Features

- Fast read access time – 70ns
- Low-power CMOS operation
  - 100µA max standby
  - 30mA max active at 5MHz
- JEDEC standard packages
  - 32-lead PDIP
  - 32-lead PLCC
- 5V ± 10% supply
- High-reliability CMOS technology
  - 2000V ESD protection
  - 200mA latchup immunity
- Rapid programming algorithm – 100µs/byte (typical)
- CMOS- and TTL-compatible inputs and outputs
- Industrial temperature range
- Green (Pb/halide-free) packaging option

4Mb (512K x 8) One-time Programmable, Read-only Memory

Atmel AT27C040

1. Description

The Atmel® AT27C040 is a low-power, high-performance, 4,194,304-bit, one-time programmable, read-only memory (OTP EPROM) organized as 512K by 8 bits. The AT27C040 requires only one 5V power supply in normal read mode operation. Any byte can be accessed in less than 70ns, eliminating the need for speed reducing WAIT states on high-performance microprocessor systems.

The Atmel scaled CMOS technology provides low active power consumption and fast programming. Power consumption is typically 8mA in active mode and less than 10µA in standby mode.

The AT27C040 is available in a choice of industry standard, JEDEC-approved, one-time programmable (OTP) PDIP and PLCC packages. The device features two-line control ($\overline{CE}$, $\overline{OE}$) to eliminate bus contention in high-speed systems.

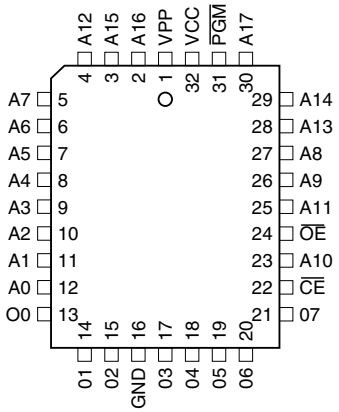
The AT27C040 has additional features to ensure high quality and efficient production use. The rapid programming algorithm reduces the time required to program the part and guarantees reliable programming. Programming time is typically only 100µs/byte. The integrated product identification code electronically identifies the device and manufacturer. This feature is used by industry standard programming equipment to select the proper programming algorithms and voltages.

0189H–EPROM–4/11

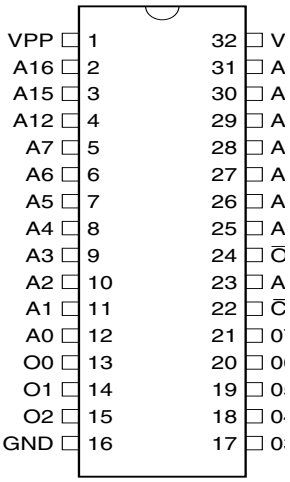
2. Pin configurations

Pin name	Function
A0 - A18	Addresses
O0 - O7	Outputs
$\overline{CE}$	Chip enable
$\overline{OE}$	Output enable

32-lead PLCC
Top view



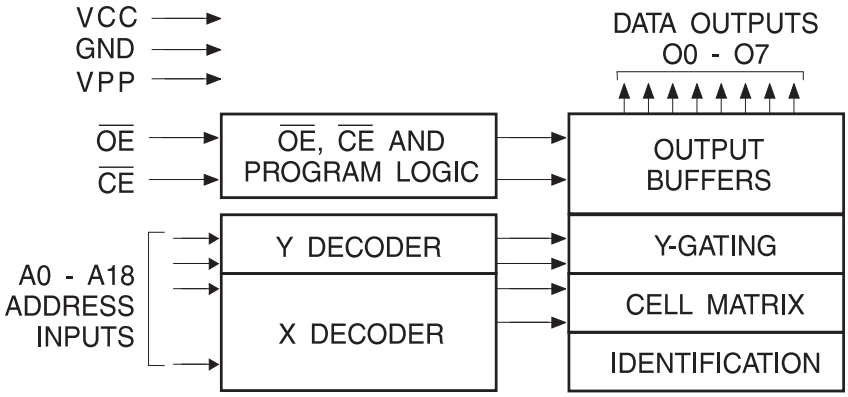
32-lead PDIP
Top view



3. Switching considerations

Switching between active and standby conditions via the chip enable pin may produce transient voltage excursions. Unless accommodated by the system design, these transients may exceed datasheet limits, resulting in device non-conformance. At a minimum, a 0.1µF, high-frequency, low inherent inductance, ceramic capacitor should be utilized for each device. This capacitor should be connected between the V_{CC} and ground terminals of the device, as close to the device as possible. Additionally, to stabilize the supply voltage level on printed circuit boards with large EPROM arrays, a 4.7 µF bulk electrolytic capacitor should be utilized, again connected between the V_{CC} and Ground terminals. This capacitor should be positioned as close as possible to the point where the power supply is connected to the array.

Figure 3-1. Block diagram



4. Absolute maximum ratings*

Temperature under bias	-55°C to +125°C
Storage temperature	-65°C to +150°C
Voltage on any pin with respect to ground	-2.0V to +7.0V
Voltage on A9 with respect to ground	-2.0V to +14.0V
V_{PP} supply voltage with respect to ground	-2.0V to +14.0V

*NOTICE: Stresses beyond those listed under "Absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

5. DC and AC characteristics

Table 5-1. Operating modes

Mode/Pin	$\overline{CE}$	$\overline{OE}$	Ai	V_{PP}	Outputs
Read	V_{IL}	V_{IL}	Ai	X(1)	D_{OUT}
Output disable	X	V_{IH}	X	X	High Z
Standby	V_{IH}	X	X	X	High Z
Rapid program(2)	V_{IL}	V_{IH}	Ai	V_{PP}	D_{IN}
PGM verify	X	V_{IL}	Ai	V_{PP}	D_{OUT}
PGM inhibit	V_{IH}	V_{IH}	X	V_{PP}	High Z
Product identification(4)	V_{IL}	V_{IL}	A9 = V_H(3) A0 = V_{IH} or V_{IL} A1 - A18 = V_{IL}	X	Identification code

Notes:
1. X can be V_{IL} or V_{IH}.
2. Refer to programming characteristics.
3. V_H = 12.0 ± 0.5V.
4. Two identifier bytes may be selected. All Ai inputs are held low (V_{IL}), except A9, which is set to V_H, and A0, which is toggled low (V_{IL}) to select the manufacturer's identification byte and high (V_{IH}) to select the device code byte.

Table 5-2. DC and AC operating conditions for read operation

	Atmel AT27C040-70	Atmel AT27C040-90
Industrial operating temperature (case)	-40°C - 85°C	-40°C - 85°C
V_{CC} power supply	5V ± 10%	5V ± 10%

Table 5-3. DC and operating characteristics for read operation

Symbol	Parameter	Condition	Min	Max	Units
I_{LI}	Input load current	V_{IN} = 0V to V_{CC}		±1	µA
I_{LO}	Output leakage current	V_{OUT} = 0V to V_{CC}		±5	µA
I_{PP1} [2]	V_{PP} [1] read/standby current	V_{PP} = V_{CC}		10	µA
I_{SB}	V_{CC1} [1] standby current	I_{SB1} (CMOS), $\overline{CE}$ = V_{CC} ± 0.3V		100	µA
		I_{SB2} (TTL), $\overline{CE}$ = 2.0 to V_{CC} + 0.5V		1	mA
I_{CC}	V_{CC} active current	f = 5MHz, I_{OUT} = 0mA, $\overline{CE}$ = V_{IL}		30	mA
V_{IL}	Input low voltage		-0.6	0.8	V
V_{IH}	Input high voltage		2.0	V_{CC} + 0.5	V
V_{OL}	Output low voltage	I_{OL} = 2.1mA		0.4	V
V_{OH}	Output high voltage	I_{OH} = -400µA	2.4		V

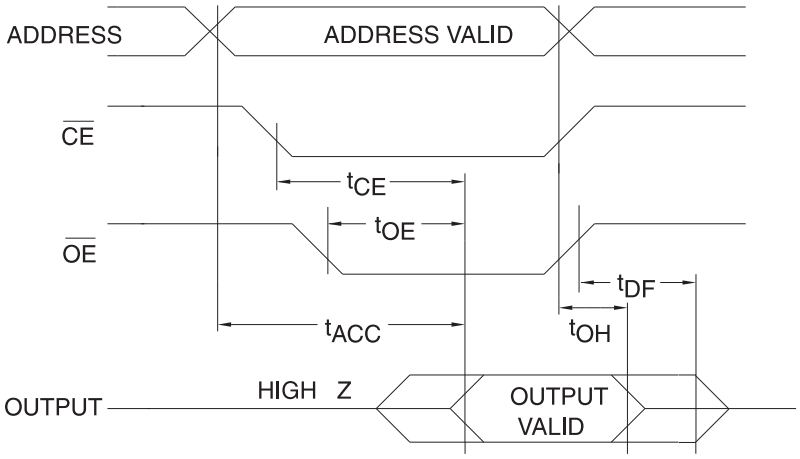
Notes: 1. V_{CC} must be applied simultaneously with or before V_{PP}, and removed simultaneously with or after V_{PP}.
2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

Table 5-4. AC characteristics for read operation

			Atmel AT27C040				
			-70		-90		
Symbol	Parameter	Condition	Min	Max	Min	Max	Units
t_{ACC} [1]	Address to output delay	$\overline{CE}$ = $\overline{OE}$ = V_{IL}		70		90	ns
t_{CE} [1]	$\overline{CE}$ to output delay	$\overline{OE}$ = V_{IL}		70		90	ns
t_{OE} [1]	$\overline{OE}$ to output delay	$\overline{CE}$ = V_{IL}		30		35	ns
t_{DF} [1]	$\overline{OE}$ or $\overline{CE}$ high to output float. Whichever occurred first			20		20	ns
t_{OH}	Output hold from address, $\overline{CE}$ or $\overline{OE}$. Whichever occurred first		0		0		ns

Note: 1. See AC waveforms for read operation.

Figure 5-1. AC waveforms for read operation[1]



Notes:
1. Timing measurement references are 0.8V and 2.0V. Input AC drive levels are 0.45V and 2.4V, unless otherwise specified.
2. $\overline{OE}$ may be delayed up to $t_{CE} - t_{OE}$ after the falling edge of $\overline{CE}$ without impact on t_{CE}.
3. $\overline{OE}$ may be delayed up to $t_{ACC} - t_{OE}$ after the address is valid without impact on t_{ACC}.
4. This parameter is only sampled, and is not 100% tested.
5. Output float is defined as the point when data is no longer driven.

Figure 5-2. Input test waveforms and measurement levels

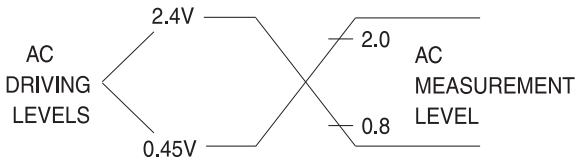


Figure 5-3. Output test load

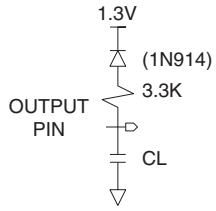


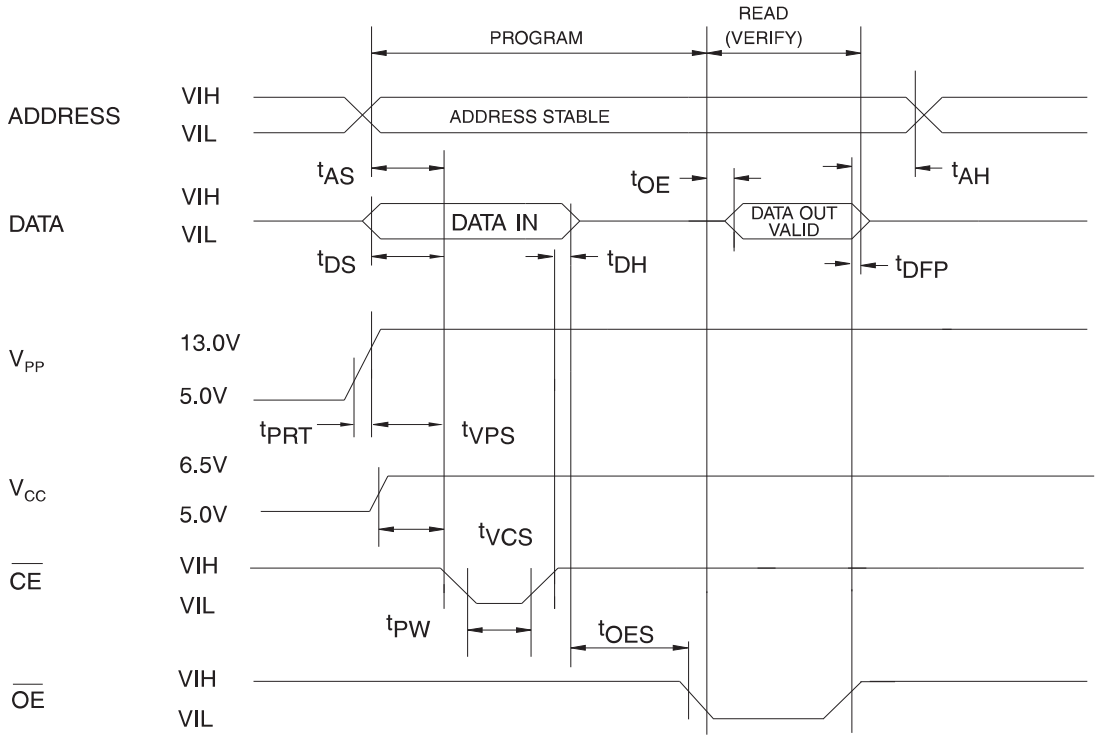
Table 5-5. Pin capacitance

f = 1MHz, T = 25°C [1]

Symbol	Typ	Max	Units	Conditions
C_{IN}	4	8	pF	V_{IN} = 0V
C_{OUT}	8	12	pF	V_{OUT} = 0V

Note: 1. Typical values for nominal supply voltage. This parameter is only sampled and is not 100% tested.

Figure 5-4. Programming waveforms [1]



Notes: 1. The input timing reference is 0.8V for V_{IL} and 2.0V for V_{IH}.

2. t_{OE} and t_{DFP} are characteristics of the device, but must be accommodated by the programmer.

3. When programming the Atmel AT27C040, a 0.1µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

Table 5-6. DC programming characteristics

T_A = 25 ± 5°C, V_{CC} = 6.5 ± 0.25V, V_{PP} = 13.0 ± 0.25V

Symbol	Parameter	Test conditions	Limits		Units
			Min	Max	
I_{LI}	Input load current	$V_{IN} = V_{IL}, V_{IH}$		±10	µA
V_{IL}	Input low level		-0.6	0.8	V
V_{IH}	Input high level		2.0	V_{CC} + 0.7	V
V_{OL}	Output low voltage	I_{OL} = 2.1mA		0.4	V
V_{OH}	Output high voltage	I_{OH} = -400µA	2.4		V
I_{CC2}	V_{CC} supply current (program and verify)			40	mA
I_{PP2}	V_{PP} supply current	$\overline{CE} = V_{IL}$		20	mA
V_{ID}	A9 product identification voltage		11.5	12.5	V

Table 5-7. AC programming characteristics

T_A = 25 ± 5°C, V_{CC} = 6.5 ± 0.25V, V_{PP} = 13.0 ± 0.25V

Symbol	Parameter	Test Conditions[1]	Limits		Units
			Min	Max	
t_{AS}	Address setup time	Input rise and fall times: (10% to 90%) 20ns Input pulse levels: 0.45V to 2.4V Input timing reference level: 0.8V to 2.0V Output timing reference level: 0.8V to 2.0V	2		µs
t_{OES}	$\overline{OE}$ setup time		2		µs
t_{DS}	Data setup time		2		µs
t_{AH}	Address hold time		0		µs
t_{DH}	Data hold time		2		µs
t_{DFP}	$\overline{OE}$ high to output float delay[2]		0	130	ns
t_{VPS}	V_{PP} setup time		2		µs
t_{VCS}	V_{CC} setup time		2		µs
t_{PW}	$\overline{CE}$ program pulse width[3]		95	105	µs
t_{OE}	Data valid from $\overline{OE}$[2]			150	ns
t_{PRT}	V_{PP} pulse rise time during programming		50		ns

Notes:
1. V_{CC} must be applied simultaneously with or before V_{PP} and removed simultaneously with or after V_{PP}.
2. This parameter is only sampled, and is not 100% tested. Output float is defined as the point where data is no longer driven. See timing diagram.
3. Program pulse width tolerance is 100µs ± 5%.

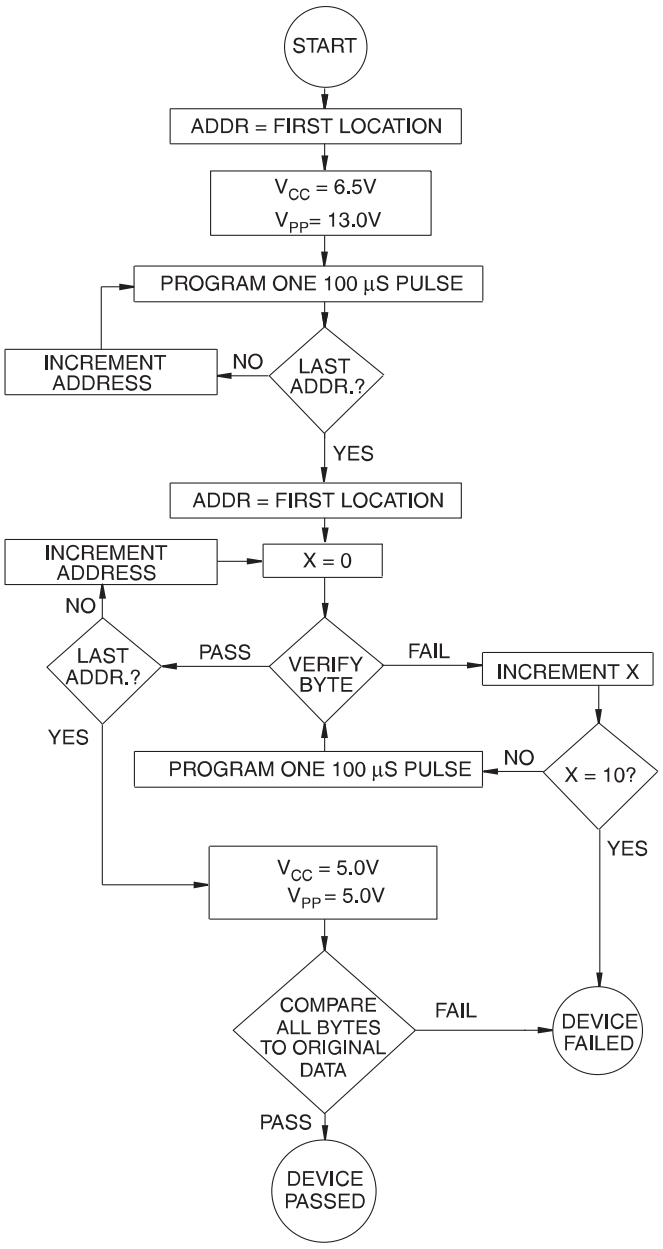
Table 5-8. The Atmel AT27C040 integrated product identification code

Codes	Pins									Hex data
	A0	O7	O6	O5	O4	O3	O2	O1	O0	
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device type	1	0	0	0	0	1	0	1	1	0B

6. Rapid programming algorithm

A 100µs $\overline{CE}$ pulse width is used to program. The address is set to the first location. V_{CC} is raised to 6.5V and V_{PP} is raised to 13.0V. Each address is first programmed with one 100µs $\overline{CE}$ pulse without verification. Then a verification/reprogramming loop is executed for each address. In the event a byte fails to pass verification, up to 10 successive 100µs pulses are applied with a verification after each pulse. If the byte fails to verify after 10 pulses have been applied, the part is considered failed. After the byte verifies properly, the next address is selected until all have been checked. V_{PP} is then lowered to 5.0V and V_{CC} to 5.0V. All bytes are read again and compared with the original data to determine if the device passes or fails.

Figure 6-1. Rapid programming algorithm



7. Ordering Information

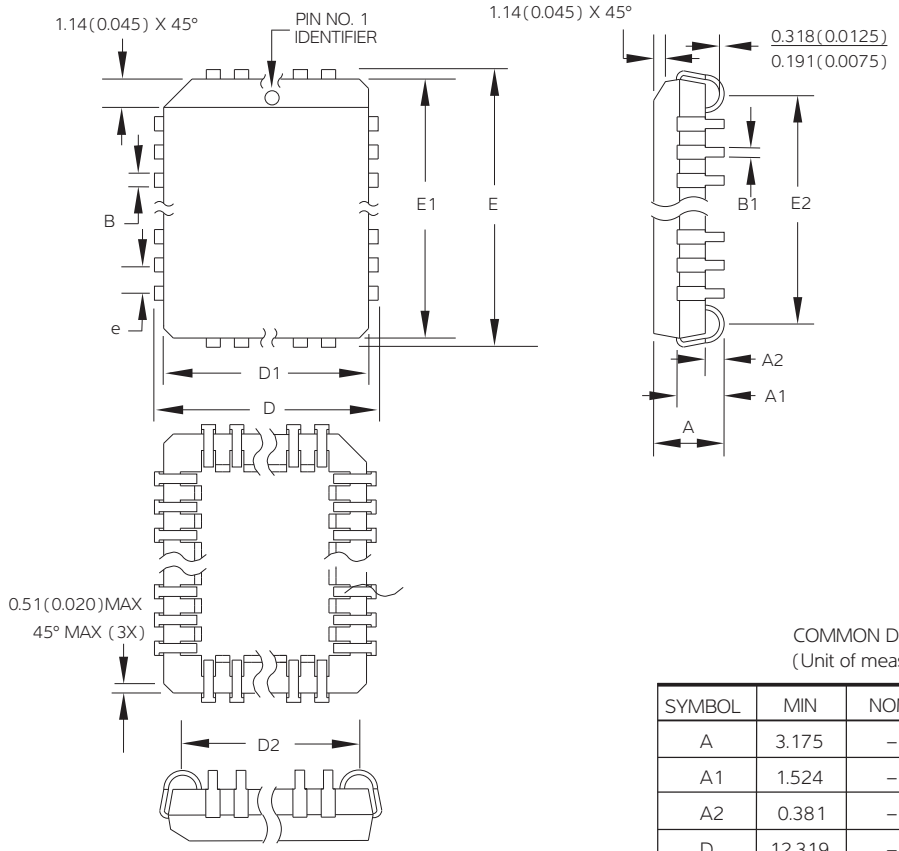
Green package option (Pb/halide-free)

t_{ACC} (ns)	I_{CC} (mA)		Atmel ordering code	Package	Lead finish	Operation range
	Active	Standby				
70	30	0.1	AT27C040-70JU AT27C040-70PU	32J 32P6	Matte tin Matte Tin	Industrial (-40°C to 85°C)
90	30	0.1	AT27C040-90JU AT27C040-90PU	32J 32P6	Matte tin Matte tin	Industrial (-40°C to 85°C)

Package type	
32J	32-lead, plastic, J-leaded chip carrier (PLCC)
32P6	32-lead, 0.600" wide, plastic, dual inline package (PDIP)

8. Package information

32J – PLCC



COMMON DIMENSIONS
(Unit of measure = mm)

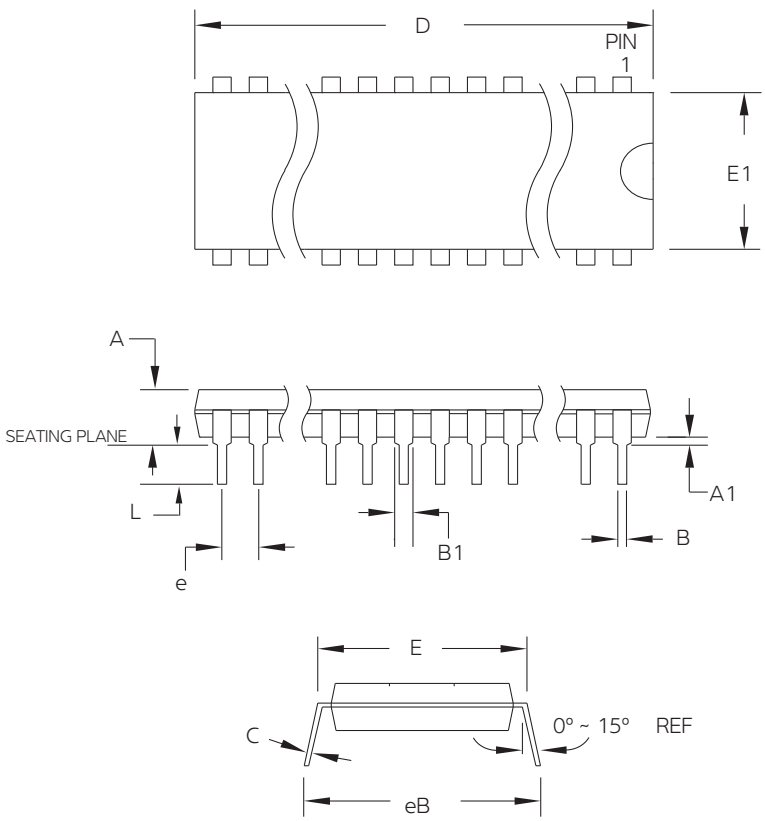
SYMBOL	MIN	NOM	MAX	NOTE
A	3.175	–	3.556	
A1	1.524	–	2.413	
A2	0.381	–	–	
D	12.319	–	12.573	
D1	11.354	–	11.506	Note 2
D2	9.906	–	10.922	
E	14.859	–	15.113	
E1	13.894	–	14.046	Note 2
E2	12.471	–	13.487	
B	0.660	–	0.813	
B1	0.330	–	0.533	
e	1.270 TYP			

Notes:
1. This package conforms to JEDEC reference MS-016, Variation AE.
2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is .010"(0.254mm) per side. Dimension D1 and E1 include mold mismatch and are measured at the extreme material condition at the upper or lower parting line.
3. Lead coplanarity is 0.004" (0.10mm) maximum.

10/04/01

Package Drawing Contact: packagedrawings@atmel.com	TITLE	DRAWING NO.	REV.
	32J, 32-lead, Plastic J-leaded Chip Carrier (PLCC)	32J	B

32P6 – PDIP



COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	4.826	
A1	0.381	–	–	
D	41.783	–	42.291	Note 1
E	15.240	–	15.875	
E1	13.462	–	13.970	Note 1
B	0.356	–	0.559	
B1	1.041	–	1.651	
L	3.048	–	3.556	
C	0.203	–	0.381	
eB	15.494	–	17.526	
e	2.540 TYP			

Note: 1. Dimensions D and E1 do not include mold Flash or Protrusion. Mold Flash or Protrusion shall not exceed 0.25mm (0.010").

09/28/01

	TITLE	DRAWING NO.	REV.
Package Drawing Contact: packagedrawings@atmel.com	32P6, 32-lead (0.600"/15.24mm wide) Plastic Dual Inline Package (PDIP)	32P6	B

9. Revision history

Doc. Rev.	Date	Comments
0189I	04/2011	Remove TSOP package Add lead finish to ordering information
0189H	12/2007	

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