

Features

- Fast Read Access Time - 45 ns
- Low-Power CMOS Operation
 - 100 μ A 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 $\pm$ 10% Supply
- High Reliability CMOS Technology
 - 2000V ESD Protection
 - 200 mA Latchup Immunity
- Rapid™ Programming Algorithm - 100 μ s/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 programmable 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.

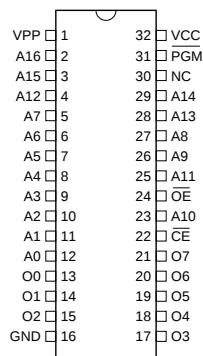
Two power versions are offered. In read mode, the AT27C010 typically consumes 25 mA while the AT27C010L requires only 8 mA. Standby mode supply current for both parts is typically less than 10 μ A.

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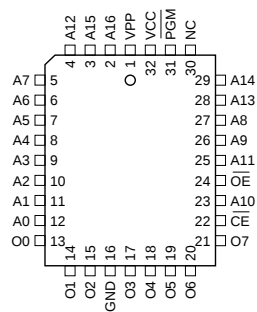
Pin Configurations

Pin Name	Function
A0 - A16	Addresses
O0 - O7	Outputs
$\overline{CE}$	Chip Enable
$\overline{OE}$	Output Enable
$\overline{PGM}$	Program Strobe
NC	No Connect

PDIP Top View

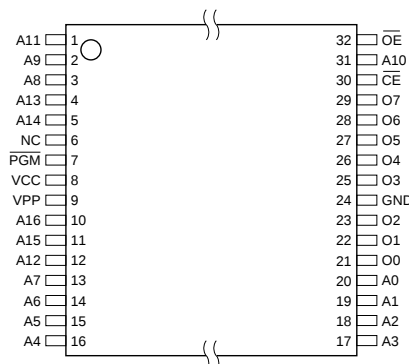


PLCC Top View



TSOP Top View

Type 1



1-Megabit (128K x 8) OTP EPROM

AT27C010(L)



The AT27C010(L) is 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 ($\overline{CE}$, $\overline{OE}$) to give designers the flexibility to prevent bus contention.

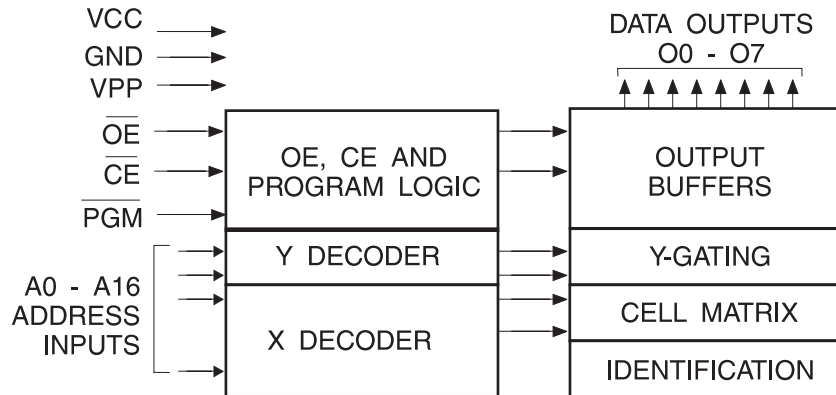
With 128K byte storage capability, the AT27C010(L) allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

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 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.

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 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



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 ⁽¹⁾
Voltage on A9 with Respect to Ground	-2.0V to +14.0V ⁽¹⁾
V _{PP} Supply Voltage with Respect to Ground	-2.0V to +14.0V ⁽¹⁾

*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: 1. 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	$\overline{CE}$	$\overline{OE}$	$\overline{PGM}$	Ai	V _{PP}	Outputs
Read	V _{IL}	V _{IL}	X ⁽¹⁾	Ai	X	D _{OUT}
Output Disable	X	V _{IH}	X	X	X	High Z
Standby	V _{IH}	X	X	X	X	High Z
Rapid Program ⁽²⁾	V _{IL}	V _{IH}	V _{IL}	Ai	V _{PP}	D _{IN}
PGM Verify	V _{IL}	V _{IL}	V _{IH}	Ai	V _{PP}	D _{OUT}
PGM Inhibit	V _{IH}	X	X	X	V _{PP}	High Z
Product Identification ⁽⁴⁾	V _{IL}	V _{IL}	X	A9 = V _H ⁽³⁾ A0 = V _{IH} or V _{IL} A1 - A16 = 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.

DC and AC Operating Conditions for Read Operation

		AT27C010/AT27C010L					
		-45	-55	-70	-90	-12	-15
Operating Temp. (Case)	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
	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
	Auto.				-40°C - 125°C	-40°C - 125°C	-40°C - 125°C
V _{CC} 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
I _{LI}	Input Load Current	V _{IN} = 0V to V _{CC}	Com., Ind.	± 1	μA
			Auto.	± 5	μA
I _{LO}	Output Leakage Current	V _{OUT} = 0V to V _{CC}	Com., Ind.	± 5	μA
			Auto.	±10	μA
IPP1 ⁽²⁾	V _{PP} ⁽¹⁾ Read/Standby Current	V _{PP} = V _{CC}		10	μA
I _{SB}	V _{CC} ⁽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, $\overline{CE} = V_{IL}$	AT27C010(L)	25	mA
			AT27C010	35	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}.

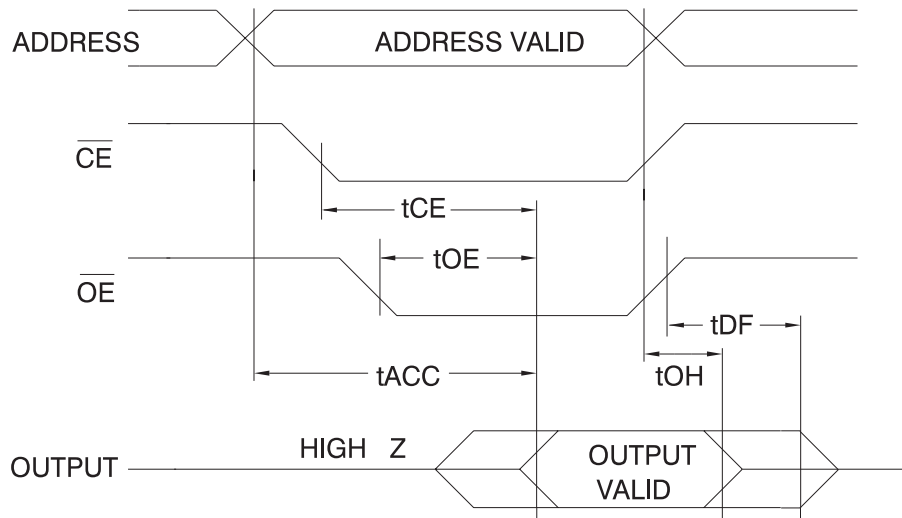
2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

AC Characteristics for Read Operation

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

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

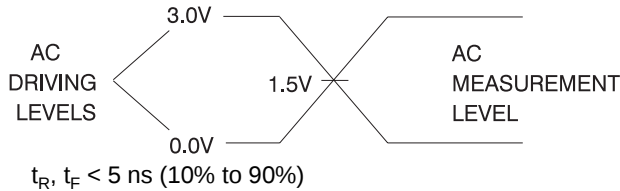
AC Waveforms for Read Operation⁽¹⁾



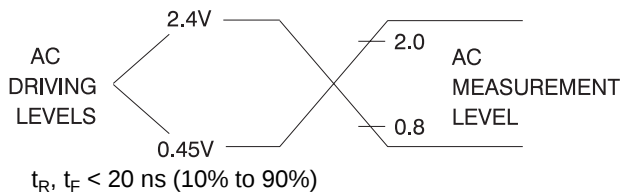
- Notes:
1. Timing measurement reference level is 1.5V for -45 and -55 devices. Input AC drive levels are $V_{IL} = 0.0V$ and $V_{IH} = 3.0V$. Timing measurement reference levels for all other speed grades are $V_{OL} = 0.8V$ and $V_{OH} = 2.0V$. Input AC drive levels are $V_{IL} = 0.45V$ and $V_{IH} = 2.4V$.
 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

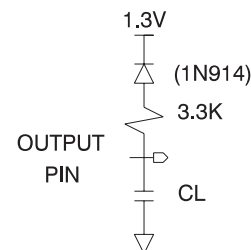
For -45 and -55 devices only:



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



Output Test Load



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

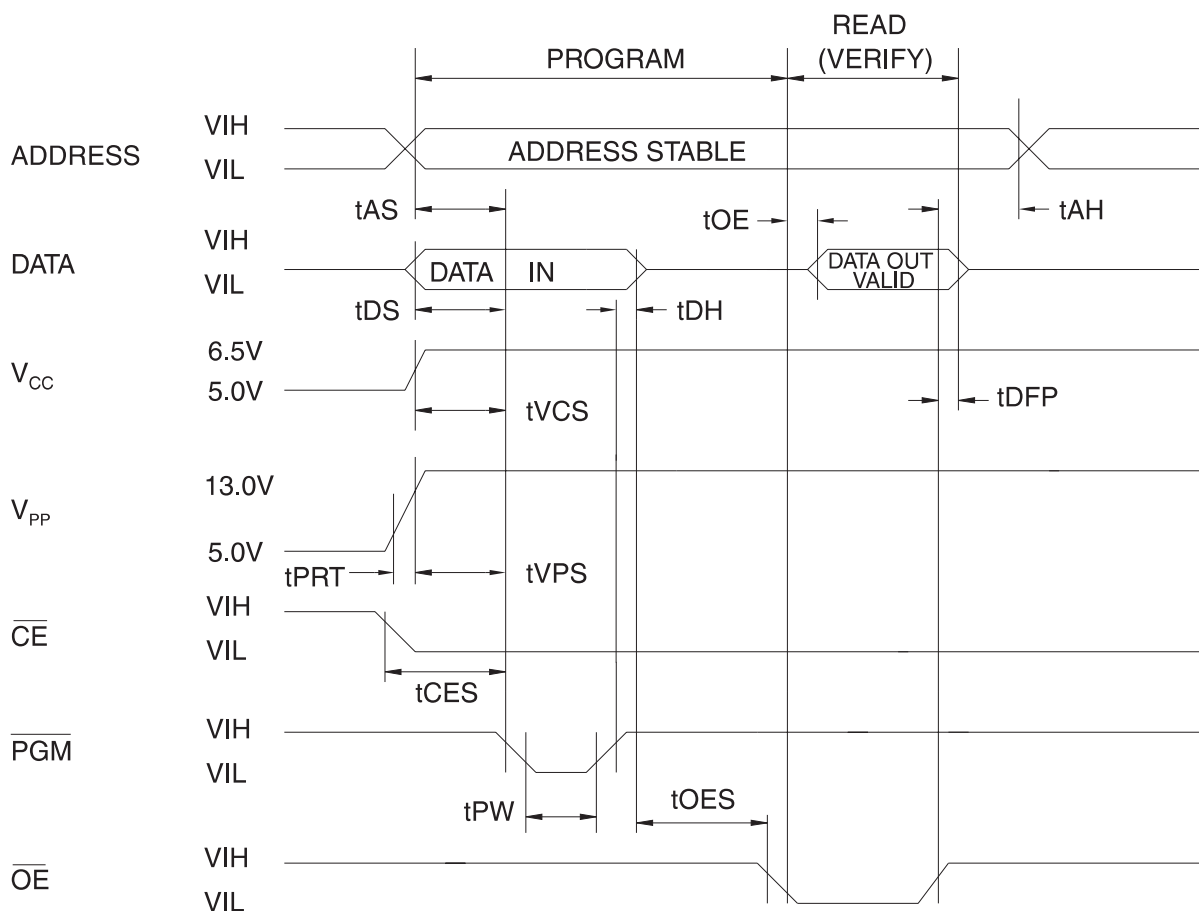
Pin Capacitance

$f = 1 \text{ MHz}$, $T = 25^\circ\text{C}$ ⁽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_{DFP} are characteristics of the device but must be accommodated by the programmer.
 3. When programming the AT27C010(L) at 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°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}		$\pm$ 10	μ A
V _{IL}	Input Low Level		-0.6	0.8	V
V _{IH}	Input High Level		2.0	V _{CC} + 1	V
V _{OL}	Output Low Voltage	I _{OL} = 2.1 mA		0.4	V
V _{OH}	Output High Voltage	I _{OH} = -400 μ A	2.4		V
I _{CC2}	V _{CC} Supply Current (Program and Verify)			40	mA
I _{PP2}	V _{PP} Supply Current	$\overline{CE} = \overline{PGM} = V_{IL}$		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%) 20ns	2		μs
t_{CES}	$\overline{CE}$ Setup Time		2		μs
t_{OES}	$\overline{OE}$ Setup Time		2		μs
t_{DS}	Data Setup Time		2		μs
t_{AH}	Address Hold Time	Input Pulse Levels 0.45V to 2.4V	0		μs
t_{DH}	Data Hold Time		2		μs
t_{DFP}	$\overline{OE}$ High to Output Float Delay ⁽²⁾	Input Timing Reference Level 0.8V to 2.0V	0	130	ns
t_{VPS}	V_{PP} Setup Time		2		μs
t_{VCS}	V_{CC} Setup Time	Output Timing Reference Level 0.8V to 2.0V	2		μs
t_{PW}	$\overline{PGM}$ Program Pulse Width ⁽³⁾		95	105	μs
t_{OE}	Data Valid from $\overline{OE}$			150	ns
t_{PRT}	V_{PP} Pulse Rise Time During Programming		50		ns

- Notes:
- V_{CC} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP} .
 - 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.
 - Program Pulse width tolerance is $100\text{ }\mu\text{sec} \pm 5\%$.

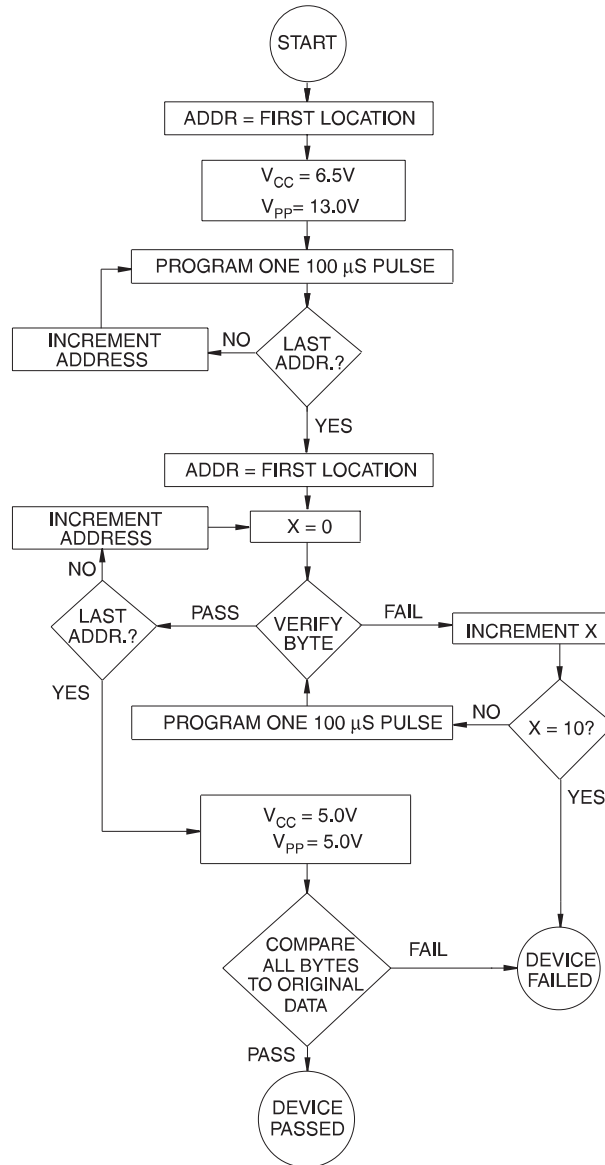
Atmel's 27C010(L) Integrated Product Identification Code

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	0	1	0	1	05

Rapid Programming Algorithm

A 100 μs $\overline{\text{PGM}}$ 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 μs $\overline{\text{PGM}}$ 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 μs 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_{ACC} (ns)	I_{CC} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
45	35	0.1	AT27C010-45JC	32J	Commercial (0°C to 70°C)
			AT27C010-45PC	32P6	
			AT27C010-45TC	32T	
	35	0.1	AT27C010-45JI	32J	Industrial (-40°C to 85°C)
			AT27C010-45PI	32P6	
			AT27C010-45TI	32T	
55	35	0.1	AT27C010-55JC	32J	Commercial (0°C to 70°C)
			AT27C010-55PC	32P6	
			AT27C010-55TC	32T	
	35	0.1	AT27C010-55JI	32J	Industrial (-40°C to 85°C)
			AT27C010-55PI	32P6	
			AT27C010-55TI	32T	
70	35	0.1	AT27C010-70JC	32J	Commercial (0°C to 70°C)
			AT27C010-70PC	32P6	
			AT27C010-70TC	32T	
	35	0.1	AT27C010-70JI	32J	Industrial (-40°C to 85°C)
			AT27C010-70PI	32P6	
			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	32-Lead, Plastic Thin Small Outline Package (TSOP)



AT27C010 Ordering Information (Continued)

t_{ACC} (ns)	I_{CC} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
90	35	0.1	AT27C010-90JC AT27C010-90PC AT27C010-90TC	32J 32P6 32T	Commercial (0°C to 70°C)
			AT27C010-90JI AT27C010-90PI AT27C010-90TI	32J 32P6 32T	Industrial (-40°C to 85°C)
			AT27C010-90JA AT27C010-90PA	32J 32P6	Automotive (-40°C to 125°C)
	35	0.1	AT27C010-12JC AT27C010-12PC AT27C010-12TC	32J 32P6 32T	Commercial (0°C to 70°C)
			AT27C010-12JI AT27C010-12PI AT27C010-12TI	32J 32P6 32T	Industrial (-40°C to 85°C)
			AT27C010-12JA AT27C010-12PA	32J 32P6	Automotive (-40°C to 125°C)
	35	0.1	AT27C010-15JC AT27C010-15PC AT27C010-15TC	32J 32P6 32T	Commercial (0°C to 70°C)
			AT27C010-15JI AT27C010-15PI AT27C010-15TI	32J 32P6 32T	Industrial (-40°C to 85°C)
			AT27C010-15JA AT27C010-15PA	32J 32P6	Automotive (-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 _{ACC} (ns)	I _{CC} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
45	25	0.1	AT27C010L-45JC	32J	Commercial (0°C to 70°C)
			AT27C010L-45PC	32P6	
			AT27C010L-45TC	32T	
	25	0.1	AT27C010L-45JI	32J	Industrial (-40°C to 85°C)
			AT27C010L-45PI	32P6	
			AT27C010L-45TI	32T	
55	25	0.1	AT27C010L-55JC	32J	Commercial (0°C to 70°C)
			AT27C010L-55PC	32P6	
			AT27C010L-55TC	32T	
	25	0.1	AT27C010L-55JI	32J	Industrial (-40°C to 85°C)
			AT27C010L-55PI	32P6	
			AT27C010L-55TI	32T	
70	25	0.1	AT27C010L-70JC	32J	Commercial (0°C to 70°C)
			AT27C010L-70PC	32P6	
			AT27C010L-70TC	32T	
	25	0.1	AT27C010L-70JI	32J	Industrial (-40°C to 85°C)
			AT27C010L-70PI	32P6	
			AT27C010L-70TI	32T	
90	25	0.1	AT27C010L-90JC	32J	Commercial (0°C to 70°C)
			AT27C010L-90PC	32P6	
			AT27C010L-90TC	32T	
	25	0.1	AT27C010L-90JI	32J	Industrial (-40°C to 85°C)
			AT27C010L-90PI	32P6	
			AT27C010L-90TI	32T	
120	25	0.1	AT27C010L-12JC	32J	Commercial (0°C to 70°C)
			AT27C010L-12PC	32P6	
			AT27C010L-12TC	32T	
	25	0.1	AT27C010L-12JI	32J	Industrial (-40°C to 85°C)
			AT27C010L-12PI	32P6	
			AT27C010L-12TI	32T	
150	25	0.1	AT27C010L-15JC	32J	Commercial (0°C to 70°C)
			AT27C010L-15PC	32P6	
			AT27C010L-15TC	32T	
	25	0.1	AT27C010L-15JI	32J	Industrial (-40°C to 85°C)
			AT27C010L-15PI	32P6	
			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)



Atmel Headquarters

Corporate Headquarters

2325 Orchard Parkway
San Jose, CA 95131
TEL (408) 441-0311
FAX (408) 487-2600

Europe

Atmel U.K., Ltd.
Coliseum Business Centre
Riverside Way
Camberley, Surrey GU15 3YL
England
TEL (44) 1276-686677
FAX (44) 1276-686697

Asia

Atmel Asia, Ltd.
Room 1219
Chinachem Golden Plaza
77 Mody Road
Tsimshatsui East
Kowloon, Hong Kong
TEL (852) 27219778
FAX (852) 27221369

Japan

Atmel Japan K.K.
Tonetsu Shinkawa Bldg., 9F
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
TEL (81) 3-3523-3551
FAX (81) 3-3523-7581

Atmel Operations

Atmel Colorado Springs

1150 E. Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL (719) 576-3300
FAX (719) 540-1759

Atmel Rousset

Zone Industrielle
13106 Rousset Cedex, France
TEL (33) 4 42 53 60 00
FAX (33) 4 42 53 60 01

Fax-on-Demand

North America:
1-(800) 292-8635
International:
1-(408) 441-0732

e-mail

literature@atmel.com

Web Site

<http://www.atmel.com>

BBS

1-(408) 436-4309

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