

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 (ATtiny25/45/85)
 - Endurance: 10,000 Write/Erase Cycles
 - 128/256/512 Bytes In-System Programmable EEPROM (ATtiny25/45/85)
 - Endurance: 100,000 Write/Erase Cycles
 - 128/256/512 Bytes Internal SRAM (ATtiny25/45/85)
 - Programming Lock for Self-Programming Flash Program and EEPROM Data Security
- Peripheral Features
 - 8-bit Timer/Counter with Prescaler and Two PWM Channels
 - 8-bit High Speed Timer/Counter with Separate Prescaler
 - 2 High Frequency PWM Outputs with Separate Output Compare Registers
 - Programmable Dead Time Generator
 - USI – Universal Serial Interface with Start Condition Detector
 - 10-bit ADC
 - 4 Single Ended Channels
 - 2 Differential ADC Channel Pairs with Programmable Gain (1x, 20x)
 - Temperature Measurement
 - Programmable Watchdog Timer with Separate On-chip Oscillator
 - On-chip Analog Comparator
- 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, and Power-down Modes
 - Enhanced Power-on Reset Circuit
 - Programmable Brown-out Detection Circuit
 - Internal Calibrated Oscillator
- I/O and Packages
 - Six Programmable I/O Lines
 - 8-pin PDIP, 8-pin SOIC and 20-pad QFN/MLF
- Operating Voltage
 - 1.8 - 5.5V for ATtiny25/45/85V
 - 2.7 - 5.5V for ATtiny25/45/85
- Speed Grade
 - ATtiny25/45/85V: 0 - 4 MHz @ 1.8 - 5.5V, 0 - 10 MHz @ 2.7 - 5.5V
 - ATtiny25/45/85: 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: 300 μ A
 - Power-down Mode:
 - 0.1 μ A at 1.8V



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

ATtiny25/V *
ATtiny45/V
ATtiny85/V *

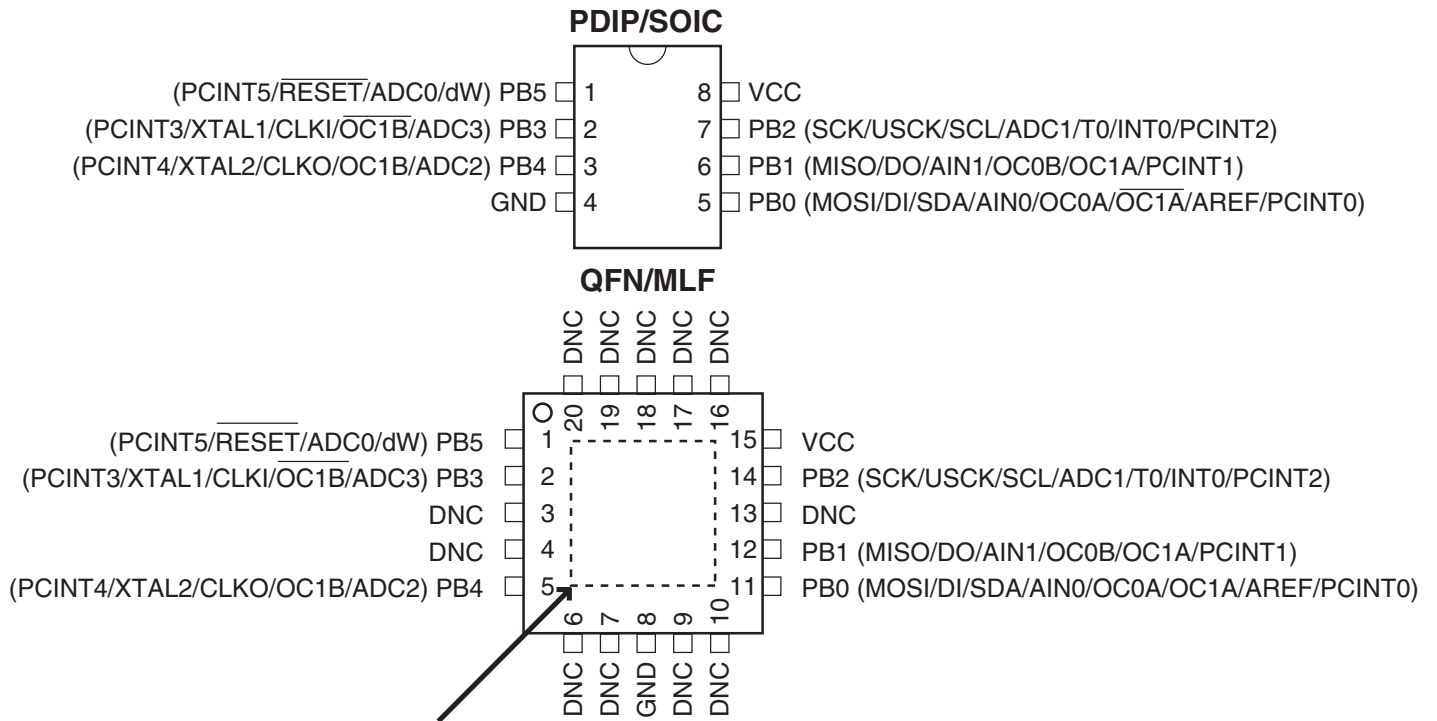
*** Preliminary
Summary**

2586KS-AVR-01/08



1. Pin Configurations

Figure 1-1. Pinout ATtiny25/45/85



NOTE: Bottom pad should be soldered to ground.
DNC: Do Not Connect

1.1 Pin Descriptions

1.1.1 VCC

Supply voltage.

1.1.2 GND

Ground.

1.1.3 Port B (PB5..PB0)

Port B is a 6-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. 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 ATtiny25/45/85 as listed in [“Alternate Functions of Port B”](#) on page 61.

On ATtiny25, the programmable I/O ports PB3 and PB4 (pins 2 and 3) are exchanged in ATtiny15 Compatibility Mode for supporting the backward compatibility with ATtiny15.

1.1.4 **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 21-4 on page 170](#). Shorter pulses are not guaranteed to generate a reset.

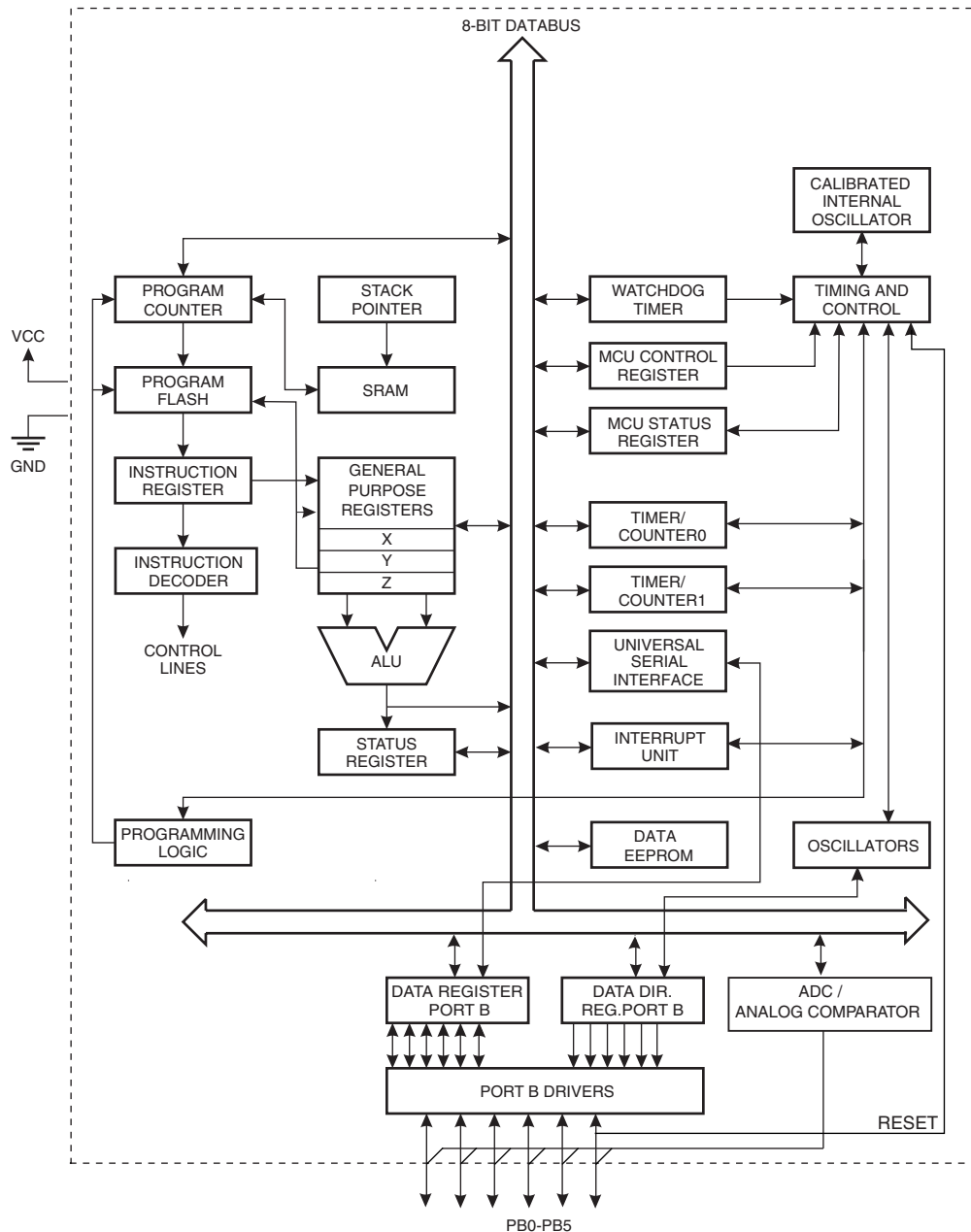
The reset pin can also be used as a (weak) I/O pin.

2. Overview

The ATtiny25/45/85 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 ATtiny25/45/85 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 ATtiny25/45/85 provides the following features: 2/4/8K byte of In-System Programmable Flash, 128/256/512 bytes EEPROM, 128/256/256 bytes SRAM, 6 general purpose I/O lines, 32 general purpose working registers, one 8-bit Timer/Counter with compare modes, one 8-bit high speed Timer/Counter, Universal Serial Interface, Internal and External Interrupts, a 4-channel, 10-bit ADC, a programmable Watchdog Timer with internal Oscillator, and three 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.

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 ATtiny25/45/85 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. About

3.1 Resources

A comprehensive set of development tools, application notes and datasheets are available for download on <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.

4. Register Summary

| Address | Name | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Page | |
|---------|----------|--|--------|--------|--------|---------|---------|---------|---------|--|-----------------------------------|
| 0x3F | SREG | I | T | H | S | V | N | Z | C | page 8 | |
| 0x3E | SPH | – | – | – | – | – | – | SP9 | SP8 | page 11 | |
| 0x3D | SPL | SP7 | SP6 | SP5 | SP4 | SP3 | SP2 | SP1 | SP0 | page 11 | |
| 0x3C | Reserved | – | | | | | | | | | |
| 0x3B | GIMSK | – | INT0 | PCIE | – | – | – | – | – | page 53 | |
| 0x3A | GIFR | – | INTF0 | PCIF | – | – | – | – | – | page 53 | |
| 0x39 | TIMSK | – | OCIE1A | OCIE1B | OCIE0A | OCIE0B | TOIE1 | TOIE0 | – | page 84/page 106 | |
| 0x38 | TIFR | – | OCF1A | OCF1B | OCF0A | OCF0B | TOV1 | TOV0 | – | page 84 | |
| 0x37 | SPMCSR | – | – | RSIG | CTPB | RFLB | PGWRT | PGERS | SPMEN | page 149 | |
| 0x36 | Reserved | – | | | | | | | | | |
| 0x35 | MCUCR | BODS | PUD | SE | SM1 | SM0 | BODSE | ISC01 | ISC00 | page 38, page 52, page 66, | |
| 0x34 | MCUSR | – | – | – | – | WDRF | BORF | EXTRF | PORF | page 47, | |
| 0x33 | TCCR0B | FOC0A | FOC0B | – | – | WGM02 | CS02 | CS01 | CS00 | page 82 | |
| 0x32 | TCNT0 | Timer/Counter0 | | | | | | | | | page 83 |
| 0x31 | OSCCAL | Oscillator Calibration Register | | | | | | | | | page 32 |
| 0x30 | TCCR1 | CTC1 | PWM1A | COM1A1 | COM1A0 | CS13 | CS12 | CS11 | CS10 | page 92, page 103 | |
| 0x2F | TCNT1 | Timer/Counter1 | | | | | | | | | page 94, page 105 |
| 0x2E | OCR1A | Timer/Counter1 Output Compare Register A | | | | | | | | | page 94, page 105 |
| 0x2D | OCR1C | Timer/Counter1 Output Compare Register C | | | | | | | | | page 95, page 106 |
| 0x2C | GTCCR | TSM | PWM1B | COM1B1 | COM1B0 | FOC1B | FOC1A | PSR1 | PSR0 | page 80, page 93, page | |
| 0x2B | OCR1B | Timer/Counter1 Output Compare Register B | | | | | | | | | page 95 |
| 0x2A | TCCR0A | COM0A1 | COM0A0 | COM0B1 | COM0B0 | – | – | WGM01 | WGM00 | page 80 | |
| 0x29 | OCR0A | Timer/Counter0 – Output Compare Register A | | | | | | | | | page 83 |
| 0x28 | OCR0B | Timer/Counter0 – Output Compare Register B | | | | | | | | | page 84 |
| 0x27 | PLLCSR | LSM | – | – | – | – | PCKE | PLLE | PLOCK | page 97, page 107 | |
| 0x26 | CLKPR | CLKPCE | – | – | – | CLKPS3 | CLKPS2 | CLKPS1 | CLKPS0 | page 33 | |
| 0x25 | DT1A | DT1AH3 | DT1AH2 | DT1AH1 | DT1AH0 | DT1AL3 | DT1AL2 | DT1AL1 | DT1AL0 | page 110 | |
| 0x24 | DT1B | DT1BH3 | DT1BH2 | DT1BH1 | DT1BH0 | DT1BL3 | DT1BL2 | DT1BL1 | DT1BL0 | page 110 | |
| 0x23 | DTPS1 | – | – | – | – | – | – | DTPS11 | DTPS10 | page 109 | |
| 0x22 | DWDR | DWDR[7:0] | | | | | | | | | page 144 |
| 0x21 | WDTCR | WDIF | WDIE | WDP3 | WDCE | WDE | WDP2 | WDP1 | WDP0 | page 47 | |
| 0x20 | PRR | – | – | – | – | PRTIM1 | PRTIM0 | PRUSI | PRADC | page 37 | |
| 0x1F | EEARH | – | | | | | | | | | page 20 |
| 0x1E | EEARL | EEAR7 | EEAR6 | EEAR5 | EEAR4 | EEAR3 | EEAR2 | EEAR1 | EEAR0 | page 20 | |
| 0x1D | EEDR | EEPROM Data Register | | | | | | | | | page 20 |
| 0x1C | EECR | – | – | EPPM1 | EPPM0 | EERIE | EEMPE | EEPE | EERE | page 21 | |
| 0x1B | Reserved | – | | | | | | | | | |
| 0x1A | Reserved | – | | | | | | | | | |
| 0x19 | Reserved | – | | | | | | | | | |
| 0x18 | PORTB | – | – | PORTB5 | PORTB4 | PORTB3 | PORTB2 | PORTB1 | PORTB0 | page 66 | |
| 0x17 | DDRB | – | – | DDB5 | DDB4 | DDB3 | DDB2 | DDB1 | DDB0 | page 66 | |
| 0x16 | PINB | – | – | PINB5 | PINB4 | PINB3 | PINB2 | PINB1 | PINB0 | page 66 | |
| 0x15 | PCMSK | – | – | PCINT5 | PCINT4 | PCINT3 | PCINT2 | PCINT1 | PCINT0 | page 54 | |
| 0x14 | DIDR0 | – | – | ADC0D | ADC2D | ADC3D | ADC1D | AIN1D | AIN0D | page 125, page 142 | |
| 0x13 | GPIOR2 | General Purpose I/O Register 2 | | | | | | | | | page 10 |
| 0x12 | GPIOR1 | General Purpose I/O Register 1 | | | | | | | | | page 10 |
| 0x11 | GPIOR0 | General Purpose I/O Register 0 | | | | | | | | | page 10 |
| 0x10 | USIBR | USI Buffer Register | | | | | | | | | page 118 |
| 0x0F | USIDR | USI Data Register | | | | | | | | | page 118 |
| 0x0E | USISR | USISIF | USIOIF | USIPF | USIDC | USICNT3 | USICNT2 | USICNT1 | USICNT0 | page 119 | |
| 0x0D | USICR | USISIE | USIOIE | USIWM1 | USIWM0 | USICS1 | USICS0 | USICLK | USITC | page 120 | |
| 0x0C | Reserved | – | | | | | | | | | |
| 0x0B | Reserved | – | | | | | | | | | |
| 0x0A | Reserved | – | | | | | | | | | |
| 0x09 | Reserved | – | | | | | | | | | |
| 0x08 | ACSR | ACD | ACBG | ACO | ACI | ACIE | – | ACIS1 | ACIS0 | page 124 | |
| 0x07 | ADMUX | REFS1 | REFS0 | ADLAR | REFS2 | MUX3 | MUX2 | MUX1 | MUX0 | page 138 | |
| 0x06 | ADCSRA | ADEN | ADSC | ADATE | ADIF | ADIE | ADPS2 | ADPS1 | ADPS0 | page 140 | |
| 0x05 | ADCH | ADC Data Register High Byte | | | | | | | | | page 141 |
| 0x04 | ADCL | ADC Data Register Low Byte | | | | | | | | | page 141 |
| 0x03 | ADCSRB | BIN | ACME | IPR | – | – | ADTS2 | ADTS1 | ADTS0 | page 124, page 141 | |
| 0x02 | Reserved | – | | | | | | | | | |
| 0x01 | Reserved | – | | | | | | | | | |
| 0x00 | Reserved | – | | | | | | | | | |

- 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 AVR's, 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 | 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 |
| 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 |
| 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 |

| Mnemonics | Operands | Description | Operation | Flags | #Clocks |
|-----------------------------------|----------|----------------------------------|--|---------|---------|
| 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 ATtiny25

| Speed (MHz) ⁽³⁾ | Power Supply | Ordering Code ⁽²⁾ | Package ⁽¹⁾ | Operational Range |
|----------------------------|--------------|---|----------------------------|-------------------------------|
| 10 | 1.8 - 5.5V | ATtiny25V-10PU ATtiny25V-10SU ATtiny25V-10SSU ATtiny25V-10MU | 8P3 8S2 S8S1 20M1 | Industrial (-40°C to 85°C) |
| 20 | 2.7 - 5.5V | ATtiny25-20PU ATtiny25-20SU ATtiny25-20SSU ATtiny25-20MU | 8P3 8S2 S8S1 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.
 3. For Speed vs. V_{CC} , see [Figure 21.3 on page 168](#)

| Package Type | |
|--------------|---|
| 8P3 | 8-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP) |
| 8S2 | 8-lead, 0.200" Wide, Plastic Gull-Wing Small Outline (EIAJ SOIC) |
| S8S1 | 8-lead, 0.150" Wide, Plastic Gull-Wing Small Outline (JEDEC SOIC) |
| 20M1 | 20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF) |

6.2 ATtiny45

| Speed (MHz) ⁽³⁾ | Power Supply | Ordering Code ⁽²⁾ | Package ⁽¹⁾ | Operational Range |
|----------------------------|--------------|--|------------------------|-------------------------------|
| 10 | 1.8 - 5.5V | ATtiny45V-10PU ATtiny45V-10SU ATtiny45V-10MU | 8P3 8S2 20M1 | Industrial (-40°C to 85°C) |
| 20 | 2.7 - 5.5V | ATtiny45-20PU ATtiny45-20SU ATtiny45-20MU | 8P3 8S2 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.
 3. For Speed vs. V_{CC} , see [Figure 21.3 on page 168](#)

| Package Type | |
|--------------|---|
| 8P3 | 8-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP) |
| 8S2 | 8-lead, 0.200" Wide, Plastic Gull-Wing Small Outline (EIAJ SOIC) |
| 20M1 | 20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF) |

6.3 ATtiny85

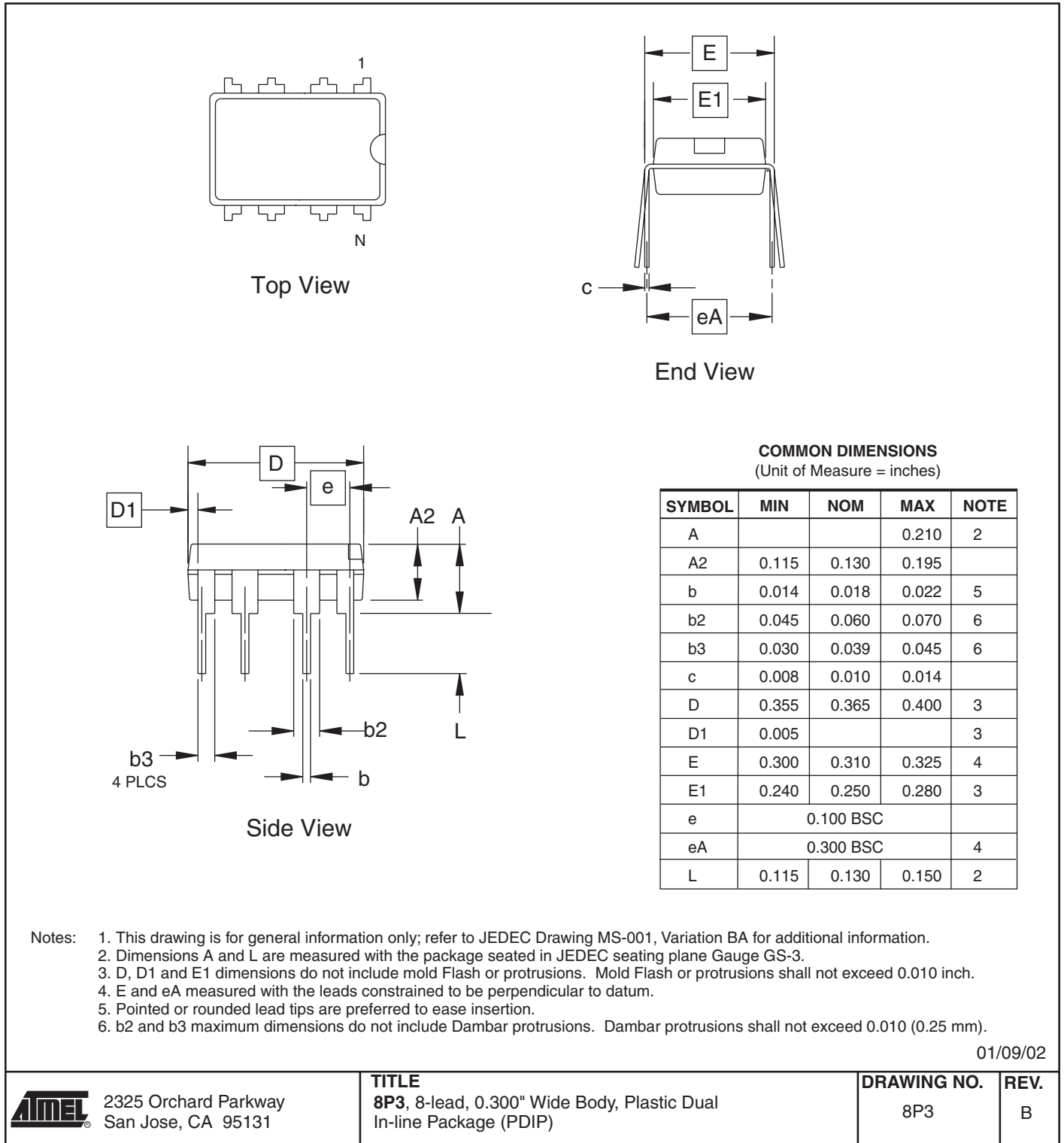
| Speed (MHz) ⁽³⁾ | Power Supply | Ordering Code ⁽²⁾ | Package ⁽¹⁾ | Operational Range |
|----------------------------|--------------|--|------------------------|-------------------------------|
| 10 | 1.8 - 5.5V | ATtiny85V-10PU ATtiny85V-10SU ATtiny85V-10MU | 8P3 8S2 20M1 | Industrial (-40°C to 85°C) |
| 20 | 2.7 - 5.5V | ATtiny85-20PU ATtiny85-20SU ATtiny85-20MU | 8P3 8S2 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.
 3. For Speed vs. V_{CC} , see [Figure 21.3 on page 168](#)

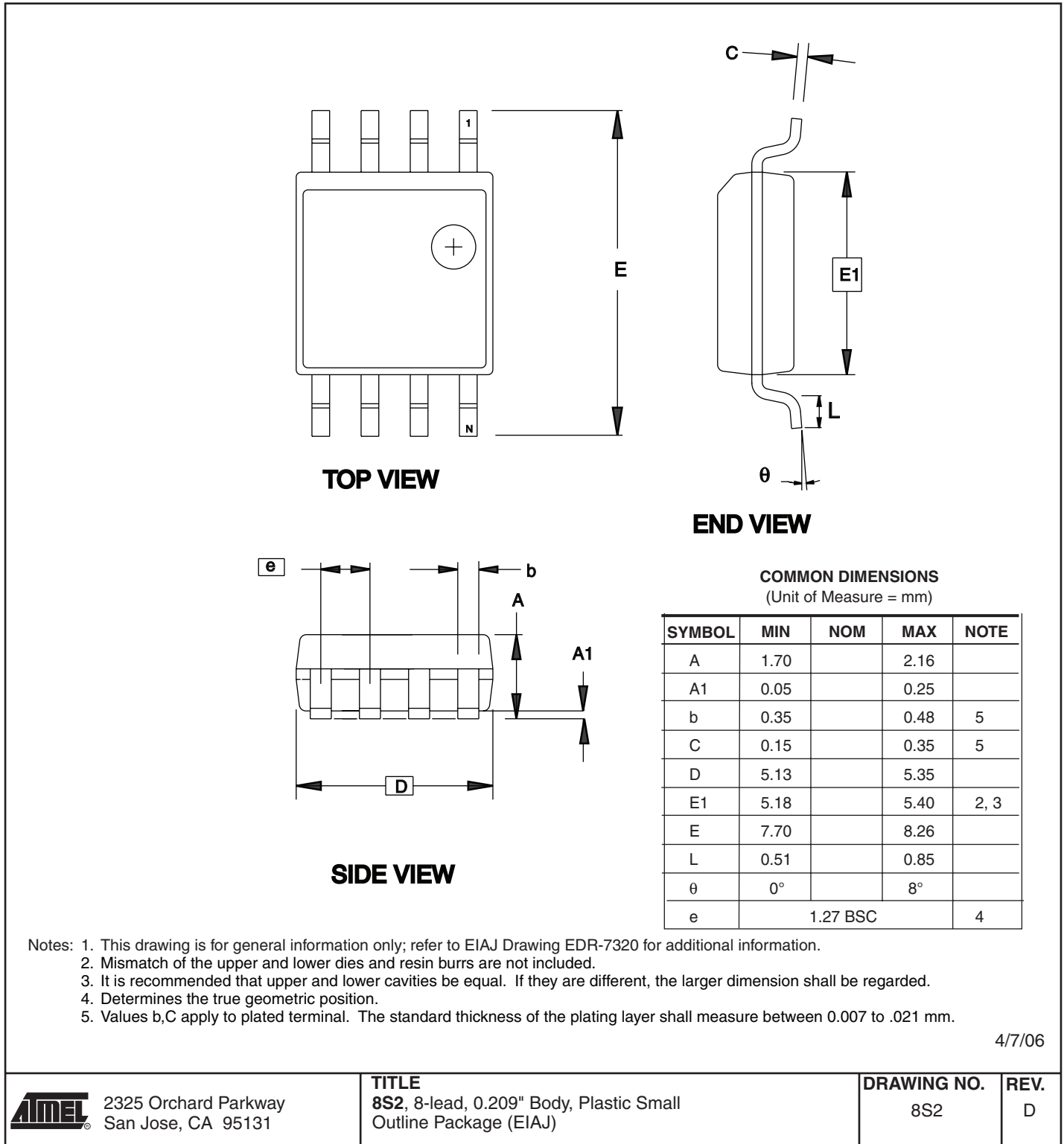
| Package Type | |
|--------------|---|
| 8P3 | 8-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP) |
| 8S2 | 8-lead, 0.200" Wide, Plastic Gull-Wing Small Outline (EIAJ SOIC) |
| 20M1 | 20-pad, 4 x 4 x 0.8 mm Body, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF) |

7. Packaging Information

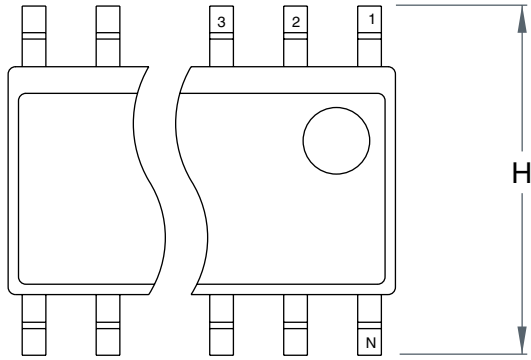
7.1 8P3



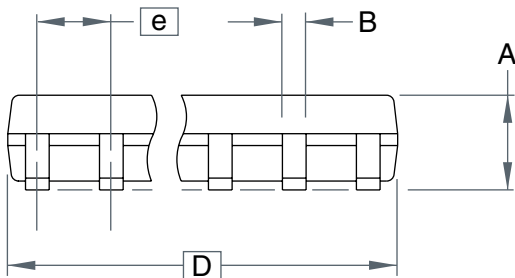
7.2 8S2



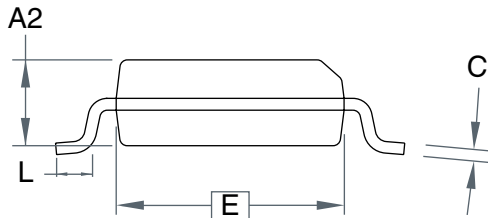
7.3 S8S1



Top View



Side View



End View

COMMON DIMENSIONS
(Unit of Measure = mm)

| SYMBOL | MIN | NOM | MAX | NOTE |
|--------|----------|-----|------|------|
| A | - | - | 1.75 | |
| B | - | - | 0.51 | |
| C | - | - | 0.25 | |
| D | - | - | 5.00 | |
| E | - | - | 4.00 | |
| e | 1.27 BSC | | | |
| H | - | - | 6.20 | |
| L | - | - | 1.27 | |

Note: This drawing is for general information only. Refer to JEDEC Drawing MS-012 for proper dimensions, tolerances, datums, etc.

10/10/01



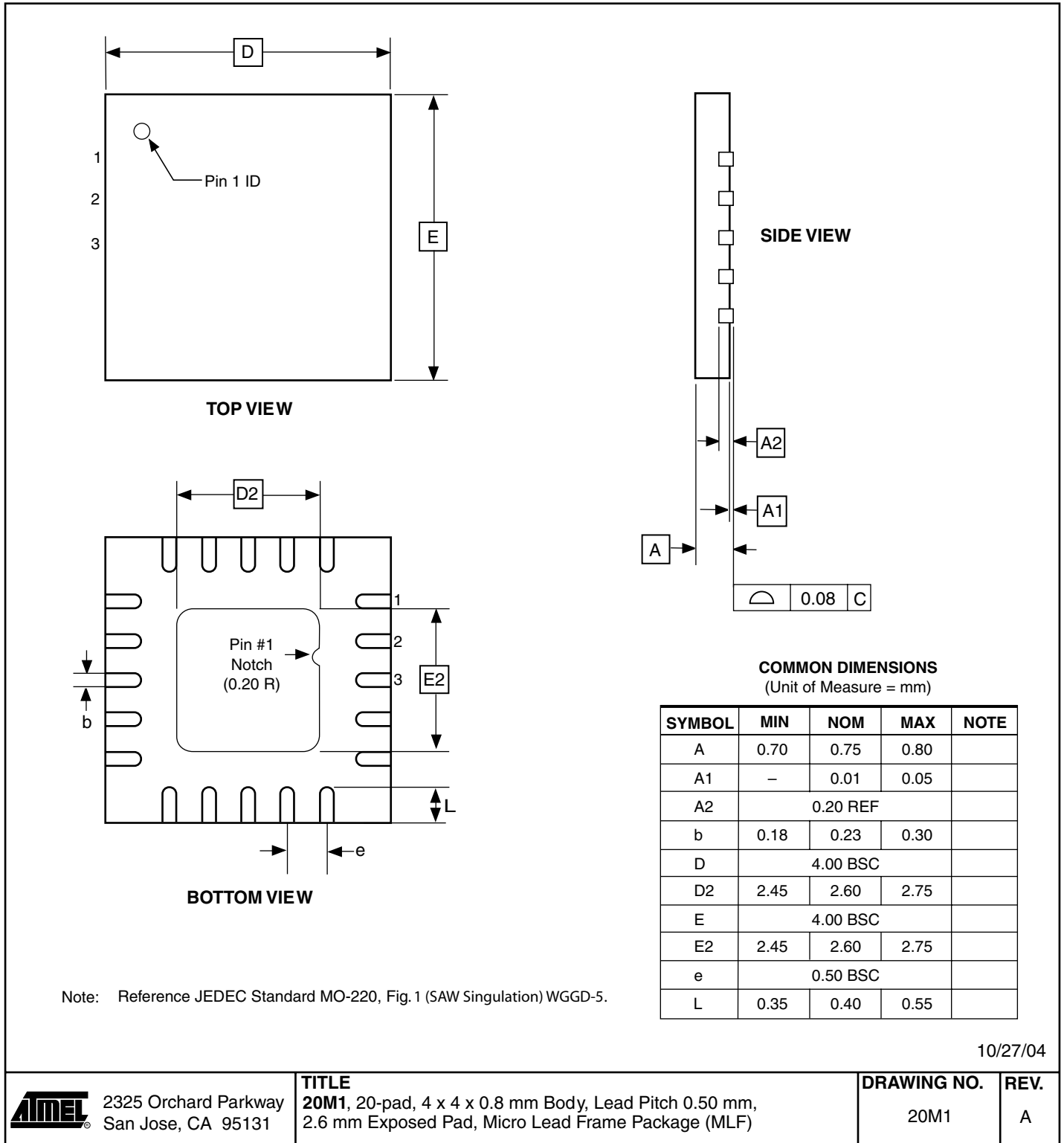
2325 Orchard Parkway
San Jose, CA 95131

TITLE
8S1, 8-lead (0.150" Wide Body), Plastic Gull Wing
Small Outline (JEDEC SOIC)

DRAWING NO.
8S1

REV.
A

7.4 20M1



8. Errata

8.1 Errata ATtiny25

The revision letter in this section refers to the revision of the ATtiny25 device.

8.1.1 Rev D and E

No known errata.

8.1.2 Rev B and C

- **EEPROM read may fail at low supply voltage / low clock frequency**

1. **EEPROM read may fail at low supply voltage / low clock frequency**

Trying to read EEPROM at low clock frequencies and/or low supply voltage may result in invalid data.

Problem Fix/Workaround

Do not use the EEPROM when clock frequency is below 1 MHz and supply voltage is below 2V. If operating frequency can not be raised above 1 MHz then supply voltage should be more than 3V. Similarly, if supply voltage can not be raised above 2V then operating frequency should be more than 2 MHz.

This feature is known to be temperature dependent but it has not been characterised. Guidelines are given for room temperature, only.

8.1.3 Rev A

Not sampled.

8.2 Errata ATtiny45

The revision letter in this section refers to the revision of the ATtiny45 device.

8.2.1 Rev F and G

No known errata

8.2.2 Rev D and E

- **EEPROM read may fail at low supply voltage / low clock frequency**

1. **EEPROM read may fail at low supply voltage / low clock frequency**

Trying to read EEPROM at low clock frequencies and/or low supply voltage may result in invalid data.

Problem Fix/Workaround

Do not use the EEPROM when clock frequency is below 1 MHz and supply voltage is below 2V. If operating frequency can not be raised above 1 MHz then supply voltage should be more than 3V. Similarly, if supply voltage can not be raised above 2V then operating frequency should be more than 2 MHz.

This feature is known to be temperature dependent but it has not been characterised. Guidelines are given for room temperature, only.

8.2.3 Rev B and C

- **PLL not locking**
- **EEPROM read from application code does not work in Lock Bit Mode 3**
- **EEPROM read may fail at low supply voltage / low clock frequency**
- **Timer Counter 1 PWM output generation on OC1B- XOC1B does not work correctly**

1. **PLL not locking**

When at frequencies below 6.0 MHz, the PLL will not lock

Problem fix / Workaround

When using the PLL, run at 6.0 MHz or higher.

2. **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.

3. **EEPROM read may fail at low supply voltage / low clock frequency**

Trying to read EEPROM at low clock frequencies and/or low supply voltage may result in invalid data.

Problem Fix/Workaround

Do not use the EEPROM when clock frequency is below 1 MHz and supply voltage is below 2V. If operating frequency can not be raised above 1 MHz then supply voltage should be

more than 3V. Similarly, if supply voltage can not be raised above 2V then operating frequency should be more than 2 MHz.

This feature is known to be temperature dependent but it has not been characterised. Guidelines are given for room temperature, only.

- 4. Timer Counter 1 PWM output generation on OC1B – XOC1B does not work correctly**
Timer Counter1 PWM output OC1B-XOC1B does not work correctly. Only in the case when the control bits, COM1B1 and COM1B0 are in the same mode as COM1A1 and COM1A0, respectively, the OC1B-XOC1B output works correctly.

Problem Fix/Work around

The only workaround is to use same control setting on COM1A(1:0) and COM1B(1:0) control bits, see table 14-4 in the data sheet. The problem has been fixed for Tiny45 rev D.

8.2.4 Rev A

- **Too high power down power consumption**
- **DebugWIRE loses communication when single stepping into interrupts**
- **PLL not locking**
- **EEPROM read from application code does not work in Lock Bit Mode 3**
- **EEPROM read may fail at low supply voltage / low clock frequency**

- 1. Too high power down power consumption**

Three situations will lead to a too high power down power consumption. These are:

- An external clock is selected by fuses, but the I/O PORT is still enabled as an output.
- The EEPROM is read before entering power down.
- VCC is 4.5 volts or higher.

Problem fix / Workaround

- When using external clock, avoid setting the clock pin as Output.
- Do not read the EEPROM if power down power consumption is important.
- Use VCC lower than 4.5 Volts.

- 2. DebugWIRE loses communication when single stepping into interrupts**

When receiving an interrupt during single stepping, debugwire will lose communication.

Problem fix / Workaround

- When singlestepping, disable interrupts.
- When debugging interrupts, use breakpoints within the interrupt routine, and run into the interrupt.

- 3. PLL not locking**

When at frequencies below 6.0 MHz, the PLL will not lock

Problem fix / Workaround

When using the PLL, run at 6.0 MHz or higher.

- 4. 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.

5. EEPROM read may fail at low supply voltage / low clock frequency

Trying to read EEPROM at low clock frequencies and/or low supply voltage may result in invalid data.

Problem Fix/Workaround

Do not use the EEPROM when clock frequency is below 1 MHz and supply voltage is below 2V. If operating frequency can not be raised above 1 MHz then supply voltage should be more than 3V. Similarly, if supply voltage can not be raised above 2V then operating frequency should be more than 2 MHz.

This feature is known to be temperature dependent but it has not been characterised. Guidelines are given for room temperature, only.

8.3 Errata ATtiny85

The revision letter in this section refers to the revision of the ATtiny85 device.

8.3.1 Rev B and C

No known errata.

8.3.2 Rev A

- **EEPROM read may fail at low supply voltage / low clock frequency**

1. **EEPROM read may fail at low supply voltage / low clock frequency**

Trying to read EEPROM at low clock frequencies and/or low supply voltage may result in invalid data.

Problem Fix/Workaround

Do not use the EEPROM when clock frequency is below 1 MHz and supply voltage is below 2V. If operating frequency can not be raised above 1 MHz then supply voltage should be more than 3V. Similarly, if supply voltage can not be raised above 2V then operating frequency should be more than 2 MHz.

This feature is known to be temperature dependent but it has not been characterised. Guidelines are given for room temperature, only.

9. Datasheet Revision History

9.1 Rev. 2586K-01/08

1. Updated Document Template.
2. Added Sections:
 - “Data Retention” on page 6
 - “Low Level Interrupt” on page 51
 - “Device Signature Imprint Table” on page 153
3. Updated Sections:
 - “Internal PLL for Fast Peripheral Clock Generation - clkPCK” on page 24
 - “System Clock and Clock Options” on page 23
 - “Internal PLL in ATtiny15 Compatibility Mode” on page 24
 - “Sleep Modes” on page 35
 - “Software BOD Disable” on page 36
 - “External Interrupts” on page 51
 - “Timer/Counter1 in PWM Mode” on page 101
 - “USI – Universal Serial Interface” on page 111
 - “Temperature Measurement” on page 137
 - “Reading Lock, Fuse and Signature Data from Software” on page 147
 - “Program And Data Memory Lock Bits” on page 151
 - “Fuse Bytes” on page 152
 - “Signature Bytes” on page 154
 - “Calibration Bytes” on page 154
 - “System and Reset Characteristics” on page 170
4. Added Figures:
 - “Reset Pin Output Voltage vs. Sink Current ($V_{CC} = 3V$)” on page 188
 - “Reset Pin Output Voltage vs. Sink Current ($V_{CC} = 5V$)” on page 189
 - “Reset Pin Output Voltage vs. Source Current ($V_{CC} = 3V$)” on page 189
 - “Reset Pin Output Voltage vs. Source Current ($V_{CC} = 5V$)” on page 190
5. Updated Figure:
 - “Reset Logic” on page 41
6. Updated Tables:
 - “Start-up Times for Internal Calibrated RC Oscillator Clock” on page 28
 - “Start-up Times for Internal Calibrated RC Oscillator Clock (in ATtiny15 Mode)” on page 28
 - “Start-up Times for the 128 kHz Internal Oscillator” on page 29
 - “Compare Mode Select in PWM Mode” on page 89
 - “Compare Mode Select in PWM Mode” on page 101
 - “DC Characteristics. $T_A = -40^{\circ}C$ to $85^{\circ}C$ ⁽¹⁾” on page 166
 - “Calibration Accuracy of Internal RC Oscillator” on page 169
 - “ADC Characteristics – Preliminary” on page 172

7. Updated Code Example in Section:
 - “Write” on page 17
8. Updated Bit Descriptions in:
 - “MCUCR – MCU Control Register” on page 38
 - “Bits 7:6 – COM0A1:0: Compare Match Output A Mode” on page 80
 - “Bits 5:4 – COM0B1:0: Compare Match Output B Mode” on page 80
 - “Bits 2:0 – ADTS2:0: ADC Auto Trigger Source” on page 142
 - “SPMCSR – Store Program Memory Control and Status Register” on page 149.
9. Updated description of feature “EEPROM read may fail at low supply voltage / low clock frequency” in Sections:
 - “Errata ATtiny25” on page 18
 - “Errata ATtiny45” on page 19
 - “Errata ATtiny85” on page 22
10. Updated Package Description in Sections:
 - “ATtiny25” on page 11
 - “ATtiny45” on page 12
 - “ATtiny85” on page 13
11. Updated Package Drawing:
 - “S8S1” on page 16
12. Updated Order Codes for:
 - “ATtiny25” on page 11

9.2 Rev. 2586J-12/06

1. Updated “Low Power Consumption” on page 1.
2. Updated description of instruction length in “Architectural Overview” , starting on page 7.
3. Updated Flash size in “In-System Re-programmable Flash Program Memory” on page 15.
4. Updated cross-references in sections “Atomic Byte Programming” , “Erase” and “Write” , starting on page 17.
5. Updated “Atomic Byte Programming” on page 17.
6. Updated “Internal PLL for Fast Peripheral Clock Generation - clkPCK” on page 24.
7. Replaced single clocking system figure with two: Figure 6-2 and Figure 6-3 on page 24.
8. Updated Table 6-1 on page 25, Table 6-12 on page 30 and Table 6-6 on page 28.
9. Updated “Calibrated Internal Oscillator” on page 27.
10. Updated Table 6-5 on page 27.
11. Updated “OSCCAL – Oscillator Calibration Register” on page 32.
12. Updated “CLKPR – Clock Prescale Register” on page 33.
13. Updated “Power-down Mode” on page 36.
14. Updated “Bit 0” in “PRR – Power Reduction Register” on page 39.
15. Added footnote to Table 8-3 on page 49.
16. Updated Table 10-5 on page 65.
17. Deleted “Bits 7, 2” in “MCUCR – MCU Control Register” on page 66.

18. Updated and moved section “Timer/Counter0 Prescaler and Clock Sources”, now located on [page 68](#).
19. Updated “[Timer/Counter1 Initialization for Asynchronous Mode](#)” on [page 89](#).
20. Updated bit description in “[PLLCSR – PLL Control and Status Register](#)” on [page 97](#) and “[PLLCSR – PLL Control and Status Register](#)” on [page 107](#).
21. Added recommended maximum frequency in “[Prescaling and Conversion Timing](#)” on [page 129](#).
22. Updated [Figure 17-8](#) on [page 133](#).
23. Updated “[Temperature Measurement](#)” on [page 137](#).
24. Updated [Table 17-3](#) on [page 138](#).
25. Updated bit R/W descriptions in:
 “[TIMSK – Timer/Counter Interrupt Mask Register](#)” on [page 84](#),
 “[TIFR – Timer/Counter Interrupt Flag Register](#)” on [page 84](#),
 “[TIMSK – Timer/Counter Interrupt Mask Register](#)” on [page 95](#),
 “[TIFR – Timer/Counter Interrupt Flag Register](#)” on [page 96](#),
 “[PLLCSR – PLL Control and Status Register](#)” on [page 97](#),
 “[TIMSK – Timer/Counter Interrupt Mask Register](#)” on [page 106](#),
 “[TIFR – Timer/Counter Interrupt Flag Register](#)” on [page 106](#),
 “[PLLCSR – PLL Control and Status Register](#)” on [page 107](#) and
 “[DIDR0 – Digital Input Disable Register 0](#)” on [page 142](#).
26. Added limitation to “[Limitations of debugWIRE](#)” on [page 144](#).
27. Updated “[DC Characteristics](#)” on [page 166](#).
28. Updated [Table 21-7](#) on [page 171](#).
29. Updated [Figure 21-6](#) on [page 175](#).
30. Updated [Table 21-11](#) on [page 175](#).
31. Updated [Table 22-1](#) on [page 181](#).
32. Updated [Table 22-2](#) on [page 181](#).
33. Updated [Table 22-30](#), [Table 22-31](#) and [Table 22-32](#), starting on [page 192](#).
34. Updated [Table 22-33](#), [Table 22-34](#) and [Table 22-35](#), starting on [page 193](#).
35. Updated [Table 22-37](#) on [page 195](#).
36. Updated [Table 22-44](#), [Table 22-45](#), [Table 22-46](#) and [Table 22-47](#), starting on [page 199](#).

9.3 Rev. 2586I-09/06

1. All Characterization data moved to “[Electrical Characteristics](#)” on [page 166](#).
2. All Register Descriptions are gathered up in separate sections in the end of each chapter.
3. Updated [Table 11-3](#) on [page 81](#), [Table 11-5](#) on [page 82](#), [Table 11-6](#) on [page 83](#) and [Table 20-4](#) on [page 152](#).
4. Updated “[Calibrated Internal Oscillator](#)” on [page 27](#).
5. Updated Note in [Table 7-1](#) on [page 35](#).
6. Updated “[System Control and Reset](#)” on [page 41](#).
7. Updated Register Description in “[I/O Ports](#)” on [page 55](#).
8. Updated Features in “[USI – Universal Serial Interface](#)” on [page 111](#).
9. Updated Code Example in “[SPI Master Operation Example](#)” on [page 113](#) and “[SPI Slave Operation Example](#)” on [page 114](#).
10. Updated “[Analog Comparator Multiplexed Input](#)” on [page 123](#).

11. Updated [Figure 17-1](#) on page 127.
12. Updated [“Signature Bytes”](#) on page 154.
13. Updated [“Electrical Characteristics”](#) on page 166.

9.4 Rev. 2586H-06/06

1. Updated [“Calibrated Internal Oscillator”](#) on page 27.
2. Updated [Table 6.5.1](#) on page 32.
3. Added [Table 21-2](#) on page 169.

9.5 Rev. 2586G-05/06

1. Updated [“Internal PLL for Fast Peripheral Clock Generation - clkPCK”](#) on page 24.
2. Updated [“Default Clock Source”](#) on page 31.
3. Updated [“Low-Frequency Crystal Oscillator”](#) on page 29.
4. Updated [“Calibrated Internal Oscillator”](#) on page 27.
5. Updated [“Clock Output Buffer”](#) on page 32.
6. Updated [“Power Management and Sleep Modes”](#) on page 35.
7. Added [“Software BOD Disable”](#) on page 36.
8. Updated [Figure 16-1](#) on page 123.
9. Updated [“Bit 6 – ADBG: Analog Comparator Bandgap Select”](#) on page 124.
10. Added note for [Table 17-2](#) on page 129.
11. Updated [“Register Summary”](#) on page 7.

9.6 Rev. 2586F-04/06

1. Updated [“Digital Input Enable and Sleep Modes”](#) on page 59.
2. Updated [Table 20-16](#) on page 163.
3. Updated [“Ordering Information”](#) on page 11.

9.7 Rev. 2586E-03/06

1. Updated Features in [“Analog to Digital Converter”](#) on page 126.
2. Updated Operation in [“Analog to Digital Converter”](#) on page 126.
3. Updated [Table 17-2](#) on page 138.
4. Updated [Table 17-3](#) on page 138.
5. Updated [“Errata”](#) on page 18.

9.8 Rev. 2586D-02/06

1. Updated [Table 6-12](#) on page 30, [Table 6-10](#) on page 29, [Table 6-3](#) on page 26, [Table 6-9](#) on page 29, [Table 6-5](#) on page 27, [Table 9-1](#) on page 50, [Table 17-4](#) on page 139, [Table 20-16](#) on page 163, [Table 21-8](#) on page 172.
2. Updated [“Timer/Counter1 in PWM Mode”](#) on page 89.
3. Updated text [“Bit 2 - TOV1: Timer/Counter1 Overflow Flag”](#) on page 96.
4. Updated values in [“DC Characteristics”](#) on page 166.
5. Updated [“Register Summary”](#) on page 7.
6. Updated [“Ordering Information”](#) on page 11.

7. Updated Rev B and C in [“Errata ATtiny45” on page 19](#).
8. All references to power-save mode are removed.
9. Updated Register Addresses.

9.9 Rev. 2586C-06/05

1. Updated [“Features” on page 1](#).
2. Updated [Figure 1-1 on page 2](#).
3. Updated Code Examples on [page 18](#) and [page 19](#).
4. Moved “Temperature Measurement” to [Section 17.12 page 137](#).
5. Updated [“Register Summary” on page 7](#).
6. Updated [“Ordering Information” on page 11](#).

9.10 Rev. 2586B-05/05

1. CLKI added, instances of EEMWE/EEWE renamed EEMPE/EEPE, removed some TBD.
Removed [“Preliminary Description” from “Temperature Measurement” on page 137](#).
2. Updated [“Features” on page 1](#).
3. Updated [Figure 1-1 on page 2](#) and [Figure 8-1 on page 41](#).
4. Updated [Table 7-2 on page 39](#), [Table 10-4 on page 65](#), [Table 10-5 on page 65](#)
5. Updated [“Serial Programming Instruction set” on page 157](#).
6. Updated SPH register in [“Instruction Set Summary” on page 9](#).
7. Updated [“DC Characteristics” on page 166](#).
8. Updated [“Ordering Information” on page 11](#).
9. Updated [“Errata” on page 18](#).

9.11 Rev. 2586A-02/05

Initial revision.



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