

Features

- Fast Read Access Time - 70 ns
- Low Power CMOS Operation
 - 100 μ A Maximum Standby
 - 35 mA Maximum Active at 5 MHz
- JEDEC Standard Packages
 - 40-Lead 600 mil PDIP
 - 44-Lead PLCC
 - 40-Lead TSOP (10 mm X 14 mm)
- Direct Upgrade from 512K bit and 1M bit (AT27C516 and AT27C1024) EPROMs
- 5V \pm 10% Power Supply
- High Reliability CMOS Technology
 - 2,000V ESD Protection
 - 200 mA Latchup Immunity
- Rapid[™] Programming Algorithm - 50 μ s/word (typical)
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Commercial and Industrial Temperature Ranges

Description

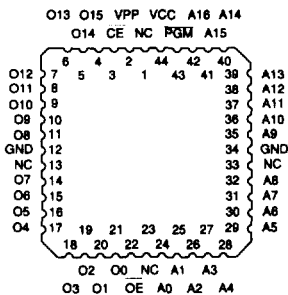
The AT27C2048 is a low-power, high performance 2,097,152 bit one-time programmable read only memory (OTP EPROM) organized as 128K by 16 bits. It requires a single 5V power supply in normal read mode operation. Any word can be accessed in less than 70 ns, eliminating the need for speed-reducing WAIT states. The by-16 organization makes this part ideal for high-performance 16 and 32 bit microprocessor systems.

Pin Configurations

Pin Name	Function
A0 - A16	Addresses
O0 - O15	Outputs
CE	Chip Enable
OE	Output Enable
PGM	Program
NC	No Connect

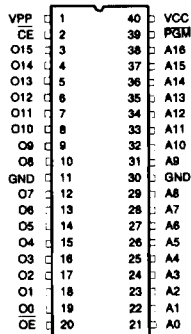
Note: Both GND pins must be connected.

PLCC Top View

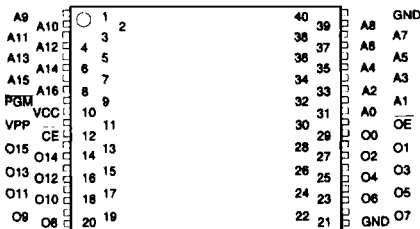


Note: PLCC package pins 1 and 23 are DON'T CONNECT.

PDIP Top View (continued)



TSOP Top View Type 1



**2 Megabit
(128K x 16)
OTP
CMOS EPROM**

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Preliminary





Description (Continued)

In read mode, the AT27C2048 typically consumes 15 mA. Standby mode supply current is typically less than 10 μ A.

The AT27C2048 is available in industry standard JEDEC-approved one-time programmable (OTP) plastic, PDIP, PLCC, and TSOP packages. The device features two-line control ($\overline{\text{CE}}$, $\overline{\text{OE}}$) to eliminate bus contention in high-speed systems.

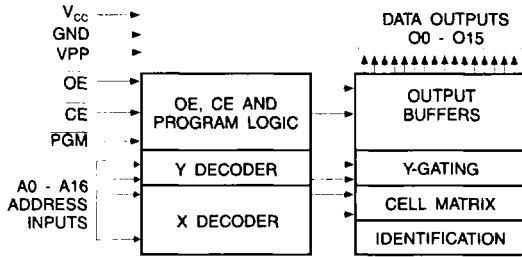
With high density 128K word storage capability, the AT27C2048 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's AT27C2048 has additional features that 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 50 μ s/word. 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 VCC 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 VCC 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⁾

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*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 +7.0V for pulses of less than 20 ns.

Operating Modes

Mode \ Pin	\overline{CE}	\overline{OE}	PGM	Ai	V_{PP}	Outputs
Read	V_{IL}	V_{IL}	X ⁽¹⁾	Ai	X ⁽¹⁾	DOUT
Output Disable	X	V_{IH}	X	X	X	High Z
Standby	V_{IH}	X	X	X	X ⁽⁵⁾	High Z
Rapid Program ⁽²⁾	V_{IL}	V_{IH}	V_{IL}	Ai	V_{PP}	DIN
PGM Verify	V_{IL}	V_{IL}	V_{IH}	Ai	V_{PP}	DOUT
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}	V_{CC}	Identification Code

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

4. Two identifier words 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 word and high (V_{IH}) to select the Device Code word.
 5. Standby V_{CC} current (I_{SB}) is specified with $V_{PP} = V_{CC}$. $V_{CC} > V_{PP}$ will cause a slight increase in I_{SB} .





DC and AC Operating Conditions for Read Operation

AT27C2048						
		-70	-90	-12	-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 _{CC} (1) Standby Current	I _{SB1} (CMOS) CE = V _{CC} ± 0.3V		100	μA
		I _{SB2} (TTL) CE = 2.0 to V _{CC} + 0.5V		1	mA
I _{CC}	V _{CC} Active Current	f = 5 MHz, I _{OUT} = 0 mA, CE = V _{IL}		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}.

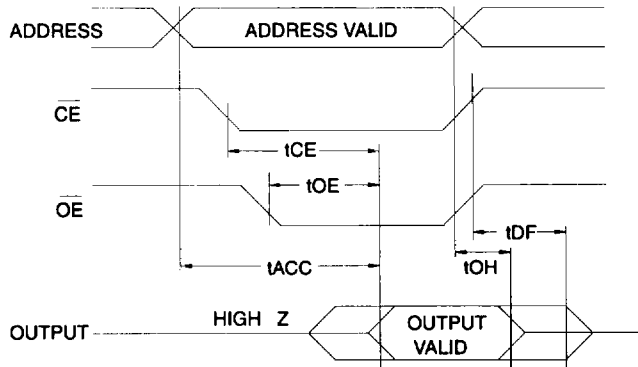
2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

AC Characteristics for Read Operation

			AT27C2048								
			-70		-90		-12		-15		
Symbol	Parameter	Condition	Min	Max	Min	Max	Min	Max	Min	Max	Units
t _{ACC} (3)	Address to Output Delay	CE = OE = V _{IL}		70		90		120		150	ns
t _{CE} (2)	CE to Output Delay	OE = V _{IL}		70		90		120		150	ns
t _{OE} (2, 3)	OE to Output Delay	CE = V _{IL}		40		40		40		50	ns
t _{DF} (4, 5)	OE or CE High to Output Float, whichever occurred first			30		30		35		40	ns
t _{OH} (4)	Output Hold from Address, CE or OE, whichever occurred first		7		0		0		0		ns

Notes: 2, 3, 4, 5. See the AC Waveforms for Read Operation diagram.

AC Waveforms for Read Operation ⁽¹⁾

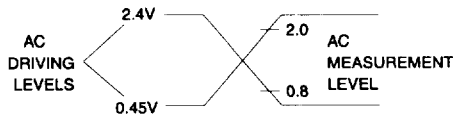


- Notes: 1. Timing measurement references are 0.8V and 2.0V. Input AC drive levels are 0.45V and 2.4V, unless otherwise specified.
2. \overline{OE} may be delayed up to $t_{CE} - t_{OE}$ after the falling edge of \overline{CE} without impact on t_{CE} .

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.

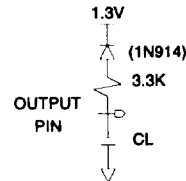
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Input Test Waveforms and Measurement Levels



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

Output Test Load



Note: $C_L = 100$ pF including jig capacitance.

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

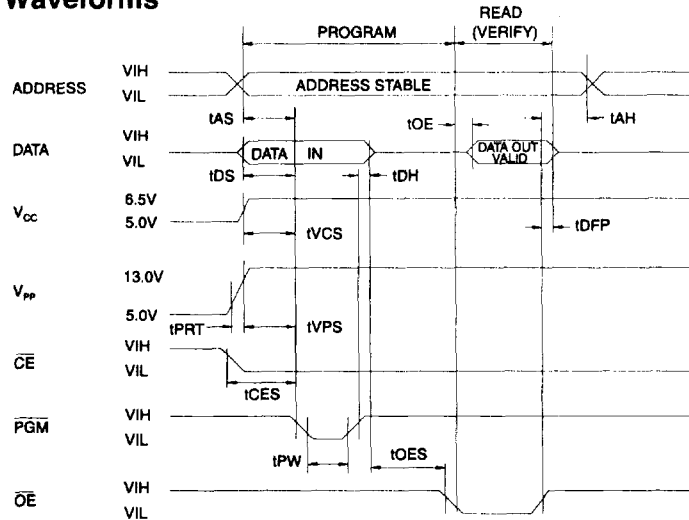
	Typ	Max	Units	Conditions
C_{IN}	4	10	pF	$V_{IN} = 0V$
C_{OUT}	8	12	pF	$V_{OUT} = 0V$

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_{IDFP} are characteristics of the device but must be accommodated by the programmer.

3. When programming the AT27C2048, a 0.1 μF capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

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} + 0.5	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
I _{CC2}	V _{CC} Supply Current (Program and Verify)			50	mA
I _{PP2}	V _{PP} Supply Current	CE = V _{IL}		30	mA
V _{ID}	A9 Product Identification Voltage		11.5	12.5	V

AC Programming Characteristics

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

Sym- bol	Parameter	Test Conditions* (1)	Limits		Units
			Min	Max	
t _{AS}	Address Setup Time		2		μs
t _{OE\barS}	$\overline{\text{OE}}$ 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}	$\overline{\text{OE}}$ 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}	P $\overline{\text{GM}}$ Program Pulse Width (3)		47.5	52.5	μs
t _{OE}	Data Valid from $\overline{\text{OE}}$			150	ns
t _{PRT}	V _{PP} Pulse Rise Time During Programming		50		ns

*AC Conditions of Test:

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

- 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 50 μsec ± 5%.

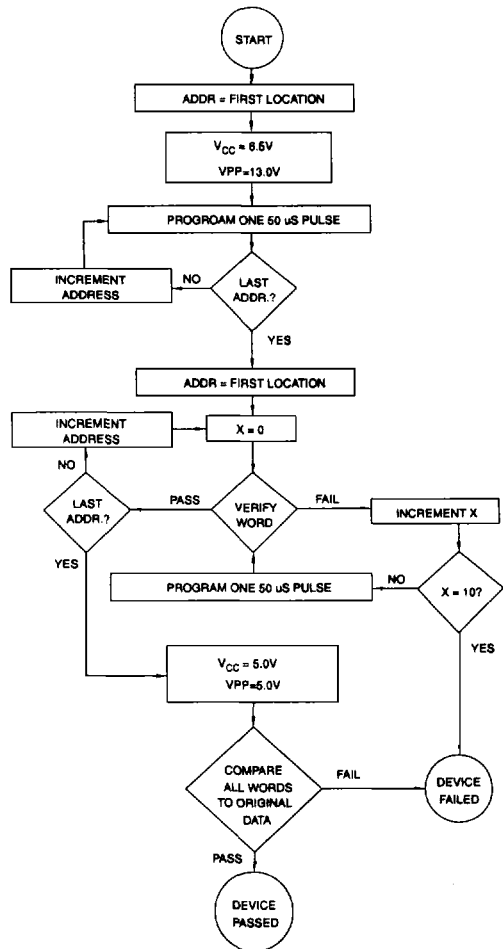
Atmel's 27C2048 Integrated Product Identification Code

Codes	Pins								Hex Data		
	A0	015-08	O7	O6	O5	O4	O3	O2		O1	O0
Manufacturer	0	0	0	0	0	1	1	1	1	0	001E
Device Type	1	0	1	1	1	1	0	1	1	1	00F7

Rapid Programming Algorithm

A 50 μs $\overline{\text{CE}}$ 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 50 μs $\overline{\text{CE}}$ pulse without verification. Then a verification/reprogramming loop is executed for each address. In the event a word fails to pass verification, up to 10 successive 50 μs pulses are applied with a verification after each pulse. If the word fails to verify after 10 pulses have been applied, the part is considered failed. After the word 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 words are read again and compared with the original data to determine if the device passes or fails.

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Ordering Information

t _{acc} (ns)	I _{cc} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
70	35	0.1	AT27C2048-70JC AT27C2048-70PC AT27C2048-70VC	44J 40P6 40V	Commercial (0°C to 70°C)
	35	0.1	AT27C2048-70JI AT27C2048-70PI AT27C2048-70VI	44J 40P6 40V	Industrial (-40°C to 85°C)
90	35	0.1	AT27C2048-90JC AT27C2048-90PC AT27C2048-90VC	44J 40P6 40V	Commercial (0°C to 70°C)
	35	0.1	AT27C2048-90JI AT27C2048-90PI AT27C2048-90VI	44J 40P6 40V	Industrial (-40°C to 85°C)
120	35	0.1	AT27C2048-12JC AT27C2048-12PC AT27C2048-12VC	44J 40P6 40V	Commercial (0°C to 70°C)
	35	0.1	AT27C2048-12JI AT27C2048-12PI AT27C2048-12VI	44J 40P6 40V	Industrial (-40°C to 85°C)
150	35	0.1	AT27C2048-15JC AT27C2048-15PC AT27C2048-15VC	44J 40P6 40V	Commercial (0°C to 70°C)
	35	0.1	AT27C2048-15JI AT27C2048-15PI AT27C2048-15VI	44J 40P6 40V	Industrial (-40°C to 85°C)

Package Type	
44J	44 Lead, Plastic J-Leaded Chip Carrier (PLCC)
40P6	40 Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)
40V	40 Lead, Plastic Thin Small Outline Package (TSOP) 10 x 14 mm