Features

- Wide Power Supply Range, 3.0 VDC to 5.5 VDC
- Compatible with JEDEC Standard AT27C040
- Low Power 3-Volt CMOS Operation
  - 100 µA max. Standby
  - 26 mW max. Active at 1 MHz for V_{CC} = 3.3 VDC
  - 138 mW max. Active at 5 MHz for V_{CC} = 5.5 VDC
- Read Access Time - 200 ns
- Wide Selection of JEDEC Standard Packages Including OTP
  - 32-Lead, 600-mil Cerdip and OTP Plastic DIP, or TSOP
  - 32-Pad LCC and OTP PLCC
- High Reliability CMOS Technology
  - 2000 V ESD Protection
  - 200 mA Latchup Immunity
- Rapid Programming - 100 µs/byte (typical)
- Two-line Control
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Commercial and Industrial Temperature Ranges

4 Megabit (512K x 8) Low Voltage UV Erasable CMOS EPROM

Preliminary

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Description

The AT27LV040 chip is a low power, low voltage 4,194,304 bit Ultraviolet Erasable and Electrically Programmable Read Only Memory (EPROM) organized as 512K x 8 bits. It requires only one supply in the range of 3.0 to 5.5 VDC in normal read mode operation, making it ideal for battery powered systems.

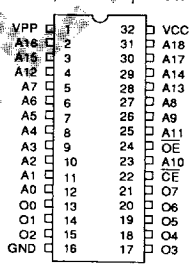
With a typical power draw of only 18 mW at 1 MHz and V_{CC} at 3.3 VDC, the AT27LV040 will draw less than one-fifth the power of a standard 5-volt EPROM. Standby mode supply current is typically less than 10 µA.

continued on next page

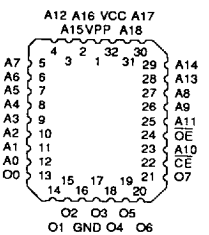
Pin Configurations

Pin Name	Function
A0-A18	Addresses
O0-O7	Outputs
$\overline{CE}$	Chip Enable
$\overline{OE}$	Output Enable

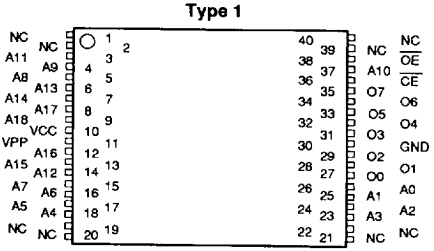
CDIP, PDIP Top View



PLCC, LCC Top View



TSOP Top View
Type 1



Description (Continued)

The AT27LV040 comes in a choice of industry standard JEDEC-approved through hole and surface mount packages including windowed and one time programmable (OTP) packages, such as the OTP thin small outline package (TSOP). All devices feature two line control ($\overline{CE}$, $\overline{OE}$) to give designers the flexibility to prevent bus contention.

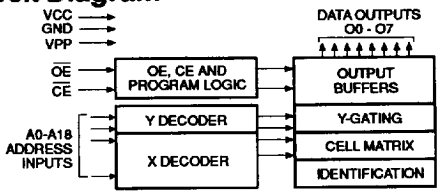
The AT27LV040 operating with V_{CC} at 3.0 VDC produces TTL level outputs that are compatible with standard TTL logic devices operating at V_{CC} = 5.0 VDC.

Atmel's 27LV040 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 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. The AT27LV040 programs identically as an AT27C040.

Erasure Characteristics

The entire memory array of the AT27LV040 is erased (all outputs read as V_{OH}) after exposure to ultraviolet light at a wavelength of 2537 Å. Complete erasure is assured after a minimum of 20 minutes exposure using 12,000 µW/cm^2 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^2. 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	-40°C to +85°C
Storage Temperature	-65°C to +125°C
Voltage on Any Pin with Respect to Ground	-2.0 V to +7.0 V(1)
Voltage on A9 with Respect to Ground	-2.0 V to +14.0 V(1)
V_{PP} Supply Voltage with Respect to Ground	-2.0 V to +14.0 V(1)
Integrated UV Erase Dose	7258 W•sec/cm^2

*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 be exceeded if certain precautions are observed (consult application notes) and which may overshoot to +7.0 V for pulses of less than 20 ns.

Operating Modes

Mode \ Pin	$\overline{CE}$	$\overline{OE}$	Ai	V_{PP}	V_{CC}	Outputs
Read	V_{IL}	V_{IL}	Ai	X(1)	V_{CC}	D_{OUT}
Output Disable	X	V_{IH}	X	X	V_{CC}	High Z
Standby	V_{IH}	X	X	X	V_{CC}	High Z
Fast Program(2)	V_{IL}	V_{IH}	Ai	V_{PP}	V_{CC}	D_{IN}
PGM Verify	X	V_{IL}	Ai	V_{PP}	V_{CC}	D_{OUT}
PGM Inhibit	V_{IH}	V_{IH}	X	V_{PP}	V_{CC}	High Z
Product Identification(4)	V_{IL}	V_{IL}	A9=V_H (3) A0=V_{IH} or V_{IL} A1-A18=V_{IL}	X	V_{CC}	Identification Code

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

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

		AT27LV040		
		-20	-25	-30
Operating Temperature (Case)	Com.	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
V_{CC} Power Supply		3.0 V to 5.5 V	3.0 V to 5.5 V	3.0 V to 5.5 V

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D.C. and Operating Characteristics for Read Operation

(V_{CC} = 3.0 V to 5.5 V unless otherwise specified)

Symbol	Parameter	Condition		Min	Max	Units
I_{LI}	Input Load Current	V_{IN} = -0.1 V to V_{CC}+1 V			5	µA
I_{LO}	Output Leakage Current	V_{OUT} = -0.1 V to V_{CC}+0.1 V			10	µA
I_{PP1} [2]	V_{PP} [1] Read/Standby Current	V_{PP} = V_{CC}-0.7 V to V_{CC}+0.3 V			10	µA
I_{SB}	V_{CC} [1] Standby Current	I_{SB1} (CMOS), $\overline{CE}$ = V_{CC}-0.3 to V_{CC}+1.0 V			100	µA
		I_{SB2} (TTL), $\overline{CE}$= 2.0 to V_{CC}+1.0 V			1	mA
I_{CC}	V_{CC} Active Current	I_{CC1} f = 5 MHz, I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, V_{CC} = 5.5 V	Com.		25	mA
			Ind.		30	mA
		I_{CC2} f = 1 MHz, I_{OUT} = 0 mA $\overline{CE}$ = V_{IL}, V_{CC} = 3.3 V	Com.		8	mA
			Ind.		10	mA
V_{IL}	Input Low Voltage			-0.6	0.8	V
V_{IH}	Input High Voltage			2.0	V_{CC}+0.75	V
V_{OL}	Output Low Voltage	I_{OL} = 2.1 mA			.45	V
V_{OH}	Output High Voltage	I_{OH} = -100 µA		V_{CC}-0.3		V
		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}.

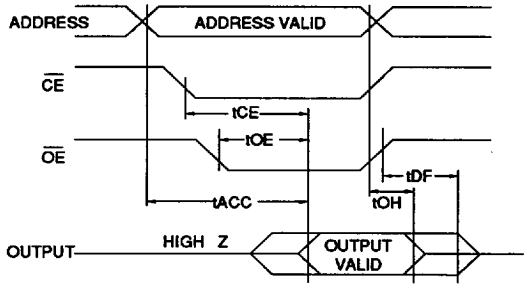
2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

A.C. Characteristics for Read Operation (V_{CC} = 3.0V to 5.5V)

			AT27LV040					
			-20		-25		-30	
Symbol	Parameter	Condition	Min	Max	Min	Max	Min	Max	Units
t_{ACC} [3]	Address to Output Delay	$\overline{CE}$ = $\overline{OE}$= V_{IL}		200		250		270	ns
t_{CE} [2]	$\overline{CE}$ to Output Delay	$\overline{OE}$ = V_{IL}		200		250		300	ns
t_{OE} [2,3]	$\overline{OE}$ to Output Delay	$\overline{CE}$ = V_{IL}		100		120		150	ns
t_{DF} [4,5]	$\overline{OE}$ High to Output Float	$\overline{CE}$ = V_{IL}		50		50		50	ns
t_{OH}	Output Hold from Address, $\overline{CE}$ or $\overline{OE}$, whichever occurred first	$\overline{CE}$ = $\overline{OE}$ = V_{IL}	0		0		0		ns

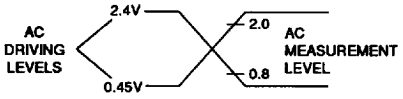
Notes: 2, 3, 4, 5. - see AC Waveforms for Read Operation.

A.C. Waveforms for Read Operation [1]



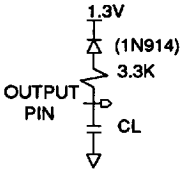
Notes:
1. Timing measurement references are 0.8 V and 2.0 V. Input AC driving levels are 0.45 V and 2.4 V. See Input Test Waveforms and Measurement Levels.
2. $\overline{OE}$ may be delayed up to t_{CE}-t_{OE} after the falling edge of $\overline{CE}$ without impact on t_{CE}.
3. $\overline{OE}$ may 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



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

Output Test Load



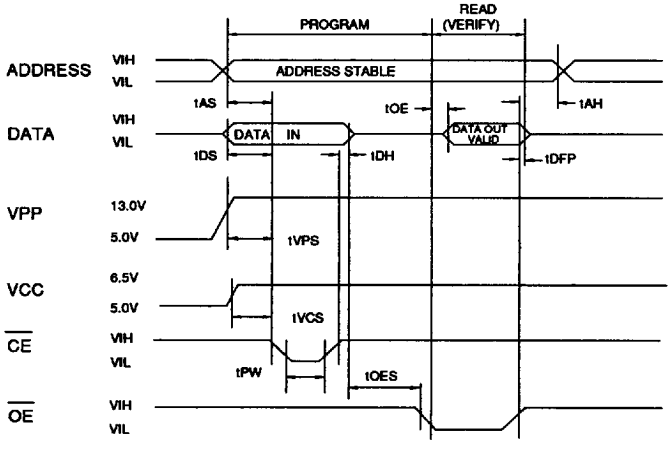
Note: C_L = 100 pF including jig capacitance.

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

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

Notes: 1. Typical values for 5-V supply voltage. This parameter is only sampled and is not 100% tested.

Programming Waveforms [1]



Notes:
1. The Input Timing Reference is 0.8 V for V_{IL} and 2.0 V 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 AT27LV040 a 0.1-µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

D.C. Programming Characteristics

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

Symbol	Parameter	Test Conditions	Limits Min	Limits Max	Units
I_{LI}	Input Load Current	$V_{IN}=V_{IL},V_{IH}$		10	µA
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.	$I_{OL}=2.1$ mA		.45	V
V_{OH}	Output High Volt.	$I_{OH}=-400$ µA	2.4		V
I_{CC2}	V_{CC} Supply Current (Program and Verify)			40	mA
I_{PP2}	V_{PP} Supply Current	$\overline{CE}=V_{IL}$		20	mA
V_{ID}	A9 Product Identification Voltage		11.5	12.5	V

A.C. Programming Characteristics

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

Symbol	Parameter	Test Conditions* (see Note 1)	Limits Min	Limits Max	Units
t_{AS}	Address Setup Time		2		µs
t_{OES}	$\overline{OE}$ 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}	$\overline{OE}$ High to Output Float Delay	(Note 2)	0	130	ns
t_{VPS}	V_{PP} Setup Time		2		µs
t_{VCS}	V_{CC} Setup Time		2		µs
t_{PW}	$\overline{CE}$ Program Pulse Width	(Note 3)	95	105	µs
t_{OE}	Data Valid from $\overline{OE}$	(Note 2)		150	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:

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 100 µsec ± 5%.

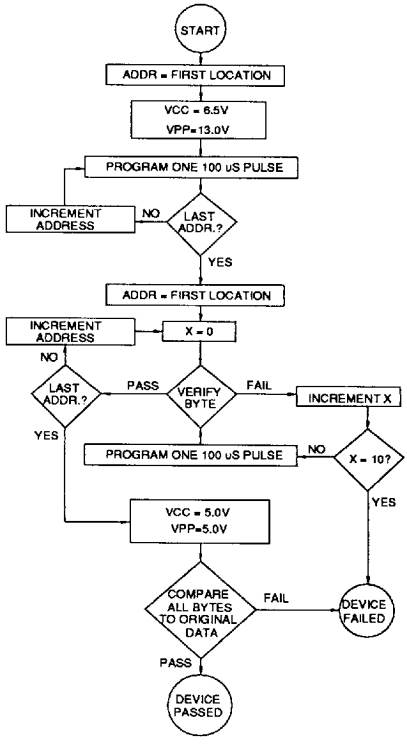
Atmel's 27LV040 Integrated Product Identification Code[1]

Codes	Pins A0	O7	O6	O5	O4	O3	O2	O1	O0	Hex Data
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device Type	1	0	0	0	0	1	0	1	1	0B

Note: 1. The AT27LV040 has the same Product Identification Code as the AT27C040. Both are programming compatible.

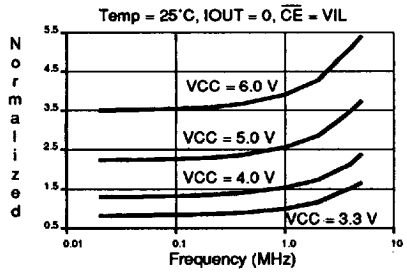
Rapid Programming Algorithm

A 100 µs $\overline{CE}$ pulse width is used to program. The address is set to the first location. V_{CC} is raised to 6.5 V and V_{PP} is raised to 13.0 V. Each address is first programmed with one 100 µs $\overline{CE}$ 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 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 5.0 V 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.

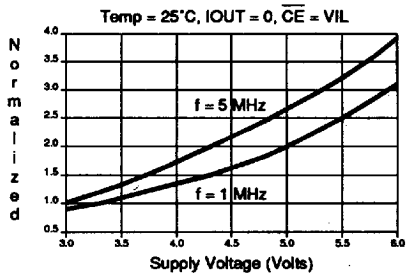


LV EPROM Product Characteristics

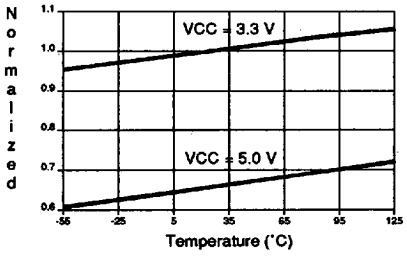
NORMALIZED SUPPLY CURRENT vs. FREQUENCY



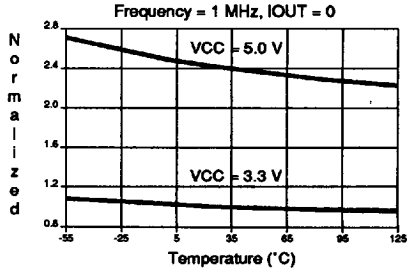
NORMALIZED SUPPLY CURRENT vs. VOLTAGE



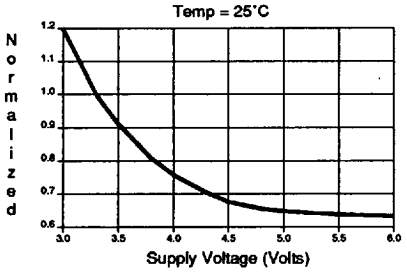
NORMALIZED ACCESS TIME vs. TEMPERATURE



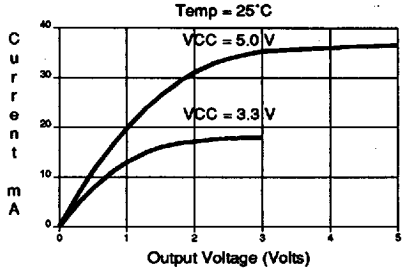
NORMALIZED SUPPLY CURRENT vs. TEMP.



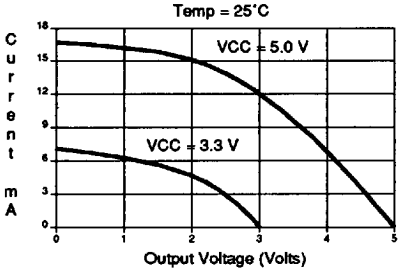
NORMALIZED ACCES TIME vs. SUPPLY VOLTAGE



OUTPUT SINK CURRENT vs. OUTPUT VOLTAGE



OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE



Ordering Information

t_{ACC} (ns)	I_{CC} (mA) V_{CC} = 3.3 V Active	Standby	Ordering Code	Package	Operation Range
200	8	0.1	AT27LV040-20DC AT27LV040-20LC	32DW6 32LW	Commercial (0°C to 70°C)
200	10	0.1	AT27LV040-20DI AT27LV040-20LI	32DW6 32LW	Industrial (-40°C to 85°C)
250	8	0.1	AT27LV040-25DC AT27LV040-25LC	32DW6 32LW	Commercial (0°C to 70°C)
250	10	0.1	AT27LV040-25DI AT27LV040-25LI	32DW6 32LW	Industrial (-40°C to 85°C)
300	8	0.1	AT27LV040-30DC AT27LV040-30JC AT27LV040-30LC AT27LV040-30PC	32DW6 32J 32LW 32P6	Commercial (0°C to 70°C)
300	10	0.1	AT27LV040-30DI AT27LV040-30LI	32DW6 32LW	Industrial (-40°C to 85°C)

t_{ACC} (ns)	I_{CC} (mA) V_{CC} = 3.3 V Active	Standby	Ordering Code	Package	Operation Range
250	8	0.1	AT27LV040-25TC	40T	Commercial (0°C to 70°C)
300	8	0.1	AT27LV040-30TC	40T	Commercial (0°C to 70°C)

Package Type	
32DW6	32 Lead, 0.600" Wide, Windowed, Ceramic Dual Inline Package (Cerdip)
32J	32 Lead, Plastic J-Leaded Chip Carrier OTP (PLCC)
32LW	32 Pad, Windowed, Ceramic Leadless Chip Carrier (LCC)
32P6	32 Lead, 0.600" Wide, Plastic Dual Inline Package OTP (PDIP)
40T	40 Lead, Plastic Thin Small Outline Package OTP (TSOP)