

Features

- **Fast Read Access Time - 45 ns**
- **Low Power CMOS Operation**
 100 μ A max. Standby
 30 mA max. 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 (AT27C516) EPROM**
- **5V \pm 10% Power Supply**
- **High Reliability CMOS Technology**
 2000V ESD Protection
 200 mA Latchup Immunity
- **Rapid™ Programming Algorithm - 100 μ s/word (typical)**
- **CMOS and TTL Compatible Inputs and Outputs**
- **Integrated Product Identification Code**
- **Commercial and Industrial Temperature Ranges**

**1 Megabit
(64K x 16)
OTP
CMOS EPROM**

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Description

The AT27C1024 is a low-power, high performance 1,048,576 bit one-time programmable read only memory (OTP EPROM) organized 64K by 16 bits. It requires only one 5V power supply in normal read mode operation. Any word can be accessed in less than 45 ns, eliminating the need for speed reducing WAIT states. The by-16 organization make this part ideal for high-performance 16 and 32 bit microprocessor systems.

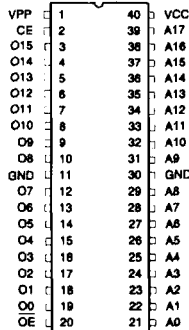
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Pin Configurations

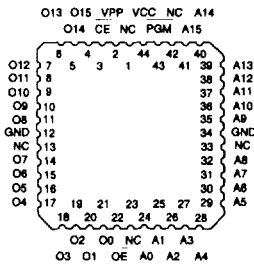
Pin Name	Function
A0 - A15	Addresses
O0 - O15	Outputs
CE	Chip Enable
OE	Output Enable
PGM	Program Strobe
NC	No Connect

Note: Both GND pins must be connected.

PDIP Top View

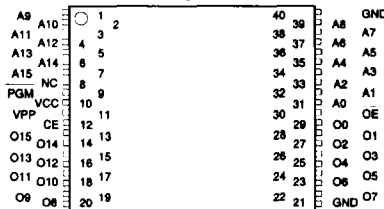


PLCC Top View



Note: PLCC Package Pins 1 and 23 are DON'T CONNECT.

TSOP Top View
Type 1



0388H





Description (Continued)

In read mode, the AT27C1024 typically consumes 15 mA. Standby mode supply current is typically less than 10 μ A.

The AT27C1024 is available in 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.

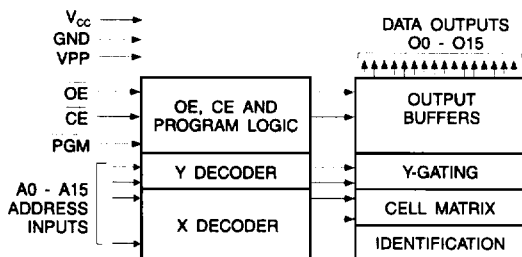
With high density 64K word storage capability, the AT27C1024 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's 27C1024 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/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.

Notes: 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}	\overline{PGM}	A _i	V _{PP}	Outputs
Read	V _{IL}	V _{IL}	X ⁽¹⁾	A _i	X	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}	A _i	V _{PP}	DIN
PGM Verify	V _{IL}	V _{IL}	V _{IH}	A _i	V _{PP}	DOUT
PGM Inhibit	V _{IH}	X	X	X	V _{PP}	High Z
Product Identification ⁽⁴⁾	V _{IL}	V _{IL}	X	A ₉ = V _{IH} ⁽³⁾ A ₀ = V _{IH} or V _{IL} A ₁ - A ₁₅ = V _{IL}	V _{CC}	Identification Code

Notes: 1. X can be V_{IL} or V_{IH}.
 2. Refer to Programming characteristics.
 3. V_{IH} = 12.0 ± 0.5V.

4. Two identifier words may be selected. All A_i inputs are held low (V_{IL}), except A₉ which is set to V_{IH} 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

		AT27C1024					
		-45	-55	-70	-85	-12	-15
Operating Temperature (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
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}		± 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), $\overline{CE} = V_{CC} \pm 0.3V$		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}.

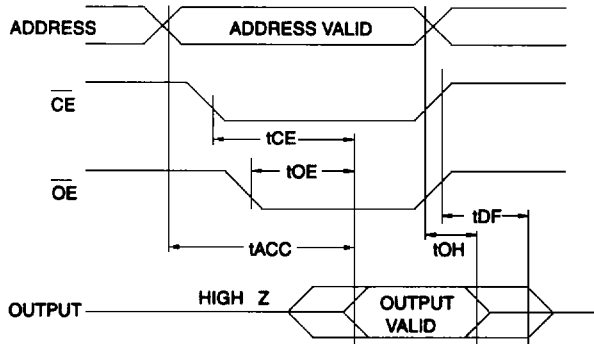
2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

AC Characteristics for Read Operation

			AT27C1024						Units					
			-45		-55		-70			-85		-12		-15
Symbol	Parameter	Condition	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		85		120		150	
t _{CE} (2)	\overline{CE} to Output Delay	$\overline{OE} = V_{IL}$	45		55		70		85		120		150	
t _{OE} (2, 3)	\overline{OE} to Output Delay	$\overline{CE} = V_{IL}$	20		25		25		30		35		50	
t _{DF} (4, 5)	\overline{OE} or \overline{CE} High to Output Float, whichever occurred first		20		25		25		30		30		40	
t _{OH}	Output Hold from Address, \overline{CE} or \overline{OE} , whichever occurred first		7		7		7		0		0		0	

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

AC Waveforms for Read Operation ⁽¹⁾



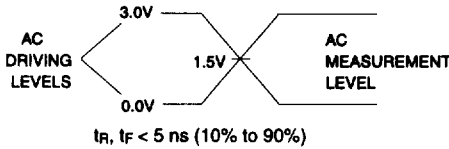
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- Notes: 1. Timing measurement reference level is 1.5V for -45 and -55 devices. Input AC drive levels are V_{IL} = 0.0V and V_{IH} = 3.0V. Timing measurement reference levels for all other speed grades are V_{OL} = 0.8V and V_{OH} = 2.0V. Input AC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

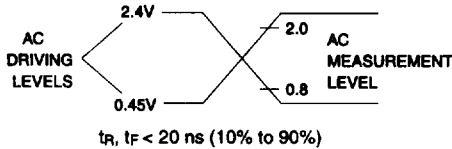
3. \overline{OE} may be delayed up to t_{ACC} - t_{OE} after the address is valid without impact on t_{ACC}.
4. This parameter is only sampled and is not 100% tested.
5. Output float is defined as the point when data is no longer driven.

Input Test Waveforms and Measurement Levels

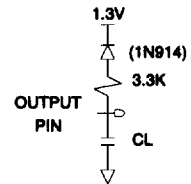
For -45, -55, and -70 Devices Only:



For -85, -10, -12, -15 Devices Only:



Output Test Load



Note: CL = 100 pF including jig capacitance except -45, -55 and -70 devices, where CL = 30 pF.

Pin Capacitance (f = 1 MHz T = 25°C) ⁽¹⁾

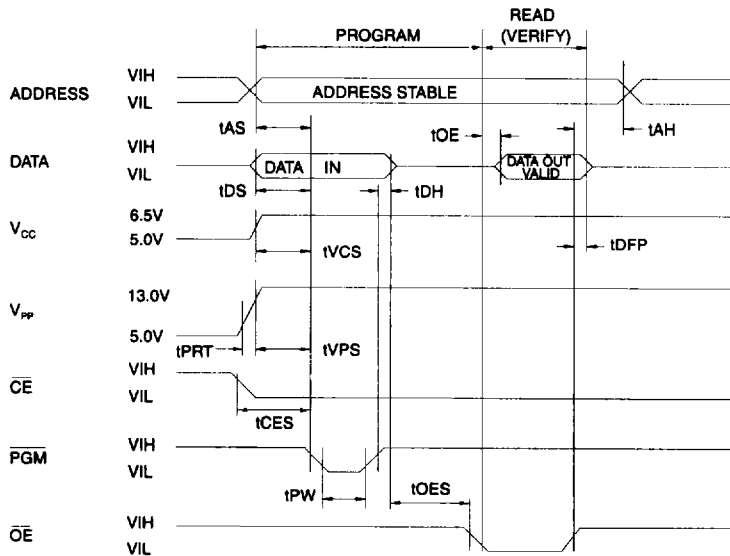
	Typ	Max	Units	Conditions
C _{IN}	4	10	pF	V _{IN} = 0V
C _{OUT}	8	12	pF	V _{OUT} = 0V

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 AT27C1024 a 0.1 μ F capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

DC Programming Characteristics

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

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	$V_{CC} + 0.1$	V
V_{OL}	Output Low Voltage	$I_{OL} = 2.1 \text{ mA}$		0.4	V
V_{OH}	Output High Voltage	$I_{OH} = -400 \mu\text{A}$	2.4		V
I_{CC2}	V_{CC} Supply Current (Program and Verify)			50	mA
I_{PP2}	V_{PP} Supply Current	$\overline{CE} = \overline{PGM} = V_{IL}$		30	mA
V_{ID}	A9 Product Identification Voltage		11.5	12.5	V

AC Programming Characteristics

TA = 25 ± 5°C, VCC = 6.5 ± 0.25V, VPP = 13.0 ± 0.25V

Sym- bol	Test Parameter	Conditions* (1)	Limits		Units
			Min	Max	
tAS	Address Setup Time		2		μs
tCES	\overline{CE} Setup Time		2		μs
tOES	\overline{OE} Setup Time		2		μs
tDS	Data Setup Time		2		μs
tAH	Address Hold Time		0		μs
tDH	Data Hold Time		2		μs
tDFP	\overline{OE} High to Out-put Float Delay (2)		0	130	ns
tvPS	VPP Setup Time		2		μs
tvCS	VCC Setup Time		2		μs
tpw	PGM Program Pulse Width (3)		95	105	μs
tOE	Data Valid from \overline{OE}			150	ns
tpRT	VPP 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 Level0.8V to 2.0V
 Output Timing Reference Level0.8V to 2.0V

- Notes: 1. VCC must be applied simultaneously or before VPP and removed simultaneously or after VPP.
 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%.

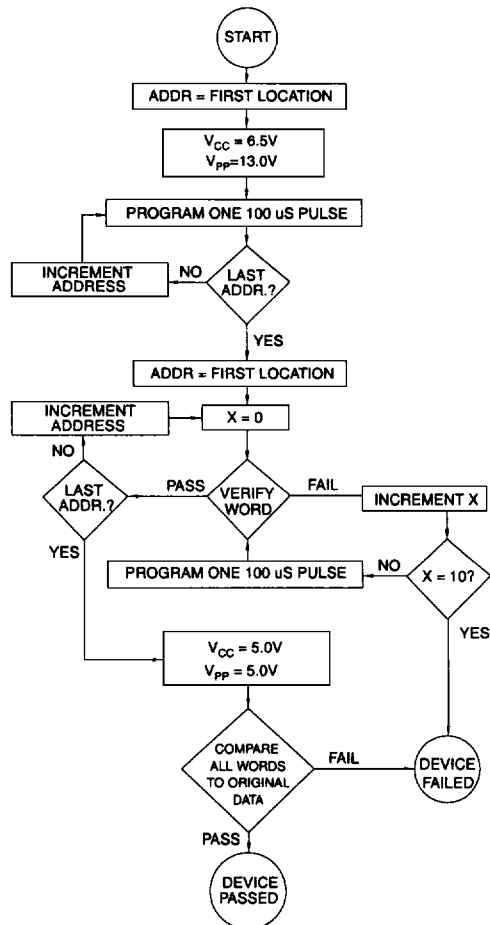
Atmel's 27C1024 Integrated Product Identification Code

Codes	Pins										Hex Data
	A0	015-08	07	06	05	04	03	02	01	00	
Manufacturer	0	0	0	0	0	1	1	1	1	0	001E
Device Type	1	0	1	1	1	1	0	0	0	1	00F1

Rapid Programming Algorithm

A 100 μs PGM pulse width is used to program. The address is set to the first location. VCC is raised to 6.5V and VPP is raised to 13.0V. Each address is first programmed with one 100 μs PGM 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 100 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. VPP is then lowered to 5.0V and VCC 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			
45	30	0.1	AT27C1024-45JC AT27C1024-45PC AT27C1024-45VC	44J 40P6 40V	Commercial (0°C to 70°C)
	30	0.1	AT27C1024-45JI AT27C1024-45PI AT27C1024-45VI	44J 40P6 40V	Industrial (-40°C to 85°C)
55	30	0.1	AT27C1024-55JC AT27C1024-55PC AT27C1024-55VC	44J 40P6 40V	Commercial (0°C to 70°C)
	30	0.1	AT27C1024-55JI AT27C1024-55VI	44J 40V	Industrial (-40°C to 85°C)
70	30	0.1	AT27C1024-70JC AT27C1024-70PC AT27C1024-70VC	44J 40P6 40V	Commercial (0°C to 70°C)
	30	0.1	AT27C1024-70JI AT27C1024-70PI AT27C1024-70VI	44J 40P6 40V	Industrial (-40°C to 85°C)
85	30	0.1	AT27C1024-85JC AT27C1024-85PC AT27C1024-85VC	44J 40P6 40V	Commercial (0°C to 70°C)
	30	0.1	AT27C1024-85JI AT27C1024-85PI AT27C1024-85VI	44J 40P6 40V	Industrial (-40°C to 85°C)
120	30	0.1	AT27C1024-12JC AT27C1024-12PC AT27C1024-12VC	44J 40P6 40V	Commercial (0°C to 70°C)
	30	0.1	AT27C1024-12JI AT27C1024-12PI AT27C1024-12VI	44J 40P6 40V	Industrial (-40°C to 85°C)
150	30	0.1	AT27C1024-15JC AT27C1024-15PC AT27C1024-15VC	44J 40P6 40V	Commercial (0°C to 70°C)
	30	0.1	AT27C1024-15JI AT27C1024-15PI AT27C1024-15VI	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