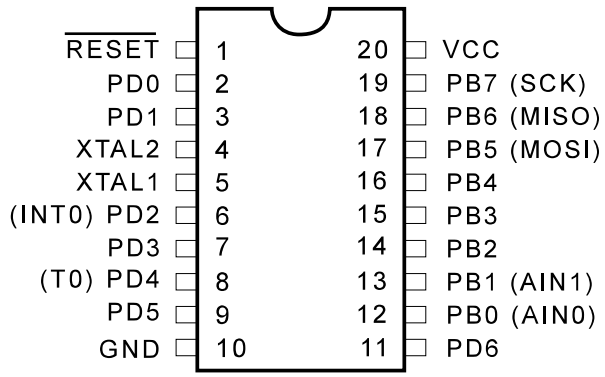
Features

- Utilizes the AVR® RISC Architecture
- AVR – High-performance and Low-power RISC Architecture
  - 89 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Up to 12 MIPS Throughput at 12 MHz
- Data and Non-volatile Program Memory
  - 1K Byte of In-System Programmable Flash
    Endurance: 1,000 Write/Erase Cycles
  - 64 Bytes of In-System Programmable EEPROM
    Endurance: 100,000 Write/Erase Cycles
  - Programming Lock for Flash Program and EEPROM Data Security
- Peripheral Features
  - One 8-bit Timer/Counter with Separate Prescaler
  - On-chip Analog Comparator
  - Programmable Watchdog Timer with On-chip Oscillator
  - SPI Serial Interface for In-System Programming
- Special Microcontroller Features
  - Low-power Idle and Power-down Modes
  - External and Internal Interrupt Sources
  - Selectable On-chip RC Oscillator for Zero External Components
- Specifications
  - Low-power, High-speed CMOS Process Technology
  - Fully Static Operation
- Power Consumption at 4 MHz, 3V, 25°C
  - Active: 2.0 mA
  - Idle Mode: 0.4 mA
  - Power-down Mode: <1 µA
- I/O and Packages
  - 15 Programmable I/O Lines
  - 20-pin PDIP, SOIC and SSOP
- Operating Voltages
  - 2.7 - 6.0V (AT90S1200-4)
  - 4.0 - 6.0V (AT90S1200-12)
- Speed Grades
  - 0 - 4 MHz, (AT90S1200-4)
  - 0 - 12 MHz, (AT90S1200-12)

Pin Configuration

PDIP/SOIC/SSOP



8-bit AVR® Microcontroller with 1K Byte of In-System Programmable Flash

AT90S1200

Summary

Rev. 0838HS–AVR–03/02

Note: This is a summary document. A complete document is available on our web site at *www.atmel.com*.

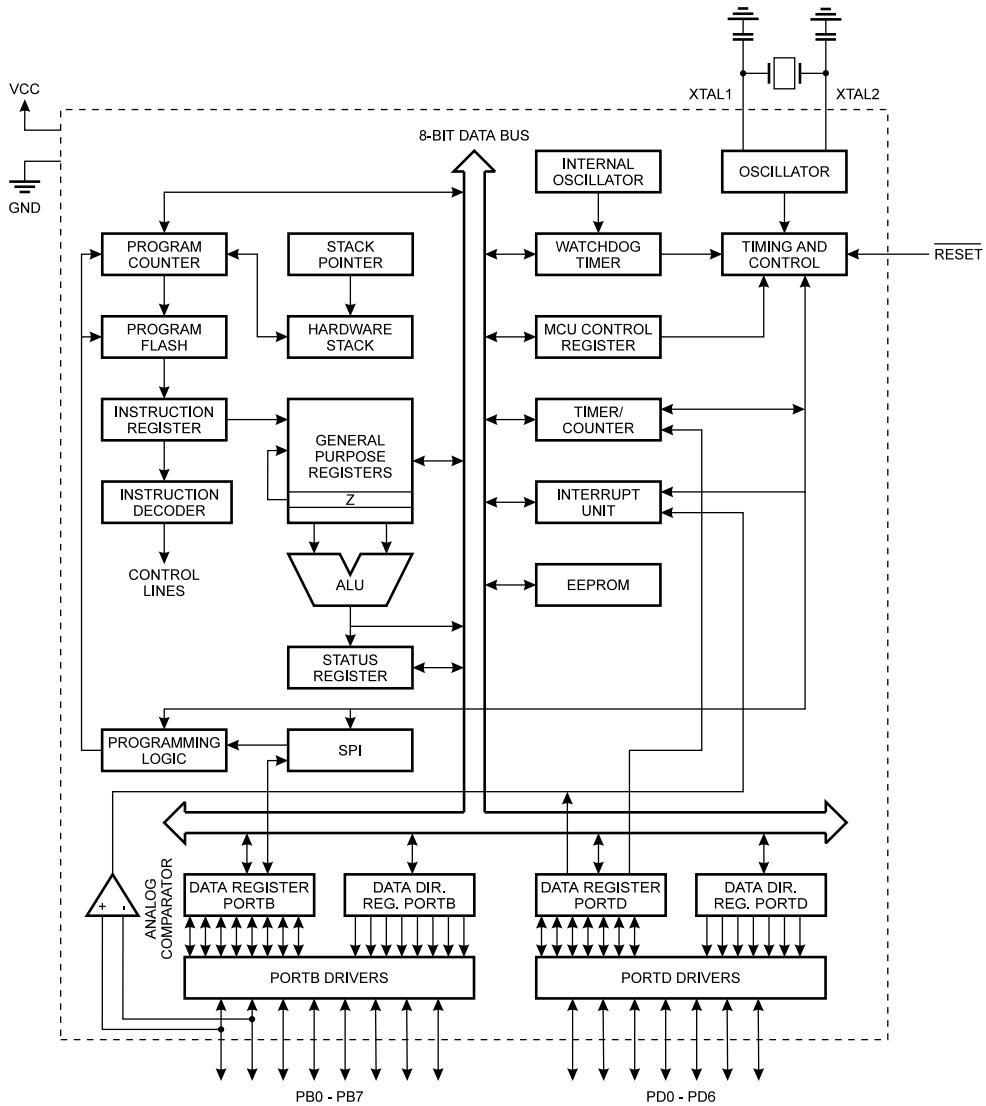
Description

The AT90S1200 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the AT90S1200 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

The AVR core combines a rich instruction set with the 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.

Block Diagram

Figure 1. The AT90S1200 Block Diagram



The architecture supports high-level languages efficiently as well as extremely dense assembler code programs. The AT90S1200 provides the following features: 1K byte of In-System Programmable Flash, 64 bytes EEPROM, 15 general purpose I/O lines, 32 general purpose working registers, internal and external interrupts, programmable watchdog timer with internal oscillator, an SPI serial port for program downloading and two software selectable power-saving modes. The Idle Mode stops the CPU while allow-

ing the Registers, Timer/Counter, Watchdog and Interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or hardware Reset.

The device is manufactured using Atmel's high-density nonvolatile memory technology. The On-chip In-System Programmable Flash allows the program memory to be reprogrammed in-system through an SPI serial interface or by a conventional nonvolatile memory programmer. By combining an enhanced RISC 8-bit CPU with In-System Programmable Flash on a monolithic chip, the Atmel AT90S1200 is a powerful microcontroller that provides a highly flexible and cost-effective solution to many embedded control applications.

The AT90S1200 AVR is supported with a full suite of program and system development tools including: macro assemblers, program debugger/simulators, in-circuit emulators, and evaluation kits.

Pin Descriptions

VCC Supply voltage pin.

GND Ground pin.

Port B (PB7..PB0) Port B is an 8-bit bi-directional I/O port. Port pins can provide internal pull-up resistors (selected for each bit). PB0 and PB1 also serve as the positive input (AIN0) and the negative input (AIN1), respectively, of the On-chip Analog Comparator. The Port B output buffers can sink 20 mA and thus drive LED displays directly. When pins PB0 to PB7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not active.

Port B also serves the functions of various special features of the AT90S1200 as listed on page 30.

Port D (PD6..PD0) Port D has seven bi-directional I/O pins with internal pull-up resistors, PD6..PD0. The Port D output buffers can sink 20 mA. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not active.

Port D also serves the functions of various special features of the AT90S1200 as listed on page 34.

$\overline{\text{RESET}}$ Reset input. A low level on this pin for more than 50 ns will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

XTAL1 Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2 Output from the inverting oscillator amplifier.

AT90S1200 Register Summary

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
$3F	SREG	I	T	H	S	V	N	Z	C	page 11
$3E	Reserved									
$3D	Reserved									
$3C	Reserved									
$3B	GIMSK	-	INT0	-	-	-	-	-	-	page 15
$3A	Reserved									
$39	TIMSK	-	-	-	-	-	-	TOIE0	-	page 16
$38	TIFR	-	-	-	-	-	-	TOV0	-	page 16
$37	Reserved									
$36	Reserved									
$35	MCUCR	-	-	SE	SM	-	-	ISC01	ISC00	page 18
$34	Reserved									
$33	TCCR0	-	-	-	-	-	CS02	CS01	CS00	page 21
$32	TCNT0	Timer/Counter0 (8 Bits)								page 22
$31	Reserved									
$30	Reserved									
$2F	Reserved									
$2E	Reserved									
$2D	Reserved									
$2C	Reserved									
$2B	Reserved									
$2A	Reserved									
$29	Reserved									
$28	Reserved									
$27	Reserved									
$26	Reserved									
$25	Reserved									
$24	Reserved									
$23	Reserved									
$22	Reserved									
$21	WDTCR	-	-	-	-	WDE	WDP2	WDP1	WDP0	page 23
$20	Reserved									
$1F	Reserved									
$1E	EEAR	-	EEPROM Address Register							page 25
$1D	EEDR	EEPROM Data Register								page 25
$1C	EECR	-	-	-	-	-	-	EEWE	EERE	page 25
$1B	Reserved									
$1A	Reserved									
$19	Reserved									
$18	PORTB	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0	page 29
$17	DDRB	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	page 29
$16	PINB	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	page 29
$15	Reserved									
$14	Reserved									
$13	Reserved									
$12	PORTD	-	PORTD6	PORTD5	PORTD4	PORTD3	PORTD2	PORTD1	PORTD0	page 34
$11	DDRD	-	DDD6	DDD5	DDD4	DDD3	DDD2	DDD1	DDD0	page 34
$10	PIND	-	PIND6	PIND5	PIND4	PIND3	PIND2	PIND1	PIND0	page 34
$0F	Reserved									
...	Reserved									
$09	Reserved									
$08	ACSR	ACD	-	ACO	ACI	ACIE	-	ACIS1	ACIS0	page 27
…	Reserved									
$00	Reserved									

Notes: 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. Some of the status flags are cleared by writing a logical “1” to them. Note that the CBI and SBI instructions will operate on all bits in the I/O register, writing a “1” back into any flag read as set, thus clearing the flag. The CBI and SBI instructions work with registers $00 to $1F only.

Instruction Set Summary

Mnemonic	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
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
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 ← $FF - Rd	Z,C,N,V	1
NEG	Rd	Two's Complement	Rd ← $00 - 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 • (FFh - 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 ← $FF	None	1
BRANCH INSTRUCTIONS					
RJMP	k	Relative Jump	PC ← PC + k + 1	None	2
RCALL	k	Relative Subroutine Call	PC ← PC + k + 1	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
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
SBRS	Rr, b	Skip if Bit in Register is Set	if (Rr(b) = 1) PC ← PC + 2 or 3	None	1/2
SBIC	P, b	Skip if Bit in I/O Register Cleared	if (P(b)= 0) PC ← PC + 2 or 3	None	1/2
SBIS	P, b	Skip if Bit in I/O Register is Set	if (P(b) = 1) PC ← PC + 2 or 3	None	1/2
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
DATA TRANSFER INSTRUCTIONS					
LD	Rd, Z	Load Register Indirect	Rd ← (Z)	None	2
ST	Z, Rr	Store Register Indirect	(Z) ← Rr	None	2
MOV	Rd, Rr	Move between Registers	Rd ← Rr	None	1
LDI	Rd, K	Load Immediate	Rd ← K	None	1
IN	Rd, P	In Port	Rd ← P	None	1
OUT	P, Rr	Out Port	P ← Rr	None	1

Instruction Set Summary (Continued)

Mnemonic	Operands	Description	Operation	Flags	# Clocks
BIT AND BIT-TEST INSTRUCTIONS					
SBI	P, b	Set Bit in I/O Register	I/O(P,b) ← 1	None	2
CBI	P, b	Clear Bit in I/O Register	I/O(P,b) ← 0	None	2
LSL	Rd	Logical Shift Left	Rd(n+1) ← Rd(n), Rd(0) ← 0	Z,C,N,V	1
LSR	Rd	Logical Shift Right	Rd(n) ← Rd(n+1), Rd(7) ← 0	Z,C,N,V	1
ROL	Rd	Rotate Left through Carry	Rd(0) ← C,Rd(n+1) ← Rd(n),C ← Rd(7)	Z,C,N,V	1
ROR	Rd	Rotate Right through Carry	Rd(7) ← C,Rd(n) ← Rd(n+1),C ← Rd(0)	Z,C,N,V	1
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 Two's Complement Overflow	V ← 1	V	1
CLV		Clear Two's 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
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

Ordering Information[1]

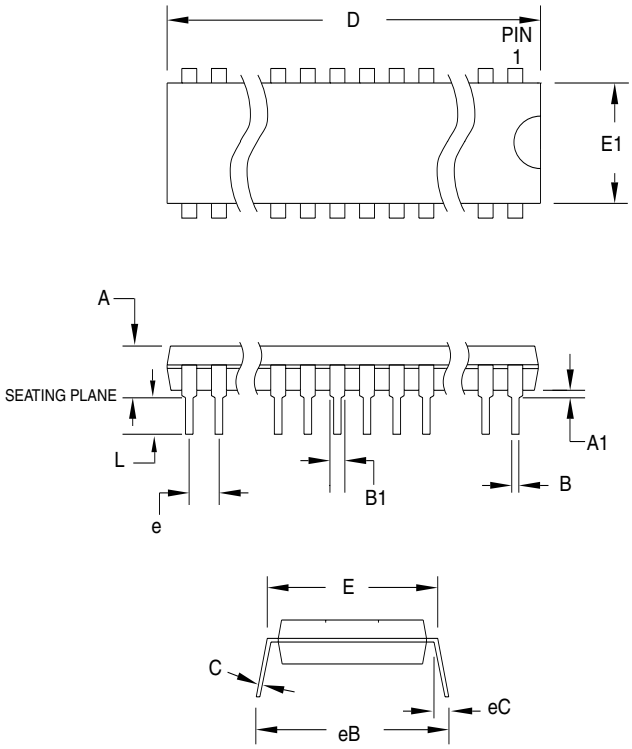
Speed (MHz)	Power Supply	Ordering Code	Package	Operation Range
4	2.7 - 6.0V	AT90S1200-4PC AT90S1200-4SC AT90S1200-4YC	20P3 20S 20Y	Commercial (0°C to 70°C)
		AT90S1200-4PI AT90S1200-4SI AT90S1200-4YI	20P3 20S 20Y	Industrial (-40°C to 85°C)
12	4.0 - 6.0V	AT90S1200-12PC AT90S1200-12SC AT90S1200-12YC	20P3 20S 20Y	Commercial (0°C to 70°C)
		AT90S1200-12PI AT90S1200-12SI AT90S1200-12YI	20P3 20S 20Y	Industrial (-40°C to 85°C)

Note: 1. Order AT90S1200A-XXX for devices with the RCEN Fuse programmed.

Package Type	
20P3	20-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
20S	20-lead, 0.300" Wide, Plastic Gull Wing Small Outline (SOIC)
20Y	20-lead, 5.3 mm Wide, Plastic Shrink Small Outline Package (SSOP)

Packaging Information

20P3



COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	5.334	
A1	0.381	–	–	
D	25.984	–	25.493	Note 2
E	7.620	–	8.255	
E1	6.096	–	7.112	Note 2
B	0.356	–	0.559	
B1	1.270	–	1.551	
L	2.921	–	3.810	
C	0.203	–	0.356	
eB	–	–	10.922	
eC	0.000	–	1.524	
e	2.540 TYP			

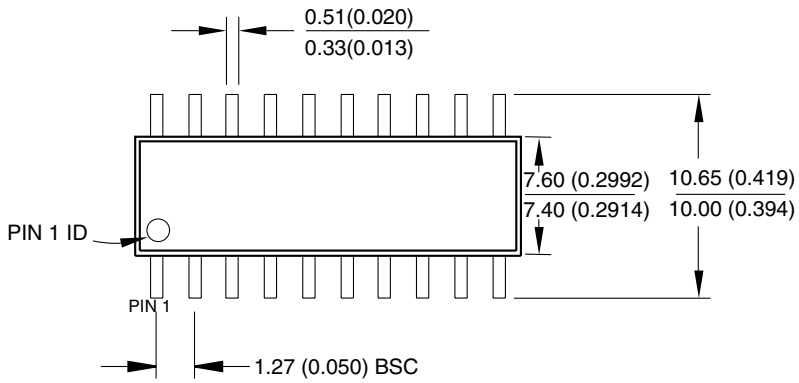
Notes: 1. This package conforms to JEDEC reference MS-001, Variation AD.
2. Dimensions D and E1 do not include mold Flash or Protrusion. Mold Flash or Protrusion shall not exceed 0.25 mm (0.010").

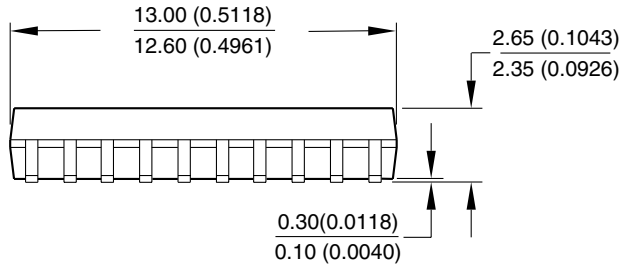
09/28/01

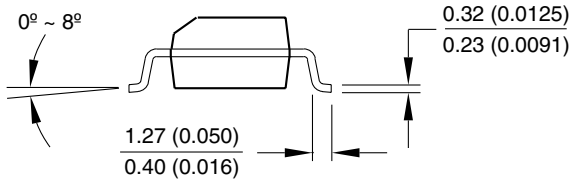
	TITLE	DRAWING NO.	REV.
2325 Orchard Parkway San Jose, CA 95131	**20P3**, 20-lead (0.300"/7.62 mm Wide) Plastic Dual Inline Package (PDIP)	20P3	B

20S

20S, 20-lead, Plastic Gull Wing Small
Outline (SOIC), 0.300" body.
Dimensions in Millineters and (Inches)*
JEDEC STANDARD MS-013





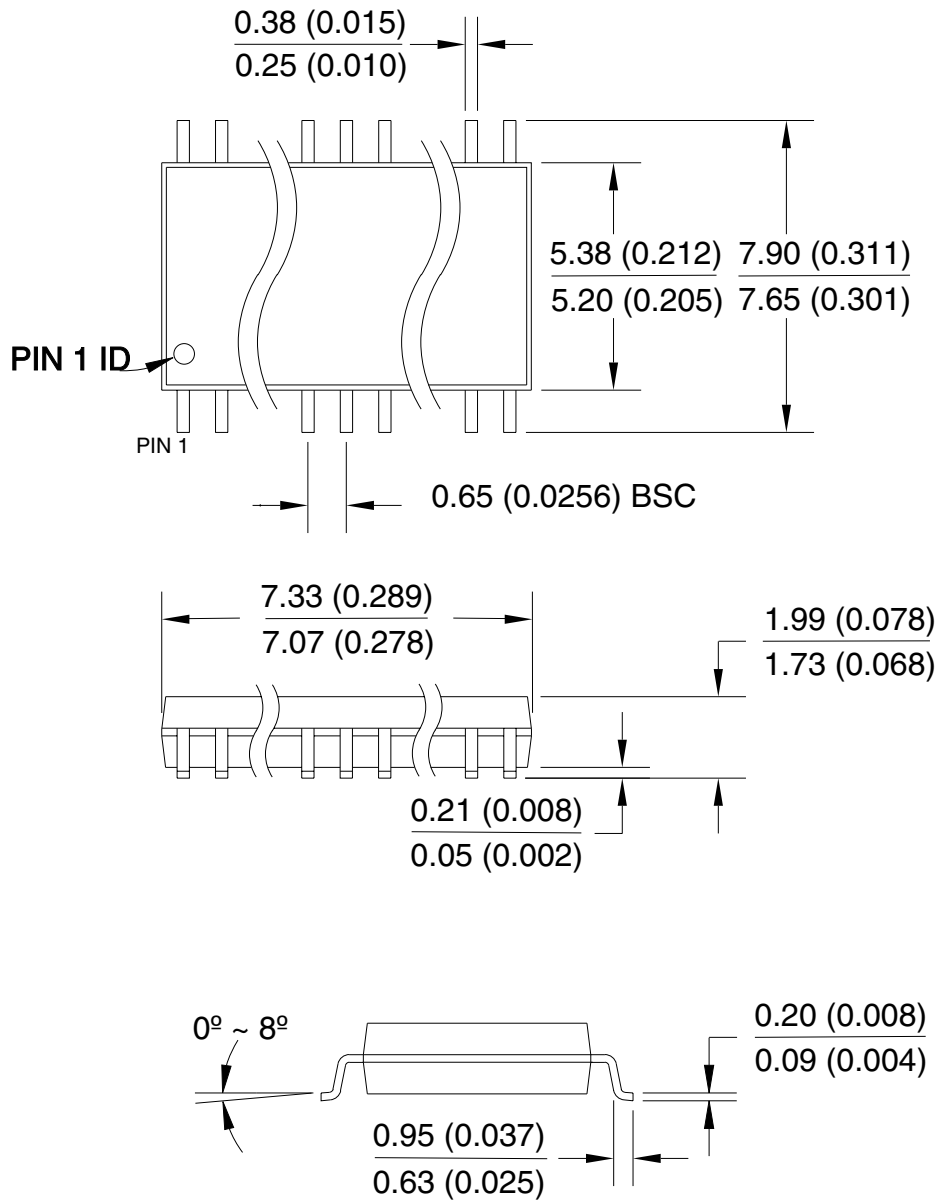


*Controlling dimension: Inches

REV. A 04/11/2001

20Y

20Y, 20-lead Plastic Shrink Small
Outline (SSOP), 5.3mm body Width.
Dimensions in Millimeters and (inches)*



*Controlling dimension: millimeters

REV. A 04/11/2001

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13106 Rousset Cedex, France
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FAX (33) 4-42-53-60-01

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FAX 1(719) 540-1759

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Scottish Enterprise Technology Park
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FAX (49) 71-31-67-2340

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1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
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High Speed Converters/RF Datacom
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