on page 145, added note for Internal 1.1V Reference
   – Table 19-16, “High-voltage Serial Programming Instruction Set for ATtiny24A/44A/84A,” on page 170, adjusted notes
   – Table 20-1, “DC Characteristics. TA = -40°C to +85°C,” on page 173, adjusted notes

9.5 Rev. 8183B – 03/10

1. Updated template.
2. Added UFBGA package (15CC1) in: “Features” on page 1, “Pin Configurations” on page 2, Section 6. “Ordering Information” on page 11, and Section 7.3 “15CC1” on page 16.
3. Separated typical characteristic plots, added Section 21.2 “ATtiny24A” on page 183.
4. Updated sections:
   – Section 14.5.4 “USIBR – USI Buffer Register” on page 127, header updated

- Section 6. “Ordering Information” on page 11, added tape & reel and topside marking, updated notes

5. Updated Figures:
   - Figure 4-1 “Block Diagram of the AVR Architecture” on page 7
   - Figure 8-1 “Reset Logic” on page 38
   - Figure 14-1 “Universal Serial Interface, Block Diagram” on page 116, USIDB -> USIBR
   - Figure 19-5 “High-voltage Serial Programming Waveforms” on page 169
6. Updated Tables:
   - Table 19-11, “Minimum Wait Delay Before Writing the Next Flash or EEPROM Location,” on page 164, updated value for t_{WD_ERASE}

9.6 Rev. 8183A – 12/08

1. Initial revision. Created from document 8006H.
2. Updated "Ordering Information" on page 19 and page 19. Pb-plated packages are no longer offered and there are no separate ordering codes for commercial operation range, the only available option now is industrial. Also, updated some order codes to reflect changes in leadframe composition and added VQFN package option.
3. Updated data sheet template.
4. Removed all references to 8K device.
5. Updated characteristic plots of section “Typical Characteristics”, starting on page 182.
6. Added characteristic plots:
   - “Bandgap Voltage vs. Supply Voltage” on page 233
   - “Bandgap Voltage vs. Temperature” on page 233
7. Updated sections:
   - “Features” on page 1
   - “Power Reduction Register” on page 35
   - “Analog Comparator” on page 128
   - “Features” on page 132
   - “Operation” on page 133
   - “Starting a Conversion” on page 134
   - “ADC Voltage Reference” on page 139
   - “Speed” on page 174
8. Updated Figures:
   - “Program Memory Map” on page 15
   - “Data Memory Map” on page 16
9. Update Tables:
   - “Device Signature Bytes” on page 161
   - “DC Characteristics. TA = -40°C to +85°C” on page 173
   - “Additional Current Consumption for the different I/O modules (absolute values)” on page 182
   - “Additional Current Consumption (percentage) in Active and Idle mode” on page 183

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