#### **Features**

- Fast Read Access Time 45 ns
- Low-Power CMOS Operation
  - 100 μA max. Standby
  - 25 mA max. Active at 5 MHz (AT27C010L)
  - 35 mA max. Active at 5 MHz (AT27C010)
- JEDEC Standard Packages
  - 32-Lead 600-mil PDIP
  - 32-Lead PLCC
  - 32-Lead TSOP
- 5V ± 10% Supply
- High Reliability CMOS Technology
  - 2000V ESD Protection
  - 200 mA Latchup Immunity
- Rapid<sup>™</sup> Programming Algorithm 100 µs/byte (typical)
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Commercial, Industrial and Automotive Temperature Ranges

#### Description

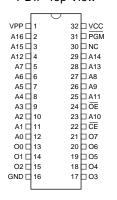
The AT27C010(L) is a low-power, high-performance 1,048,576-bit one-time program-mable read only memory (OTP EPROM) organized as 128K by 8 bits. They require only one 5V power supply in normal read mode operation. Any byte can be accessed in less than 45 ns, eliminating the need for speed reducing WAIT states on high-performance microprocessor systems.

Two power versions are offered. In read mode, the AT27C010 typically consumes 25 mA while the AT27C010L requires only 8 mA. Standby mode supply current for both parts is typically less than 10  $\mu$ A. *(continued)* 

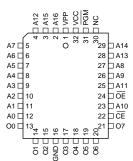
## **Pin Configurations**

Pin Name	Function
A0 - A16	Addresses
O0 - O7	Outputs
CE	Chip Enable
ŌĒ	Output Enable
PGM	Program Strobe
NC	No Connect

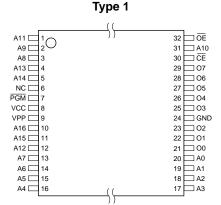
PDIP Top View



PLCC Top View



TSOP Top View





## 1-Megabit (128K x 8) OTP EPROM

## AT27C010(L)

Rev. 0321J-07/98





The AT27C010(L) in available in a choice of industry standard JEDEC-approved one-time programmable (OTP) plastic PDIP, PLCC, and TSOP packages. All devices feature two line control (CE, OE) to give designers the flexibility to prevent bus contention.

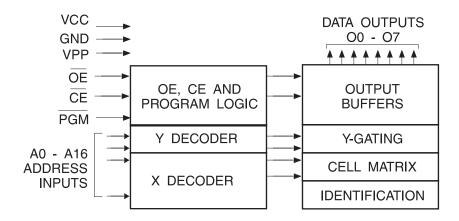
With 128K byte storage capability, the AT27C010(L) allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's 27C010(L) have 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 µs/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.

#### **System 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 data sheet limits, resulting in device non-conformance. At a minimum, a 0.1  $\mu F$  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  $\mu F$  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**



#### **Absolute Maximum Ratings\***

Ten	perature Under Bias55°C to +125°C	
Sto	rage Temperature65°C to +150°C	
	age on Any Pin with spect to Ground2.0V to +7.0V <sup>(1)</sup>	
	age on A9 with epect to Ground2.0V to +14.0V <sup>(1)</sup>	
	Supply Voltage with pect to Ground2.0V to +14.0V <sup>(1)</sup>	

\*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.

Note:

Minimum voltage is -0.6V dc which may undershoot to -2.0V for pulses of less than 20 ns. Maximum output pin voltage is  $V_{CC}$  + 0.75V dc which may overshoot to +7.0 volts for pulses of less than 20 ns.

### **Operating Modes**

Mode\Pin	CE	ŌĒ	PGM	Ai	V <sub>PP</sub>	Outputs
Read	V <sub>IL</sub>	V <sub>IL</sub>	X <sup>(1)</sup>	Ai	Х	D <sub>OUT</sub>
Output Disable	Х	V <sub>IH</sub>	Х	X	Х	High Z
Standby	V <sub>IH</sub>	Х	Х	Х	Х	High Z
Rapid Program <sup>(2)</sup>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	Ai	V <sub>PP</sub>	D <sub>IN</sub>
PGM Verify	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	Ai	V <sub>PP</sub>	D <sub>OUT</sub>
PGM Inhibit	V <sub>IH</sub>	Х	Х	X	V <sub>PP</sub>	High Z
Product Identification <sup>(4)</sup>	V <sub>IL</sub>	V <sub>IL</sub>	х	$A9 = V_{H}^{(3)}$ $A0 = V_{IH} \text{ or } V_{IL}$ $A1 - A16 = V_{IL}$	Х	Identification Code

- Notes: 1. X can be  $V_{IL}$  or  $V_{IH}$ .
  - 2. Refer to Programming Characteristics.
  - 3.  $V_H = 12.0 \pm 0.5 V$ .
  - 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.





## **DC and AC Operating Conditions for Read Operation**

		AT27C010/AT27C010L									
		-45	-55	-70	-90	-12	-15				
	Com.	0°C - 70°C	0°C - 70°C	0°C - 70°C	0°C - 70°C	0°C - 70°C	0°C - 70°C				
Operating Temp. (Case)	Ind.	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C				
iomp. (Gass)	Auto.				-40°C - 125°C	-40°C - 125°C	-40°C - 125°C				
V <sub>CC</sub> Power Supply	,	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%				

## **DC and Operating Characteristics for Read Operation**

Symbol	Parameter	Condition		Min	Max	Units
	land land Quinted	V 0V/1-V	Com., Ind.		± 1	μΑ
I <sub>LI</sub>	Input Load Current	$V_{IN} = 0V \text{ to } V_{CC}$	Auto.		± 5	μA
	Outrat Lealing Course	)/ O)/4- )/	Com., Ind.		± 5	μA
I <sub>LO</sub>	Output Leakage Current	$V_{OUT} = 0V \text{ to } V_{CC}$	Auto.		±10	μA
IPP1 <sup>(2)</sup>	V <sub>PP</sub> <sup>(1))</sup> Read/Standby Current	$V_{PP} = V_{CC}$			10	μA
	V (1) O(II) O (	$I_{SB1}$ (CMOS), $\overline{CE} = V_{CC} \pm 0.3V$		100	μA	
I <sub>SB</sub>	V <sub>CC</sub> <sup>(1)</sup> Standby Current	$I_{SB2}$ (TTL), $\overline{CE}$ = 2.0 to $V_{CC}$ + 0		1	mA	
	V. Asii a O massi	f = 5 MHz, I <sub>OUT</sub> = 0 mA,	AT27C010(L)		25	mA
I <sub>CC</sub>	V <sub>CC</sub> Active Current	$\overline{CE} = V_{IL}$	AT27C010		35	mA
V <sub>IL</sub>	Input Low Voltage			-0.6	0.8	V
V <sub>IH</sub>	Input High Voltage			2.0	V <sub>CC</sub> + 0.5	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1 mA		0.4	V	
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -400 μA	2.4		V	

Notes: 1.  $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ .

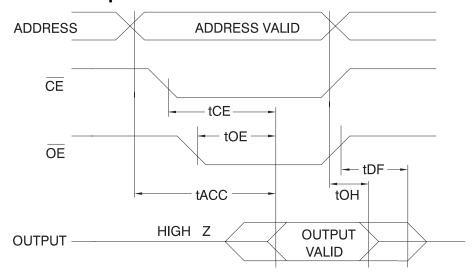
## **AC Characteristics for Read Operation**

				AT27C010/AT27C010L											
				45		55	-	70	-9	90		12	-	15	
Symbol	Parameter	Condition	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Units
t <sub>ACC</sub> <sup>(3)</sup>	Address to Output Delay	$\overline{CE} = \overline{OE} = V_{IL}$		45		55		70		90		120		150	ns
t <sub>CE</sub> <sup>(2)</sup>	CE to Output Delay	OE = V <sub>IL</sub>		45		55		70		90		120		150	ns
t <sub>OE</sub> <sup>(2)(3)</sup>	OE to Output Delay	CE = V <sub>IL</sub>		20		25		30		35		35		40	ns
t <sub>DF</sub> <sup>(4)(5)</sup>	OE or CE High to Output Float, whichever occurred first			20		20		25		25		30		35	ns
t <sub>OH</sub>	Output Hold from Address, CE or OE, whichever occurred first		7		7		7		0		0		0		ns

Notes: 2,3,4,5. - see AC Waveforms for Read Operation.

<sup>2.</sup>  $V_{PP}$  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 Waveforms for Read Operation**(1)

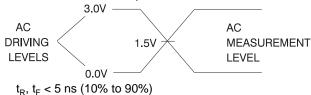


Notes:

- 1. Timing measurement reference level is 1.5V for -45 and -55 devices. Input AC drive levels are  $V_{IL} = 0.0V$  and  $V_{IH} = 3.0V$ . Timing measurement reference levels for all other speed grades are  $V_{OL} = 0.8V$  and  $V_{OH} = 2.0V$ . Input AC drive levels are  $V_{IL} = 0.45V$  and  $V_{IH} = 2.4V$ .
- OE may be delayed up to t<sub>CE</sub> t<sub>OE</sub> after the falling edge of CE without impact on t<sub>CE</sub>.
- 3.  $\overline{\text{OE}}$  may be delayed up to  $t_{\text{ACC}}$   $t_{\text{OE}}$  after the address is valid without impact on  $t_{\text{ACC}}$ .
- 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**

For -45 and -55 devices only:

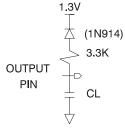


For -70, -90, -12, -15, and -20 devices:



 $t_R$ ,  $t_F < 20$  ns (10% to 90%)

#### **Output Test Load**



Note:  $C_L = 100 \text{ pF}$  including jig capacitance, except for the -45 and -55 devices, where  $C_L = 30 \text{ pF}$ .

### Pin Capacitance

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

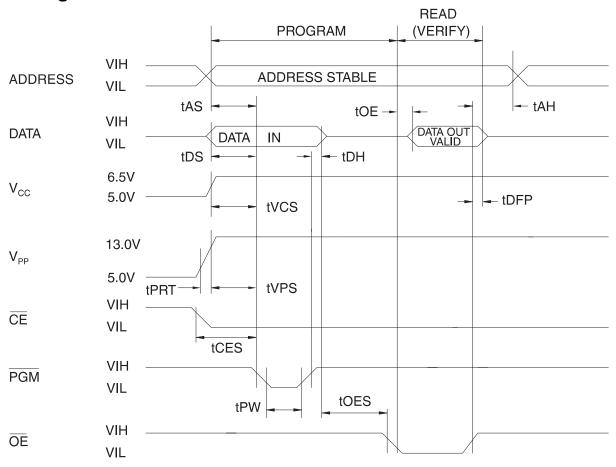
Symbol	Тур	Max	Units	Conditions
C <sub>IN</sub>	4	8	pF	V <sub>IN</sub> = 0V
C <sub>OUT</sub>	8	12	pF	V <sub>OUT</sub> = 0V

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





## **Programming Waveforms**<sup>(1)</sup>



Notes: 1.

- 1. The Input Timing Reference is 0.8V for  $V_{\rm IL}$  and 2.0V for  $V_{\rm IH}$ .
- 2. t<sub>OE</sub> and t<sub>DFP</sub> are characteristics of the device but must be accommodated by the programmer.
- When programming the AT27C010(L) at 0.1 μF capacitor is required across V<sub>PP</sub> and ground to suppress spurious voltage transients.

### **DC Programming Characteristics**

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

			Lir	nits	
Symbol	Parameter	Test Conditions	Min	Max	Units
I <sub>LI</sub>	Input Load Current	$V_{IN} = V_{IL}, V_{IH}$		±10	μΑ
$V_{IL}$	Input Low Level		-0.6	0.8	V
V <sub>IH</sub>	Input High Level		2.0	V <sub>CC</sub> + 1	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1 mA		0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -400 μA	2.4		V
I <sub>CC2</sub>	V <sub>CC</sub> Supply Current (Program and Verify)			40	mA
I <sub>PP2</sub>	V <sub>PP</sub> Supply Current	CE = PGM = V <sub>IL</sub>		20	mA
V <sub>ID</sub>	A9 Product Identification Voltage		11.5	12.5	V

#### **AC Programming Characteristics**

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

			Lir	nits	
Symbol	Parameter	Test Conditions <sup>(1)</sup>	Min	Max	Units
t <sub>AS</sub>	Address Setup Time		2		μs
t <sub>CES</sub>	CE Setup Time		2		μs
t <sub>OES</sub>	OE Setup Time	Input Rise and Fall Times	2		μs
t <sub>DS</sub>	Data Setup Time	(10% to 90%) 20ns	2		μs
t <sub>AH</sub>	Address Hold Time	Input Pulse Levels	0		μs
t <sub>DH</sub>	Data Hold Time	0.45V to 2.4V	2		μs
t <sub>DFP</sub>	OE High to Output Float Delay <sup>(2)</sup>		0	130	ns
t <sub>VPS</sub>	V <sub>PP</sub> Setup Time	Input Timing Reference Level 0.8V to 2.0V	2		μs
t <sub>VCS</sub>	V <sub>CC</sub> Setup Time	0.07 10 2.07	2		μs
t <sub>PW</sub>	PGM Program Pulse Width <sup>(3)</sup>	Output Timing Reference Level	95	105	μs
t <sub>OE</sub>	Data Valid from OE	0.8V to 2.0V		150	ns
t <sub>PRT</sub>	V <sub>PP</sub> Pulse Rise TIme During Programming		50		ns

Notes: 1.  $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ .

3. Program Pulse width tolerance is 100  $\mu$ sec  $\pm$  5%.

### Atmel's 27C010(L) Integrated Product Identification Code

		Pins						Hex		
Codes	A0	07	О6	O5	04	О3	O2	01	00	Data
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device Type	1	0	0	0	0	0	1	0	1	05



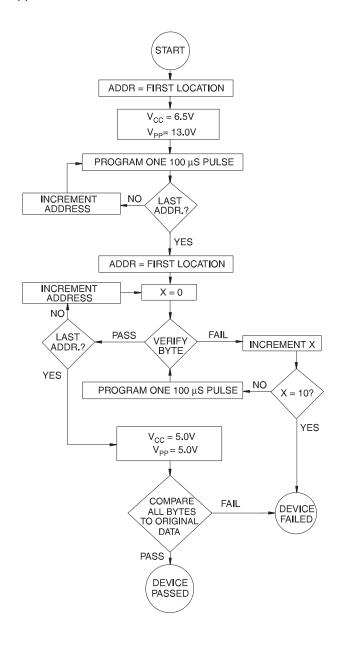
<sup>2.</sup> This parameter is only sampled and is not 100% tested. Output Float is defined as the point where data is no longer driven—see timing diagram.



#### Rapid Programming Algorithm

A 100  $\mu$ s  $\overline{PGM}$  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  $\mu$ s  $\overline{PGM}$  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  $\mu$ 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.



## **AT27C010 Ordering Information**

t <sub>ACC</sub>	I <sub>cc</sub>	(mA)			
(ns)	Active	Standby	Ordering Code	Package	Operation Range
45	35	0.1	AT27C010-45JC	32J	Commercial
			AT27C010-45PC	32P6	(0°C to 70°C)
			AT27C010-45TC	32T	
	35	0.1	AT27C010-45JI	32J	Industrial
			AT27C010-45PI	32P6	(-40°C to 85°C)
			AT27C010-45TI	32T	
55	35	0.1	AT27C010-55JC	32J	Commercial
			AT27C010-55PC	32P6	(0°C to 70°C)
			AT27C010-55TC	32T	
	35	0.1	AT27C010-55JI	32J	Industrial
			AT27C010-55PI	32P6	(-40°C to 85°C)
			AT27C010-55TI	32T	
70	35	0.1	AT27C010-70JC	32J	Commercial
			AT27C010-70PC	32P6	(0°C to 70°C)
			AT27C010-70TC	32T	
	35	0.1	AT27C010-70JI	32J	Industrial
			AT27C010-70PI	32P6	(-40°C to 85°C)
			AT27C010-70TI	32T	

(continued)

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





## **AT27C010 Ordering Information (Continued)**

t <sub>ACC</sub> (ns)	I <sub>CC</sub> (mA)				
	Active	Standby	Ordering Code	Package	Operation Range
90	35	0.1	AT27C010-90JC	32J	Commercial
			AT27C010-90PC	32P6	(0°C to 70°C)
			AT27C010-90TC	32T	
	35	0.1	AT27C010-90JI	32J	Industrial
			AT27C010-90PI	32P6	(-40°C to 85°C)
			AT27C010-90TI	32T	
	35	0.1	AT27C010-90JA	32J	Automotive
			AT27C010-90PA	32P6	(-40°C to 125°C)
120	35	0.1	AT27C010-12JC	32J	Commercial
			AT27C010-12PC	32P6	(0°C to 70°C)
			AT27C010-12TC	32T	
	35	0.1	AT27C010-12JI	32J	Industrial
			AT27C010-12PI	32P6	(-40°C to 85°C)
			AT27C010-12TI	32T	
	35	0.1	AT27C010-12JA	32J	Automotive
			AT27C010-12PA	32P6	(-40°C to 125°C)
150	35	0.1	AT27C010-15JC	32J	Commercial
			AT27C010-15PC	32P6	(0°C to 70°C)
			AT27C010-15TC	32T	
	35	0.1	AT27C010-15JI	32J	Industrial
			AT27C010-15PI	32P6	(-40°C to 85°C)
			AT27C010-15TI	32T	
	35	0.1	AT27C010-15JA	32J	Automotive
			AT27C010-15PA	32P6	(-40°C to 125°C)

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)		

## AT27C010L Ordering Information

t <sub>ACC</sub>	I <sub>CC</sub> (mA)				
(ns)	Active	Standby	Ordering Code	Package	Operation Range
45	25	0.1	AT27C010L-45JC	32J	Commercial
			AT27C010L-45PC	32P6	(0°C to 70°C)
			AT27C010L-45TC	32T	
	25	0.1	AT27C010L-45JI	32J	Industrial
			AT27C010L-45PI	32P6	(-40°C to 85°C)
			AT27C010L-45TI	32T	
55	25	0.1	AT27C010L-55JC	32J	Commercial
			AT27C010L-55PC	32P6	(0°C to 70°C)
			AT27C010L-55TC	32T	
	25	0.1	AT27C010L-55JI	32J	Industrial
			AT27C010L-55PI	32P6	(-40°C to 85°C)
			AT27C010L-55TI	32T	
70	25	0.1	AT27C010L-70JC	32J	Commercial
			AT27C010L-70PC	32P6	(0°C to 70°C)
			AT27C010L-70TC	32T	
	25	0.1	AT27C010L-70JI	32J	Industrial
			AT27C010L-70PI	32P6	(-40°C to 85°C)
			AT27C010L-70TI	32T	
90	25	0.1	AT27C010L-90JC	32J	Commercial
			AT27C010L-90PC	32P6	(0°C to 70°C)
			AT27C010L-90TC	32T	
	25	0.1	AT27C010L-90JI	32J	Industrial
			AT27C010L-90PI	32P6	(-40°C to 85°C)
			AT27C010L-90TI	32T	
120	25	0.1	AT27C010L-12JC	32J	Commercial
			AT27C010L-12PC	32P6	(0°C to 70°C)
			AT27C010L-12TC	32T	
	25	0.1	AT27C010L-12JI	32J	Industrial
			AT27C010L-12PI	32P6	(-40°C to 85°C)
			AT27C010L-12TI	32T	
150	25	0.1	AT27C010L-15JC	32J	Commercial
			AT27C010L-15PC	32P6	(0°C to 70°C)
			AT27C010L-15TC	32T	
	25	0.1	AT27C010L-15JI	32J	Industrial
			AT27C010L-15PI	32P6	(-40°C to 85°C)
			AT27C010L-15TI	32T	

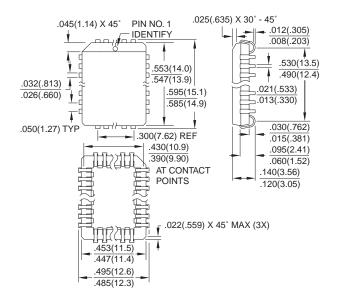
Package Type			
32J	32-Lead, Plastic J-Leaded Chip Carrier (PLCC)		
32P6	32-Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)		
32T	32-Lead, Plastic Thin Small Outline Package (TSOP)		





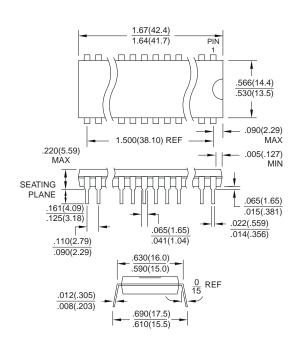
### **Packaging Information**

**32J**, 32-Lead, Plastic J-Leaded Chip Carrier (PLCC) Dimensions in Inches and (Millimeters)
JEDEC STANDARD MS-016 AE



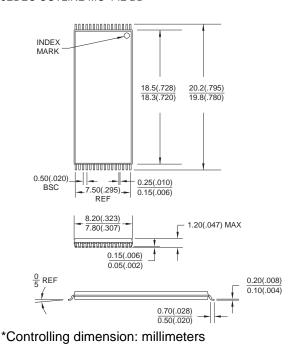
**32P6**, 32-Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)

Dimensions in Inches and (Millimeters)



**32T**, 32-Lead, Plastic Thin Small Outline Package (TSOP)

Dimensions in Millimeters and (Inches)\*
JEDEC OUTLINE MO-142 BD



AT27C010(L)









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