

Features

- **Fast Read Access Time – 70 ns**
- **Low Power CMOS Operation**
 - 100 μ A Max Standby
 - 30 mA Max Active at 5 MHz
- **JEDEC Standard Packages**
 - 32-lead, 600-mil PDIP
 - 32-lead PLCC
 - 32-lead TSOP
- **5V \pm 10% Supply**
- **High Reliability CMOS Technology**
 - 2000V ESD Protection
 - 200 mA Latchup Immunity
- **RapidTM Programming Algorithm – 100 μ s/Byte (Typical)**
- **CMOS and TTL Compatible Inputs and Outputs**
- **Integrated Product Identification Code**
- **Commercial and Industrial Temperature Ranges**

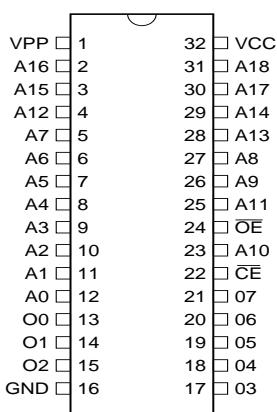
Description

The AT27C040 chip 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 70 ns, eliminating the need for speed reducing WAIT states on high-performance microprocessor systems.

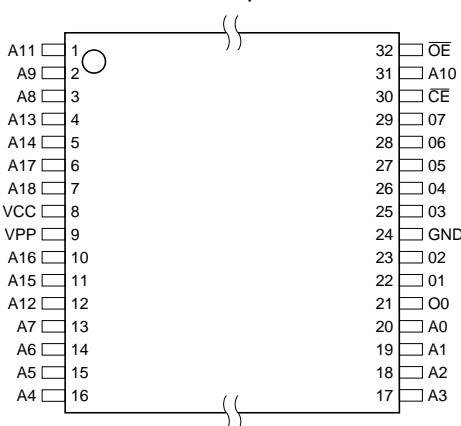
Pin Configurations

Pin Name	Function
A0 - A18	Addresses
O0 - O7	Outputs
CE	Chip Enable
OE	Output Enable

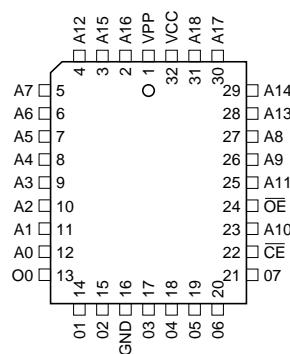
PDIP Top View



TSOP Top View



PLCC Top View



4-Megabit (512K x 8) OTP EPROM

AT27C040



Atmel's scaled CMOS technology provides low active power consumption, and fast programming. Power consumption is typically 8 mA in active mode and less than 10 μ A in standby mode.

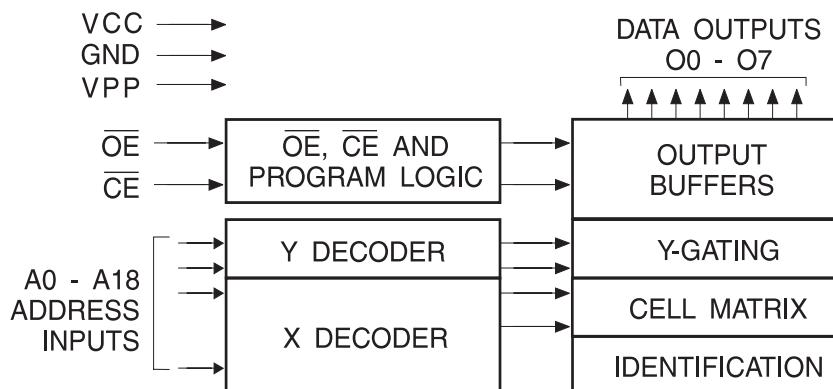
The AT27C040 is available in a choice of industry standard JEDEC-approved one-time programmable (OTP) plastic PDIP, PLCC and TSOP packages. The device features two-line control (\overline{CE} , \overline{OE}) to eliminate bus contention in high-speed systems.

Atmel's 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 100 μ s/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.

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 0.1 μ F 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 μ F 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.

Block Diagram



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. $V_H = 12.0 \pm 0.5V$.
 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.

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.

DC and AC Operating Conditions for Read Operation

		AT27C040-70	AT27C040-90	AT27C040-12	AT27C040-15
Operating Temperature (Case)	Com.	0°C - 70°C	0°C - 70°C	0°C - 70°C	0°C - 70°C
	Ind.	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C
V _{CC} Power Supply		5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%

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), $\overline{CE} = V_{CC} \pm 0.3V$		100	µA
		I _{SB2} (TTL), $\overline{CE} = 2.0$ to $V_{CC} + 0.5V$		1	mA
I _{CC}	V _{CC} Active Current	f = 5 MHz, I _{OUT} = 0 mA, $\overline{CE} = V_{IL}$		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} = 2.1 mA		0.4	V
V _{OH}	Output High Voltage	I _{OH} = -400 µA	2.4		V

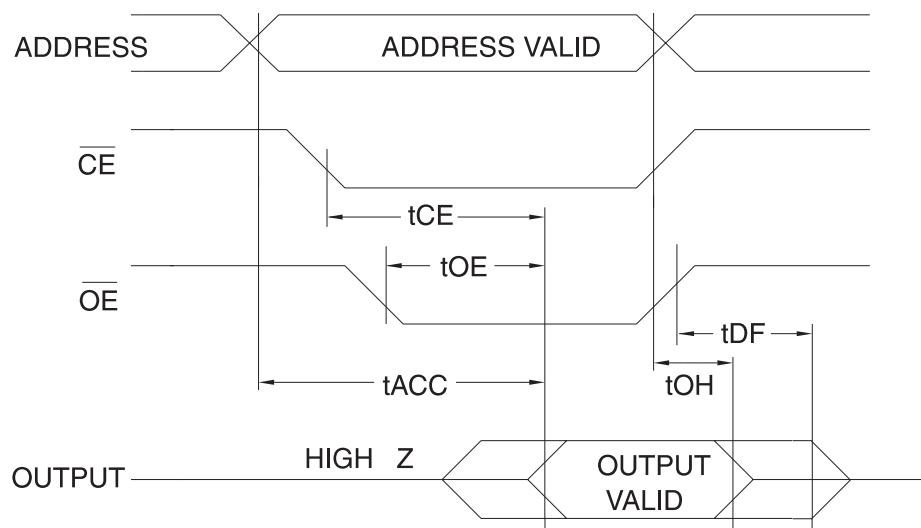
Notes: 1. V_{CC} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP}
 2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}

AC Characteristics for Read Operation

Symbol	Parameter	Condition	AT27C040								Units	
			-70		-90		-12		-15			
			Min	Max	Min	Max	Min	Max	Min	Max		
t _{ACC} ⁽³⁾	Address to Output Delay	$\overline{CE} = \overline{OE} = V_{IL}$		70		90		120		150	ns	
t _{CE} ⁽²⁾	\overline{CE} to Output Delay	$\overline{OE} = V_{IL}$		70		90		120		150	ns	
t _{OE} ⁽²⁾⁽³⁾	\overline{OE} to Output Delay	$\overline{CE} = V_{IL}$		30		35		35		40	ns	
t _{DF} ⁽⁴⁾⁽⁵⁾	\overline{OE} or \overline{CE} High to Output Float, whichever occurred first			20		20		30		30	ns	
t _{OH}	Output Hold from Address, \overline{CE} or \overline{OE} , whichever occurred first		0		0		0		0		ns	

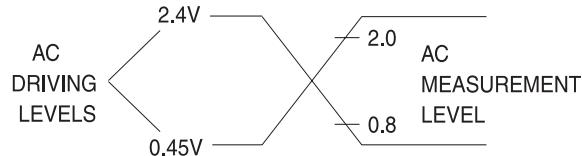
Note: 1. 2, 3, 4, 5 – see AC Waveforms for Read Operation

AC Waveforms for Read Operation⁽¹⁾

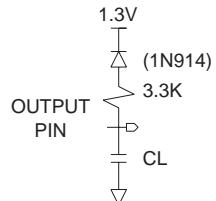


- Notes:
1. Timing measurement references are 0.8V and 2.0V. Input AC drive levels are 0.45V and 2.4V, unless otherwise specified.
 2. \overline{OE} may be delayed up to $t_{CE} - t_{OE}$ after the falling edge of \overline{CE} without impact on t_{CE} .
 3. \overline{OE} may be delayed up to $t_{ACC} - t_{OE}$ 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.

Input Test Waveforms and Measurement Levels



Output Test Load



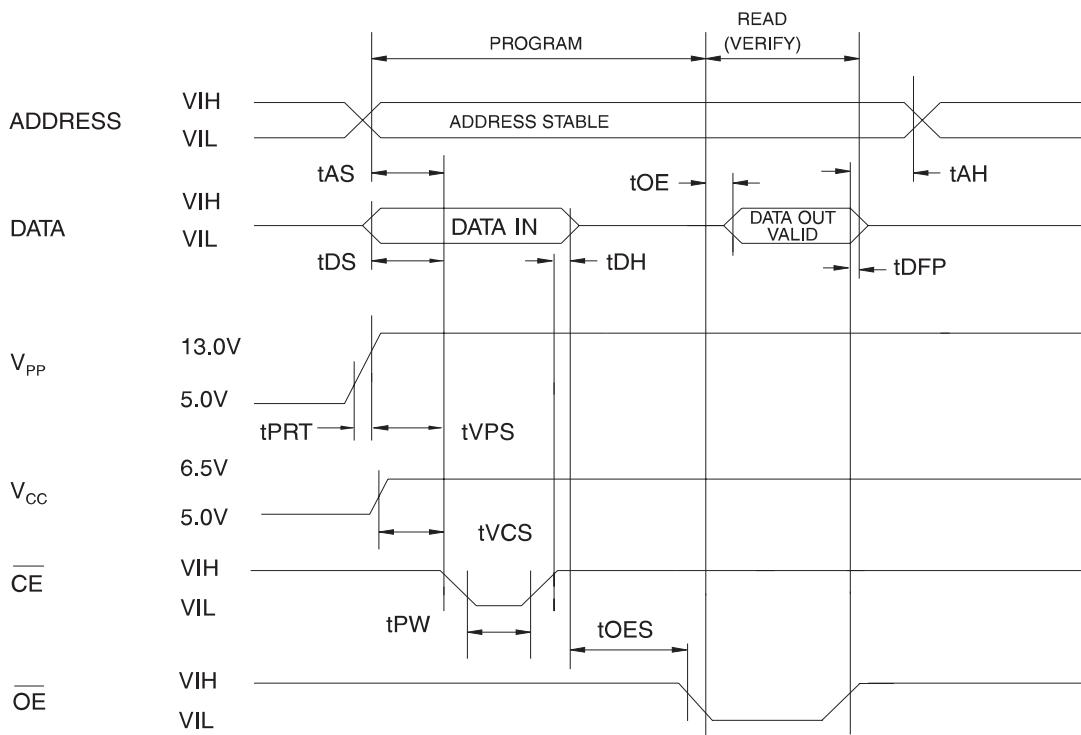
Pin Capacitance

$f = 1 \text{ MHz}$, $T = 25^\circ \text{C}$ ⁽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.

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_{DFF} are characteristics of the device but must be accommodated by the programmer.
 3. When programming the AT27C040 a 0.1 μ F capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

DC Programming Characteristics

$T_A = 25 \pm 5^\circ C$, $V_{CC} = 6.5 \pm 0.25V$, $V_{PP} = 13.0 \pm 0.25V$

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	$I_{OL} = 2.1 \text{ mA}$		0.4	V
V_{OH}	Output High Voltage	$I_{OH} = -400 \mu A$	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

AC Programming Characteristics

$T_A = 25 \pm 5^\circ\text{C}$, $V_{CC} = 6.5 \pm 0.25\text{V}$, $V_{PP} = 13.0 \pm 0.25\text{V}$

Symbol	Parameter	Test Conditions ⁽¹⁾	Limits		Units
			Min	Max	
t_{AS}	Address Setup Time	Input Rise and Fall Times: (10% to 90%) 20 ns 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

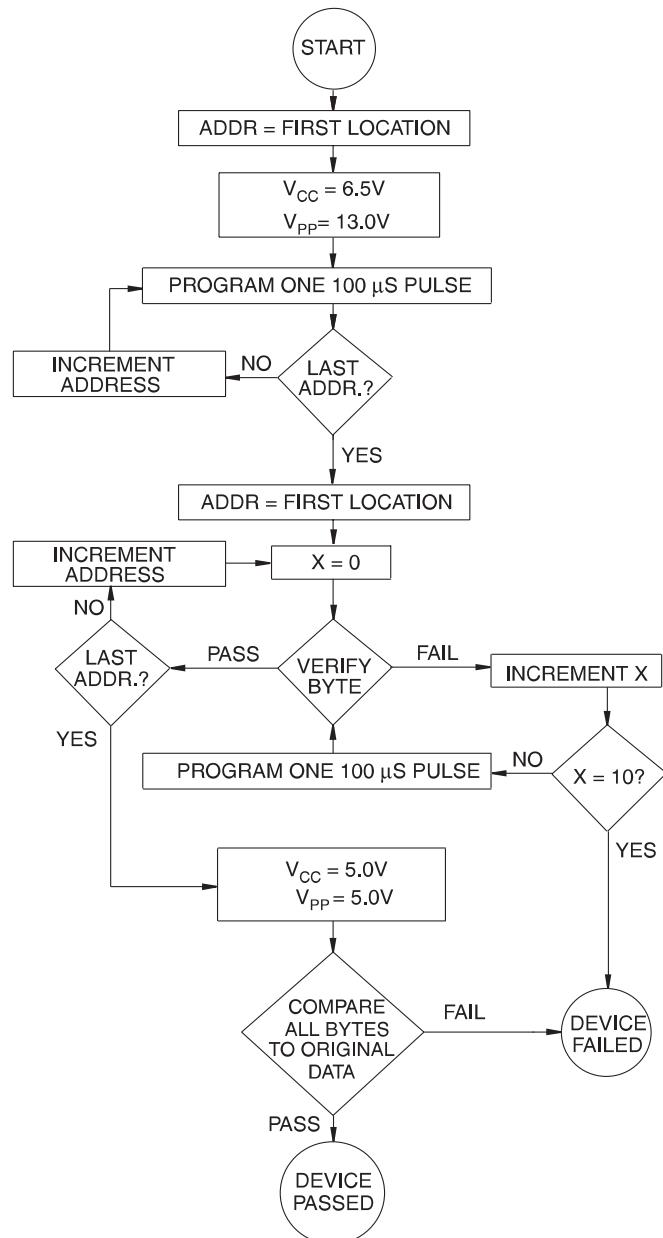
- Notes:
1. V_{CC} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP}
 2. This parameter is only sampled and is not 100% tested. Output Float is defined as the point where data is no longer driven – see timing diagram.
 3. Program Pulse width tolerance is 100 μsec ±5%.

Atmel's AT27C040 Integrated Product Identification Code

Codes	Pins									Hex Data
	A0	07	06	05	04	03	02	01	00	
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device Type	1	0	0	0	0	1	0	1	1	0B

Rapid Programming Algorithm

A 100 μ s \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 100 μ s \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 100 μ s 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.



Ordering Information

t _{ACC} (ns)	I _{CC} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
70	30	0.1	AT27C040-70JC	32J	Commercial (0°C to 70°C)
			AT27C040-70PC	32P6	
	30	0.1	AT27C040-70TC	32T	
			AT27C040-70JI	32J	Industrial (-40°C to 85°C)
90	30	0.1	AT27C040-90JC	32J	Commercial (0°C to 70°C)
			AT27C040-90PC	32P6	
	30	0.1	AT27C040-90TC	32T	
			AT27C040-90JI	32J	Industrial (-40°C to 85°C)
120	30	0.1	AT27C040-12JC	32J	Commercial (0°C to 70°C)
			AT27C040-12PC	32P6	
	30	0.1	AT27C040-12TC	32T	
			AT27C040-12JI	32J	Industrial (-40°C to 85°C)
150	30	0.1	AT27C040-15JC	32J	Commercial (0°C to 70°C)
			AT27C040-15PC	32P6	
	30	0.1	AT27C040-15TC	32T	
			AT27C040-15JI	32J	Industrial (-40°C to 85°C)
			AT27C040-15PI	32P6	
			AT27C040-15TI	32T	

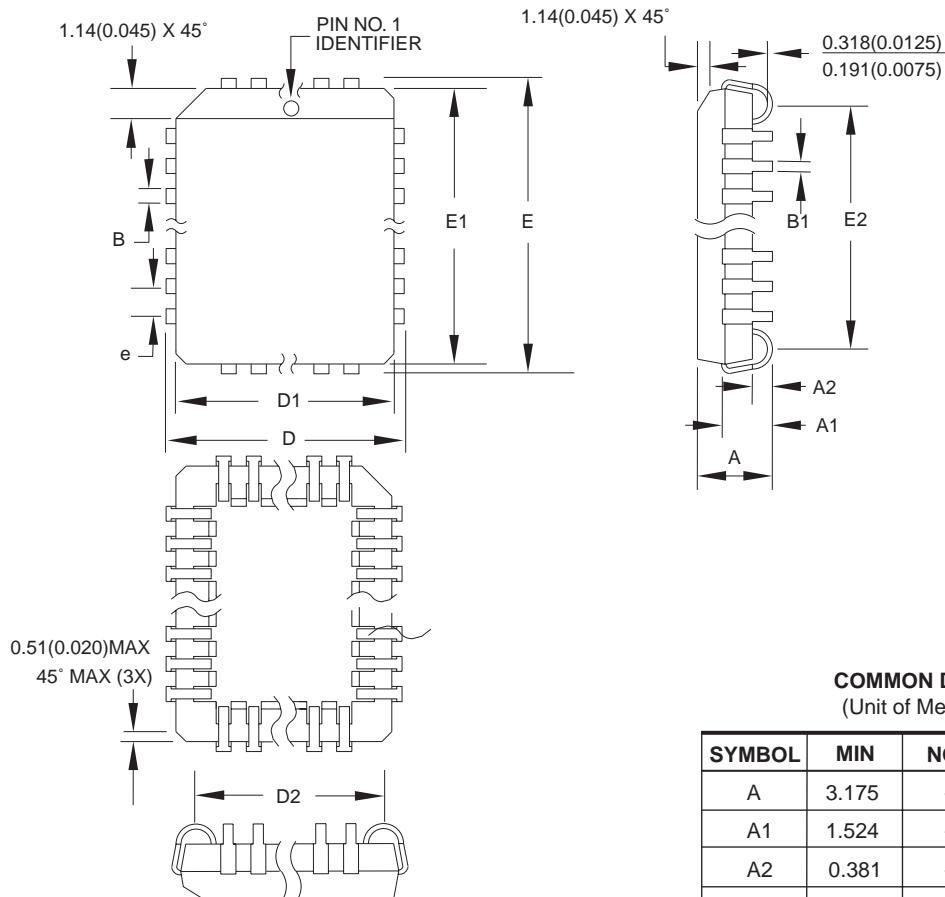
Package Type

32J	32-lead, Plastic J-leaded Chip Carrier (PLCC)
32P6	32-lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)
32T	32-lead, Plastic Thin Small Outline Package (TSOP)



Package Information

32J – PLCC



- 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" (0.254 mm) 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" (0.102 mm) maximum.

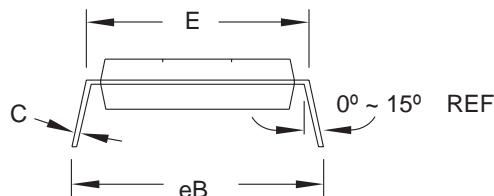
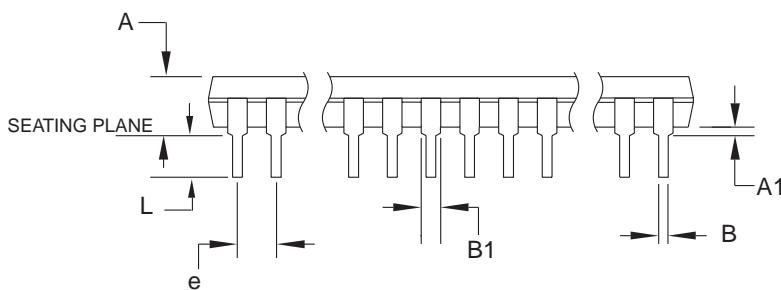
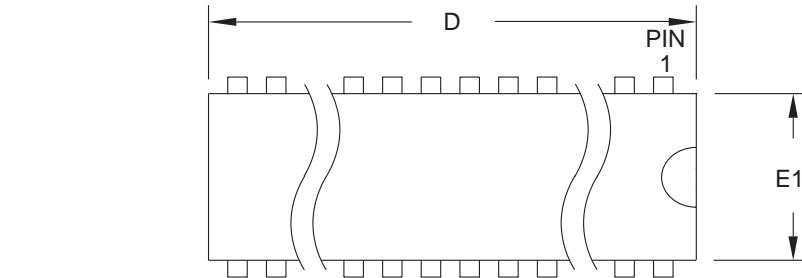
COMMON DIMENSIONS
(Unit of Measure = mm)

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			

10/04/01

 2325 Orchard Parkway San Jose, CA 95131	TITLE 32J, 32-lead, Plastic J-leaded Chip Carrier (PLCC)	DRAWING NO. 32J	REV. B
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32P6 – PDIP



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

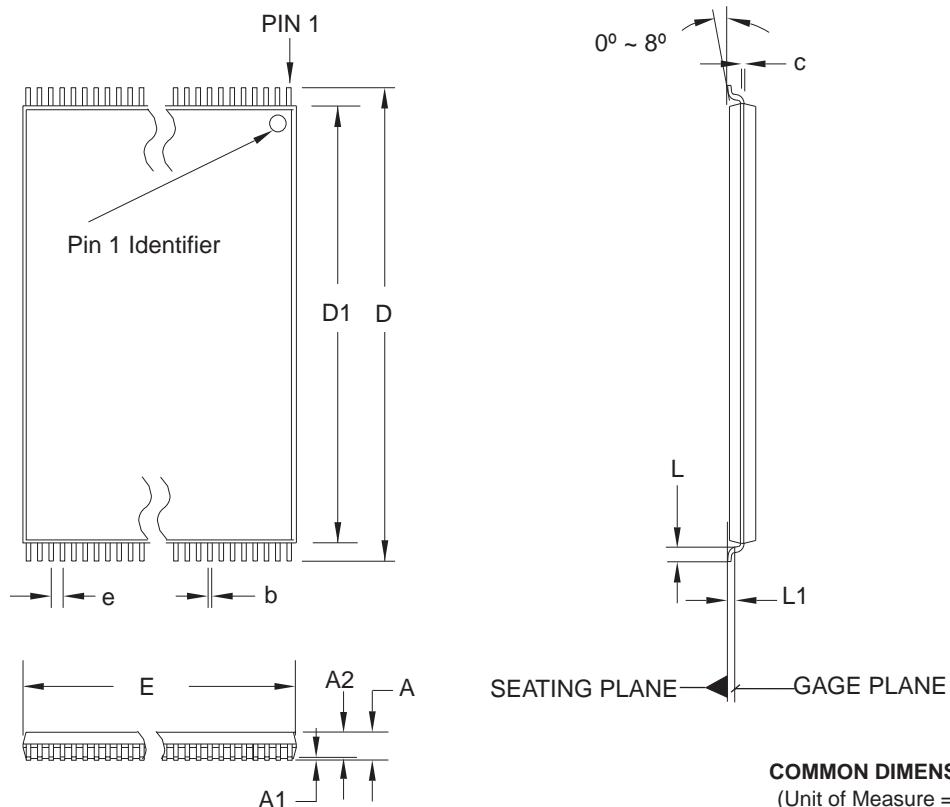
COMMON DIMENSIONS
(Unit of Measure = mm)

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			

09/28/01

AMEL	2325 Orchard Parkway San Jose, CA 95131	TITLE 32P6, 32-lead (0.600"/15.24 mm Wide) Plastic Dual Inline Package (PDIP)	DRAWING NO.	REV.
			32P6	B

32T – TSOP



Notes:

1. This package conforms to JEDEC reference MO-142, Variation BD.
2. Dimensions D1 and E do not include mold protrusion. Allowable protrusion on E is 0.15 mm per side and on D1 is 0.25 mm per side.
3. Lead coplanarity is 0.10 mm maximum.

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.20	
A1	0.05	–	0.15	
A2	0.95	1.00	1.05	
D	19.80	20.00	20.20	
D1	18.30	18.40	18.50	Note 2
E	7.90	8.00	8.10	Note 2
L	0.50	0.60	0.70	
L1	0.25 BASIC			
b	0.17	0.22	0.27	
c	0.10	–	0.21	
e	0.50 BASIC			

10/18/01

AMEL®	2325 Orchard Parkway San Jose, CA 95131	TITLE 32T, 32-lead (8 x 20 mm Package) Plastic Thin Small Outline Package, Type I (TSOP)	DRAWING NO.	REV.
			32T	B



Atmel Corporation

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

Regional Headquarters

Europe

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

Asia

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

Japan

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

Atmel Operations

Memory

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

Microcontrollers

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

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

ASIC/ASSP/Smart Cards

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

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

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

RF/Automotive

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

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

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

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

e-mail

literature@atmel.com

Web Site

<http://www.atmel.com>

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