

## Features

- Fast Read Access Time - 45 ns
- Low Power CMOS Operation
  - 100  $\mu$ A max. Standby
  - 20 mA max. Active at 5 MHz
- Wide Selection of JEDEC Standard Packages
  - 28-Lead 600-mil PDIP and Cerdip
  - 32-Pad PLCC and LCC
  - 28-Lead TSOP and SOIC
- 5 V  $\pm$  10% Supply
- High Reliability CMOS Technology
  - 2,000 V ESD Protection
  - 200 mA Latchup Immunity
- Rapid Programming - 100  $\mu$ s/byte (typical)
- Two-Line Control
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Military, Commercial and Industrial Temperature Ranges

## Description

The AT27C512R chip is a low-power, high performance 524,288 bit ultraviolet erasable and electrically programmable read only memory (EPROM) organized 64K x 8. It requires only one 5 V 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.

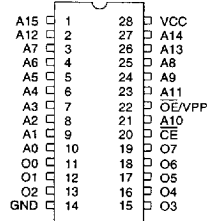
Atmel's scaled CMOS technology provides high speed, lower active power consumption, and significantly faster programming. Power consumption is typically only 8 mA in Active Mode and less than 10  $\mu$ A in Standby.

(continued)

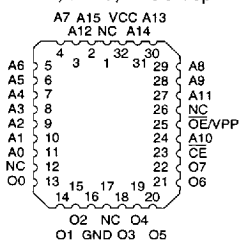
## Pin Configurations

Pin Name	Function
A0-A15	Addresses
O0-O7	Outputs
$\overline{CE}$	Chip Enable
$\overline{OE}/V_{PP}$	Output Enable
NC	No Connect

CDIP, PDIP, SOIC Top

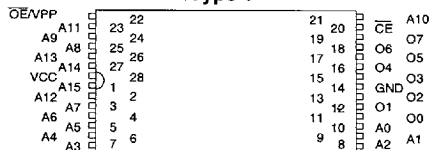


LCC, JLCC, PLCC Top



Note: PLCC Package Pins 1 and 17 are DON'T CONNECT.

TSOP Top View  
Type 1



**512K (64K x 8)**  
**UV**  
**Erasable**  
**CMOS**  
**EPROM**

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## Description (Continued)

The AT27C512R comes in a choice of industry standard JEDEC-approved packages, including: one time programmable (OTP) plastic PDIP, PLCC, SOIC, and TSOP, as well as windowed ceramic Cerdip and LCC. All devices feature two-line control ( $\overline{CE}$ ,  $\overline{OE}$ ) to give designers the flexibility to prevent bus contention.

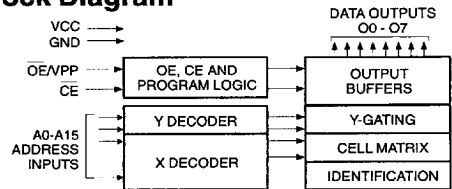
With high density 64K byte storage capability, the AT27C512R allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's 27C512R 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  $\mu$ 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.

## Erase Characteristics

The entire memory array of the AT27C512R is erased (all outputs read as  $V_{OH}$ ) after exposure to ultraviolet light at a wavelength of 2537Å. Complete erasure is assured after a minimum of 20 minutes exposure using 12,000  $\mu$ W/cm<sup>2</sup> intensity lamps spaced one inch away from the chip. Minimum erase time for lamps at other intensity ratings can be calculated from the minimum integrated erasure dose of 15 W·sec/cm<sup>2</sup>. To prevent unintentional erasure, an opaque label is recommended to cover the clear window on any UV erasable EPROM which will be subjected to continuous fluorescent indoor lighting or sunlight.

## 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.....	-2.0 V to +7.0 V <sup>(1)</sup>
Voltage on A9 with Respect to Ground .....	-2.0 V to +14.0 V <sup>(1)</sup>
V <sub>PP</sub> Supply Voltage with Respect to Ground.....	-2.0 V to +14.0 V <sup>(1)</sup>
Integrated UV Erase Dose.....	7258 W·sec/cm <sup>2</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.

Notes:

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

## Operating Modes


Mode \ Pin	$\overline{CE}$	$\overline{OE}/V_{PP}$	Ai	V <sub>CC</sub>	Outputs
Read	V <sub>IL</sub>	V <sub>IL</sub>	Ai	V <sub>CC</sub>	DOUT
Output Disable	V <sub>IL</sub>	V <sub>IH</sub>	X <sup>(1)</sup>	V <sub>CC</sub>	High Z
Standby	V <sub>IH</sub>	X	X	V <sub>CC</sub>	High Z
Rapid Program <sup>(2)</sup>	V <sub>IL</sub>	V <sub>PP</sub>	Ai	V <sub>CC</sub>	DIN
PGM Verify	V <sub>IL</sub>	V <sub>IL</sub>	Ai	V <sub>CC</sub>	DOUT
PGM Inhibit	V <sub>IH</sub>	V <sub>PP</sub>	X	V <sub>CC</sub>	High Z
Product Identification <sup>(4)</sup>	V <sub>IL</sub>	V <sub>IL</sub>	A9=V <sub>H</sub> <sup>(3)</sup> A0=V <sub>IH</sub> or V <sub>IL</sub> A1-A15=V <sub>IL</sub>	V <sub>CC</sub>	Identification Code

- Notes:
1. X can be V<sub>IL</sub> or V<sub>IH</sub>.
  2. Refer to Programming characteristics.
  3. V<sub>H</sub> = 12.0  $\pm$  0.5 V.

4. Two identifier bytes may be selected. All Ai inputs are held low (V<sub>IL</sub>), except A9 which is set to V<sub>H</sub> and A0 which is toggled low (V<sub>IL</sub>) to select the Manufacturer's Identification byte and high (V<sub>IH</sub>) to select the Device Code byte.

**D.C. and A.C. Operating Conditions for Read Operation**

AT27C512R								
		-45	-55	-70	-90	-12	-15	-20
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	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	-40°C - 85°C
	Mil.			-55°C - 125°C	-55°C - 125°C	-55°C - 125°C	-55°C - 125°C	-55°C - 125°C
Vcc Supply		5 V ± 10%	5 V ± 10%	5 V ± 10%	5 V ± 10%	5 V ± 10%	5 V ± 10%	5 V ± 10%

**3**
 = Advance Information

**D.C. and Operating Characteristics for Read Operation**


Symbol	Parameter	Condition	Min	Max	Units
I <sub>LI</sub>	Input Load Current	V <sub>IN</sub> = 0 V to V <sub>CC</sub>	Com., Ind.	±1	μA
			Mil.	±5	μA
I <sub>LO</sub>	Output Leakage Current	V <sub>OUT</sub> = 0 V to V <sub>CC</sub>	Com., Ind.	±5	μA
			Mil.	±10	mA
I <sub>SB</sub>	V <sub>CC</sub> <sup>(1)</sup> Standby Current	I <sub>SB1</sub> (CMOS), $\overline{CE} = V_{CC} \pm 0.3$ V		100	μA
		I <sub>SB2</sub> (TTL), $\overline{CE} = 2.0$ to V <sub>CC</sub> + 0.5 V		1	mA
I <sub>CC</sub>	V <sub>CC</sub> Active Current	f = 5 MHz, I <sub>OUT</sub> = 0 mA, $\overline{CE} = V_{IL}$	Com.	20	mA
			Ind., Mil.	25	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		.45	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -100 μA		V <sub>CC</sub> -0.3	V
		I <sub>OH</sub> = -2.5 mA		3.5	V
		I <sub>OH</sub> = -400 μA		2.4	V

Notes: 1. V<sub>CC</sub> must be applied simultaneously or before  $\overline{OE}/V_{PP}$ , and removed simultaneously or after  $\overline{OE}/V_{PP}$ .

**A.C. Characteristics for Read Operation**

			AT27C512R														
			-45		-55		-70		-90		-12		-15		-20		
Symbol	Parameter	Condition	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Units
t <sub>ACC</sub> <sup>(3)</sup>	Address to Output Delay	$\overline{CE} = \overline{OE}/V_{PP}$	45	55	70	90	120	150	200	ns							
		Com., Ind.															
		$= V_{IL}$															
		Mil.															
t <sub>CE</sub> <sup>(2)</sup>	$\overline{CE}$ to Output Delay	$\overline{OE}/V_{PP} = V_{IL}$	45	55	70	90	120	150	200	ns							
t <sub>OE</sub> <sup>(2,3)</sup>	$\overline{OE}/V_{PP}$ to Output Delay	$\overline{CE} = V_{IL}$	20	25	30	35	35	40	70	ns							
t <sub>DF</sub> <sup>(4,5)</sup>	$\overline{OE}/V_{PP}$ or $\overline{CE}$ High to Output Float		20	20	25	25	30	35	40	ns							
t <sub>OH</sub>	Output Hold from Address, $\overline{CE}$ or $\overline{OE}/V_{PP}$ , whichever occurred first		7	7	7	0	0	0	0	ns							

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

 = Advance Information




## D.C. Programming Characteristics

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

Sym- bol	Parameter	Test Conditions	Limits		Units
			Min	Max	
$I_{LI}$	Input Load Current	$V_{IN}=V_{IL}, V_{IH}$		10	$\mu\text{A}$
$V_{IL}$	Input Low Level	(All Inputs)	-0.6	0.8	V
$V_{IH}$	Input High Level		2.0	$V_{CC}+1$	V
$V_{OL}$	Output Low Volt.	$I_{OL}=2.1\text{ mA}$		.45	V
$V_{OH}$	Output High Volt.	$I_{OH}=-400\text{ }\mu\text{A}$	2.4		V
$I_{CC2}$	$V_{CC}$ Supply Current (Program and Verify)			25	mA
$I_{PP2}$	$\overline{OE}/V_{PP}$ Current	$\overline{CE}=V_{IL}$		25	mA
$V_{ID}$	A9 Product Identification Voltage		11.5	12.5	V

## A.C. Programming Characteristics

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

Sym- bol	Parameter	Test Conditions* (see Note 1)	Limits		Units
			Min	Max	
$t_{AS}$	Address Setup Time		2		$\mu\text{s}$
$t_{OES}$	$\overline{OE}/V_{PP}$ Setup Time		2		$\mu\text{s}$
$t_{OEH}$	$\overline{OE}/V_{PP}$ Hold Time		2		$\mu\text{s}$
$t_{DS}$	Data Setup Time		2		$\mu\text{s}$
$t_{AH}$	Address Hold Time		0		$\mu\text{s}$
$t_{DH}$	Data Hold Time		2		$\mu\text{s}$
$t_{DFP}$	$\overline{CE}$ High to Out- put Float Delay	(Note 2)	0	130	ns
$t_{VCS}$	$V_{CC}$ Setup Time		2		$\mu\text{s}$
$t_{PW}$	$\overline{CE}$ Program Pulse Width	(Note 3)	95	105	$\mu\text{s}$
$t_{DV}$	Data Valid from $\overline{CE}$	(Note 2)		1	$\mu\text{s}$
$t_{VR}$	$\overline{OE}/V_{PP}$ Recovery Time		2		$\mu\text{s}$
$t_{PRT}$	$\overline{OE}/V_{PP}$ Pulse Rise Time During Programming		50		ns

### \*A.C. Conditions of Test:

Input Rise and Fall Times (10% to 90%) ..... 20 ns  
 Input Pulse Levels ..... 0.45 V to 2.4 V  
 Input Timing Reference Level ..... 0.8 V to 2.0 V  
 Output Timing Reference Level ..... 0.8 V to 2.0 V

### Notes:

- $V_{CC}$  must be applied simultaneously or before  $\overline{OE}/V_{PP}$  and removed simultaneously or after  $\overline{OE}/V_{PP}$ .
- 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  $\mu\text{sec} \pm 5\%$ .

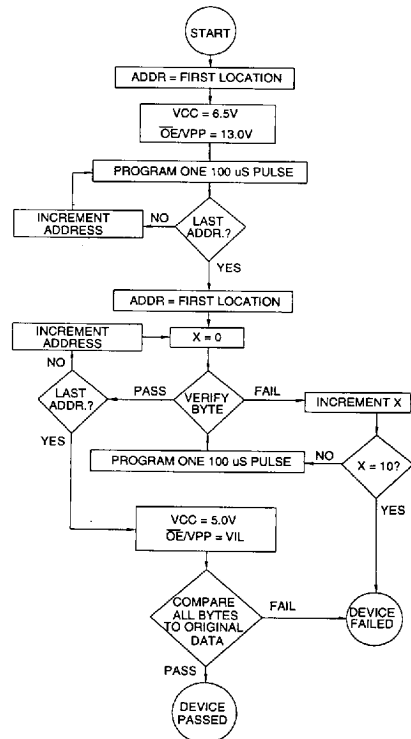
## Atmel's 27C512R Integrated Product Identification Code

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	1	0	1	0D

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## Rapid Programming Algorithm

A 100  $\mu\text{s}$   $\overline{CE}$  pulse width is used to program. The address is set to the first location.  $V_{CC}$  is raised to 6.5V and  $\overline{OE}/V_{PP}$  is raised to 13.0 V. Each address is first programmed with one 100  $\mu\text{s}$   $\overline{CE}$  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  $\mu\text{s}$  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.  $\overline{OE}/V_{PP}$  is then lowered to  $V_{IL}$  and  $V_{CC}$  to 5.0 V. All bytes are read again and compared with the original data to determine if the device passes or fails.



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## Ordering Information

 = Advance Information

I <sub>ACC</sub> (ns)	I <sub>CC</sub> (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
45	20	0.1	AT27C512R-45DC AT27C512R-45JC AT27C512R-45LC AT27C512R-45PC AT27C512R-45RC AT27C512R-45TC	28DW6 32J 32LW 28P6 28R 28T	Commercial (0°C to 70°C)
45	25	0.1	AT27C512R-45DI AT27C512R-45JI AT27C512R-45LI AT27C512R-45PI AT27C512R-45RI AT27C512R-45TI	28DW6 32J 32LW 28P6 28R 28T	Industrial (-40°C to 85°C)
55	20	0.1	AT27C512R-55DC AT27C512R-55JC AT27C512R-55LC AT27C512R-55PC AT27C512R-55RC AT27C512R-55TC	28DW6 32J 32LW 28P6 28R 28T	Commercial (0°C to 70°C)
55	25	0.1	AT27C512R-55DI AT27C512R-55JI AT27C512R-55LI AT27C512R-55PI AT27C512R-55RI AT27C512R-55TI	28DW6 32J 32LW 28P6 28R 28T	Industrial (-40°C to 85°C)
70	20	0.1	AT27C512R-70DC AT27C512R-70JC AT27C512R-70LC AT27C512R-70PC AT27C512R-70RC AT27C512R-70TC	28DW6 32J 32LW 28P6 28R 28T	Commercial (0°C to 70°C)
70	25	0.1	AT27C512R-70DI AT27C512R-70JI AT27C512R-70LI AT27C512R-70PI AT27C512R-70RI AT27C512R-70TI	28DW6 32J 32LW 28P6 28R 28T	Industrial (-40°C to 85°C)
			AT27C512R-70DM AT27C512R-70LM	28DW6 32LW	Military (-55°C to 125°C)
90	20	0.1	AT27C512R-90DC AT27C512R-90JC AT27C512R-90KC AT27C512R-90LC AT27C512R-90PC AT27C512R-90RC AT27C512R-90TC	28DW6 32J 32KW 32LW 28P6 28R 28T	Commercial (0°C to 70°C)

**Ordering Information**

t <sub>ACC</sub> (ns)	I <sub>CC</sub> (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
90	25	0.1	AT27C512R-90DI	28DW6	Industrial (-40°C to 85°C)
			AT27C512R-90JI	32J	
			AT27C512R-90KI	32KW	
			AT27C512R-90LI	32LW	Military (-55°C to 125°C)
			AT27C512R-90PI	28P6	
			AT27C512R-90RI	28R	
			AT27C512R-90TI	28T	
			AT27C512R-90DM	28DW6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT27C512R-90KM/883	32KW	
			AT27C512R-90LM/883	32LW	
120	20	0.1	AT27C512R-12DC	28DW6	Commercial (0°C to 70°C)
			AT27C512R-12JC	32J	
			AT27C512R-12KC	32KW	
			AT27C512R-12LC	32LW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT27C512R-12PC	28P6	
			AT27C512R-12RC	28R	
			AT27C512R-12TC	28T	
			AT27C512R-12DI	28DW6	Industrial (-40°C to 85°C)
			AT27C512R-12JI	32J	
			AT27C512R-12KI	32KW	
120	25	0.1	AT27C512R-12LI	32LW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT27C512R-12PI	28P6	
			AT27C512R-12RI	28R	
			AT27C512R-12TI	28T	Commercial (0°C to 70°C)
			AT27C512R-12DM	28DW6	
			AT27C512R-12KM	32KW	
			AT27C512R-12LM	32LW	
			AT27C512R-12DM/883	28DW6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT27C512R-12KM/883	32KW	
			AT27C512R-12LM/883	32LW	
150	20	0.1	AT27C512R-15DC	28DW6	Commercial (0°C to 70°C)
			AT27C512R-15JC	32J	
			AT27C512R-15KC	32KW	
			AT27C512R-15LC	32LW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT27C512R-15PC	28P6	
			AT27C512R-15RC	28R	
			AT27C512R-15TC	28T	

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## Ordering Information

t <sub>ACC</sub> (ns)	I <sub>CC</sub> (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
150	25	0.1	AT27C512R-15DI AT27C512R-15JI AT27C512R-15KI AT27C512R-15LI AT27C512R-15PI AT27C512R-15RI AT27C512R-15TI	28DW6 32J 32KW 32LW 28P6 28R 28T	Industrial (-40°C to 85°C)
			AT27C512R-15DM AT27C512R-15KM AT27C512R-15LM	28DW6 32KW 32LW	Military (-55°C to 125°C)
			AT27C512R-15DM/883 AT27C512R-15KM/883 AT27C512R-15LM/883	28DW6 32KW 32LW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
200	20	0.1	AT27C512R-20DC AT27C512R-20JC AT27C512R-20KC AT27C512R-20LC AT27C512R-20PC AT27C512R-20RC	28DW6 32J 32KW 32LW 28P6 28R	Commercial (0°C to 70°C)
200	25	0.1	AT27C512R-20DI AT27C512R-20JI AT27C512R-20KI AT27C512R-20LI AT27C512R-20PI AT27C512R-20RI	28DW6 32J 32KW 32LW 28P6 28R	Industrial (-40°C to 85°C)
			AT27C512R-20DM AT27C512R-20KM AT27C512R-20LM	28DW6 32KW 32LW	Military (-55°C to 125°C)
			AT27C512R-20DM/883 AT27C512R-20KM/883 AT27C512R-20LM/883	28DW6 32KW 32LW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
90	25	0.2	5962-87648 05 XX 5962-87648 05 YX 5962-87648 05 ZX	28DW6 32LW 32KW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
120	25	0.2	5962-87648 04 XX 5962-87648 04 YX 5962-87648 04 ZX	28DW6 32LW 32KW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
150	25	0.2	5962-87648 01 XX 5962-87648 01 YX 5962-87648 01 ZX	28DW6 32LW 32KW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
200	25	0.2	5962-87648 02 XX 5962-87648 02 YX 5962-87648 02 ZX	28DW6 32LW 32KW	Military/883C Class B, Fully Compliant (-55°C to 125°C)
250	25	0.2	5962-87648 03 XX 5962-87648 03 YX 5962-87648 03 ZX	28DW6 32LW 32KW	Military/883C Class B, Fully Compliant (-55°C to 125°C)



## Ordering Information

Package Type	
28DW6	28 Lead, 0.600" Wide, Windowed, Ceramic Dual Inline Package (Cerdip)
32J	32 Lead, Plastic J-Leaded Chip Carrier OTP (PLCC)
32KW	32 Lead, Windowed, Ceramic J-Leaded Chip Carrier (JLCC)
32LW	32 Pad, Windowed, Ceramic Leadless Chip Carrier (LCC)
28P6	28 Lead, 0.600" Wide, Plastic Dual Inline Package OTP (PDIP)
28R	28 Lead, 0.330" Wide, Plastic Gull Wing Small Outline OTP (SOIC)
28T	28 Lead, Thin Small Outline Package OTP (TSOP)

