3

8 Megabit (1M x 8) UV Erasable CMOS EPROM

Features

- Fast Read Access Time - 100 ns
- Low Power CMOS Operation
  - 100 µA max. Standby
  - 30 mA max. Active at 5 MHz
- Wide Selection of JEDEC Standard Packages
  - 32-Lead 600-mil PDIP and Cerdip
  - 32-Lead 450-mil SOIC (SOP)
  - 32-Lead TSOP
- 5 V ± 10% Supply
- High Reliability CMOS Technology
  - 2,000 V ESD Protection
  - 200 mA Latchup Immunity
- Rapid Programming - 50 µs/byte (typical)
- Two-Line Control
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Industrial and Commercial Temperature Ranges

Description

The AT27C080 chip is a low-power, high-performance 8,388,608 bit ultraviolet erasable and electrically programmable read only memory (EPROM) organized as 1M x 8 bits. The AT27C080 requires only one 5-V power supply in normal read mode operation. Any byte can be accessed in less than 100 ns, eliminating the need for speed reducing WAIT states on high-performance microprocessor systems.

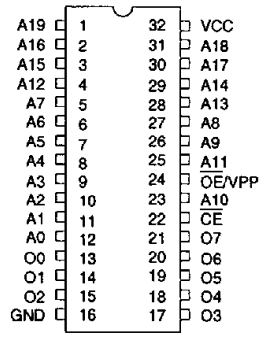
Atmel's 0.8-micron scaled CMOS technology provides for significantly lower active power consumption than competing designs. Power consumption is typically 10 mA in active mode and less than 10 µA in standby mode.

(continued)

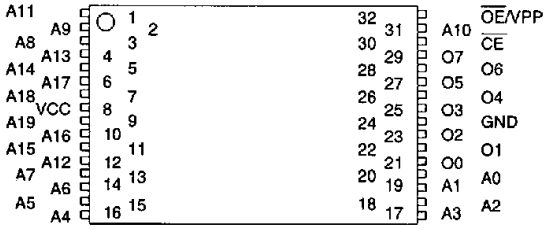
Pin Configurations

Pin Name	Function
A0-A19	Addresses
O0-O7	Outputs
$\overline{CE}$	Chip Enable
$\overline{OE}$	Output Enable

CDIP, PDIP, SOIC Top View



TSOP Top View
Type 1



Description (Continued)

The AT27C080 comes in a choice of packages, including; one time programmable (OTP) plastic PDIP, SOIC (SOP), and TSOP, as well as windowed ceramic Cerdip. All devices feature two-line control ($\overline{CE}$, $\overline{OE}$) to give designers the flexibility to prevent bus contention.

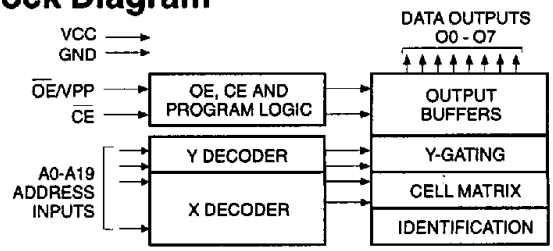
With high density 1M byte storage capability, the AT27C080 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's 27C080 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 50 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.

Erasure Characteristics

The entire memory array of the AT27C080 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 $\mu W/cm^2$ 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 $W \cdot sec/cm^2$. 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	-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(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/cm²

*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_{CC}	Outputs
Read	V_{IL}	V_{IL}	Ai	V_{CC}	D_{OUT}
Output Disable	X	V_{IH}	X(1)	V_{CC}	High Z
Standby	V_{IH}	X	X	V_{CC}	High Z
Rapid Program(2)	V_{IL}	V_{PP}	Ai	V_{CC}	D_{IN}
PGM Verify	V_{IL}	V_{IL}	Ai	V_{CC}	D_{OUT}
PGM Inhibit	V_{IH}	V_{PP}	X	V_{CC}	High Z
Product Identification(4)	V_{IL}	V_{IL}	A9=V_H (3) A0=V_{IH} or V_{IL} A1-A19=V_{IL}	V_{CC}	Identification Code

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

		AT27C080			
		-10	-12	-15	-20
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
	Mil.		-55°C - 125°C	-55°C - 125°C	-55°C - 125°C
V_{CC} Power Supply		5 V ± 10%	5 V ± 10%	5 V ± 10%	5 V ± 10%

3

D.C. and Operating Characteristics for Read Operation

Symbol	Parameter	Condition		Min	Max	Units
I_{LI}	Input Load Current	V_{IN} = 0 V to V_{CC}	Com., Ind.		±1	µA
			Mil.		±5	µA
I_{LO}	Output Leakage Current	V_{OUT} = 0 V to V_{CC}	Com., Ind.		±5	µA
			Mil.		±10	µA
I_{SB}	V_{CC} [1] Standby Current	I_{SB1} (CMOS), $\overline{CE}$ = V_{CC} ± 0.3 V			100	µA
		I_{SB2} (TTL), $\overline{CE}$ = 2.0 to V_{CC} + 0.5 V			1	mA
I_{CC}	V_{CC} Active Current	f = 5 MHz, I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}	Com.		30	mA
			Ind., Mil.		40	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			.45	V
V_{OH}	Output High Voltage	I_{OH} = -100 µA		V_{CC}-0.3		V
		I_{OH} = -2.5 mA		3.5		V
		I_{OH} = -400 µA		2.4		V

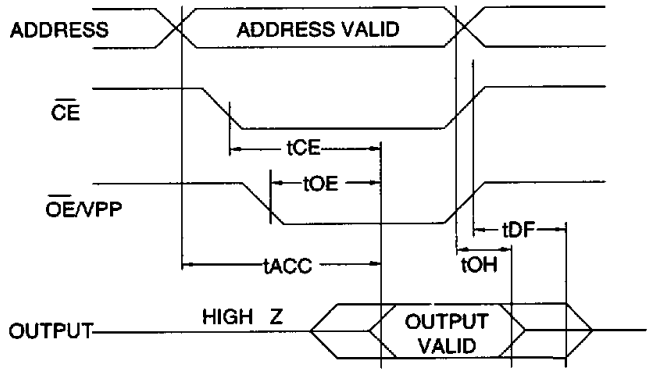
Notes: 1. V_{CC} must be applied simultaneously or before $\overline{OE}/V_{PP}$, and removed simultaneously or after $\overline{OE}/V_{PP}$.

A.C. Characteristics for Read Operation

				AT27C080								
				-10		-12		-15		-20		
Symbol	Parameter	Condition		Min	Max	Min	Max	Min	Max	Min	Max	Units
t_{ACC} [4]	Address to Output Delay	$\overline{CE}$ = $\overline{OE}/V_{PP}$ = VIL	Com., Ind.		100		120		150		200	ns
			Mil.				120		150		200	ns
t_{CE} [3]	$\overline{CE}$ to Output Delay	$\overline{OE}/V_{PP}$ = V_{IL}			100		120		150		200	ns
t_{OE} [3,4]	$\overline{OE}/V_{PP}$ to Output Delay	$\overline{CE}$ = V_{IL}			35		35		40		60	ns
t_{DF} [2,5]	$\overline{OE}/V_{PP}$ or $\overline{CE}$ High to Output Float				30		35		40		50	ns
t_{OH}	Output Hold from Address, $\overline{CE}$ or $\overline{OE}/V_{PP}$, whichever occurred first			0		0		0		0		ns

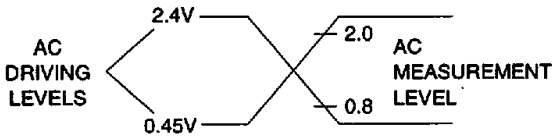
Notes: 2, 3, 4, 5. - see AC Waveforms for Read Operation.

A.C. Waveforms for Read Operation [1]



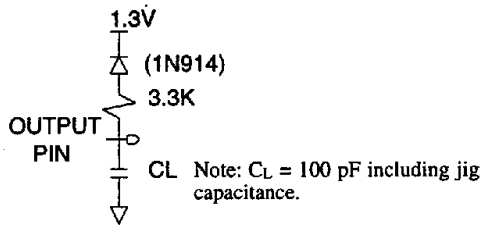
Notes:
1. Timing measurement references are 0.8 V and 2.0 V. Input AC driving levels are 0.45 V and 2.4 V, unless otherwise specified.
2. t_{DF} is specified from $\overline{OE}$ /V_{PP} or $\overline{CE}$, whichever occurs first. Output float is defined as the point when data is no longer driven.
3. $\overline{OE}$/V_{PP} may be delayed up to t_{CE}-t_{OE} after the falling edge of $\overline{CE}$ without impact on t_{CE}.
4. $\overline{OE}$ /V_{PP} may be delayed up to t_{ACC}-t_{OE} after the address is valid without impact on t_{ACC}.
5. This parameter is only sampled and is not 100% tested.

Input Test Waveforms and Measurement Levels



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

Output Test Load



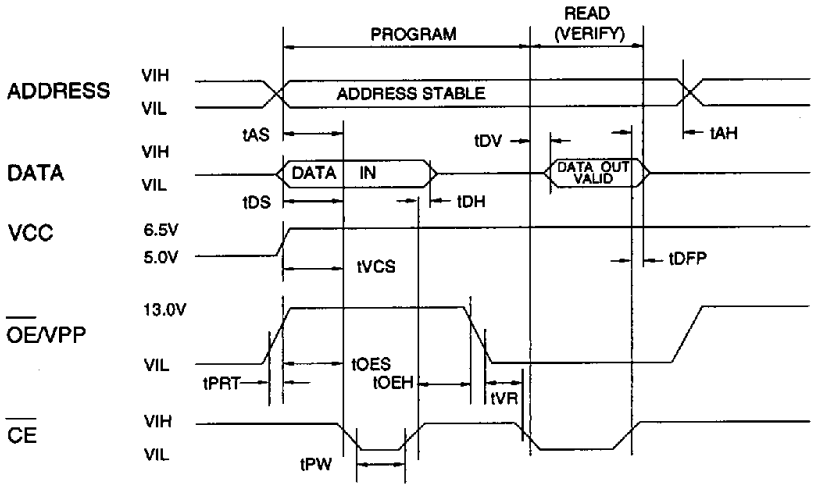
Note: C_L = 100 pF including jig capacitance.

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 nominal 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.

D.C. Programming Characteristics

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

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}	$\overline{OE}/V_{PP}$ Current	$\overline{CE}=V_{IL}$		25	mA
V_{ID}	A9 Product Identification Voltage		11.5	12.5	V

A.C. Programming Characteristics

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

Symbol	Parameter	Test Conditions* (see Note 1)	Limits Min	Limits Max	Units
t_{AS}	Address Setup Time		2		µs
t_{OES}	$\overline{OE}/V_{PP}$ Setup Time		2		µs
t_{OEH}	$\overline{OE}/V_{PP}$ Hold 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}	$\overline{CE}$ High to Output Float Delay	(Note 2)	0	130	ns
t_{VCS}	V_{CC} Setup Time		2		µs
t_{PW}	$\overline{CE}$ Program Pulse Width	(Note 3)	47	53	µs
t_{DV}	Data Valid from $\overline{CE}$	(Note 2)		1	µs
t_{VR}	$\overline{OE}/V_{PP}$ Recovery Time		2		µs
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:

1. V_{CC} must be applied simultaneously or before $\overline{OE}/V_{PP}$ and removed simultaneously or after $\overline{OE}/V_{PP}$.
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%.

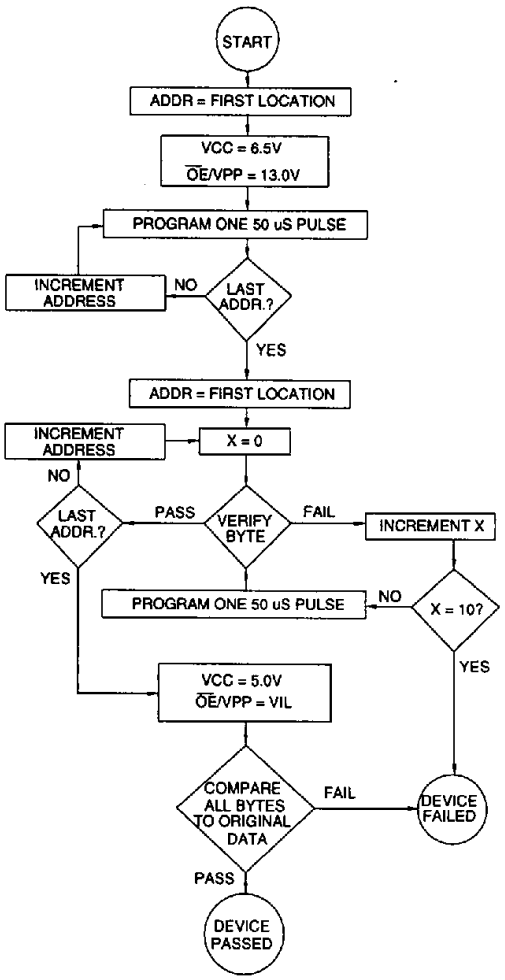
Atmel's 27C080 Integrated Product Identification Code

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	1	0	0	0	1	0	1	0	8A

3

Rapid Programming Algorithm

A 50 µs $\overline{CE}$ 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 50 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 50 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. $\overline{OE}/V_{PP}$ 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.



Ordering Information

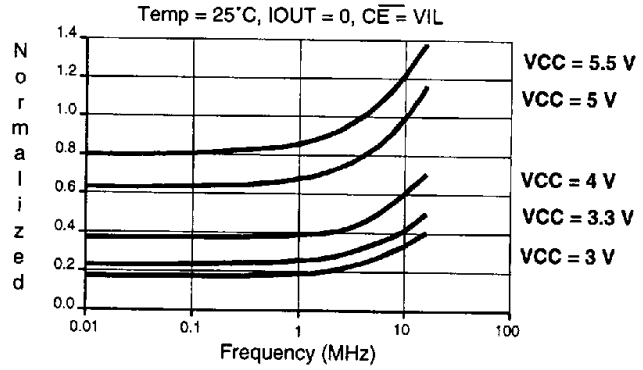
= Advance Information

t_{ACC} (ns)	I_{CC} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
100	30	0.1	AT27C080-10DC AT27C080-10PC AT27C080-10TC AT27C080-10RC	32DW6 32P6 32T 32R	Commercial (0°C to 70°C)
120	30	0.1	AT27C080-12DC AT27C080-12PC AT27C080-12TC AT27C080-12RC	32DW6 32P6 32T 32R	Commercial (0°C to 70°C)
120	40	0.1	AT27C080-12DI AT27C080-12PI AT27C080-12TI AT27C080-12RI	32DW6 32P6 32T 32R	Industrial (-40°C to 85°C)
			AT27C080-12DM	32DW6	Military (-55°C to 125°C)
150	30	0.1	AT27C080-15DC AT27C080-15PC AT27C080-15TC AT27C080-15RC	32DW6 32P6 32T 32R	Commercial (0°C to 70°C)
150	40	0.1	AT27C080-15DI AT27C080-15PI AT27C080-15TI AT27C080-15RI	32DW6 32P6 32T 32R	Industrial (-40°C to 85°C)
			AT27C080-15DM	32DW6	Military (-55°C to 125°C)
200	30	0.1	AT27C080-20DC AT27C080-20PC AT27C080-20TC AT27C080-20RC	32DW6 32P6 32T 32R	Commercial (0°C to 70°C)
200	40	0.1	AT27C080-20DI AT27C080-20PI AT27C080-20TI AT27C080-20RI	32DW6 32P6 32T 32R	Industrial (-40°C to 85°C)
			AT27C080-20DM	32DW6	Military (-55°C to 125°C)

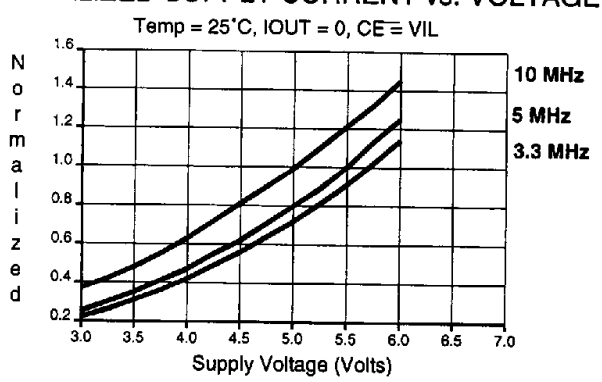
Package Type	
32DW6	32 Lead, 0.600" Wide, Windowed, Ceramic Dual Inline Package (Cerdip)
32P6	32 Lead, 0.600" Wide, Plastic Dual Inline Package OTP (PDIP)
32R	32 Lead, 0.450" Wide, Plastic Gull Wing Small Outline OTP (SOIC)
32T	32 Lead, Plastic Thin Small Outline Package OTP (TSOP)

EPROM Product Characteristics for AT27Cxxx Series Parts

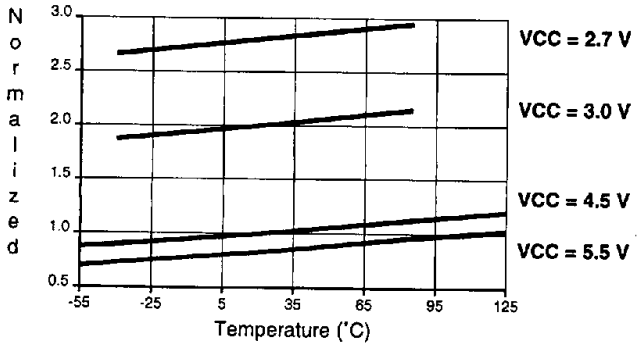
NORMALIZED SUPPLY CURRENT vs. FREQUENCY



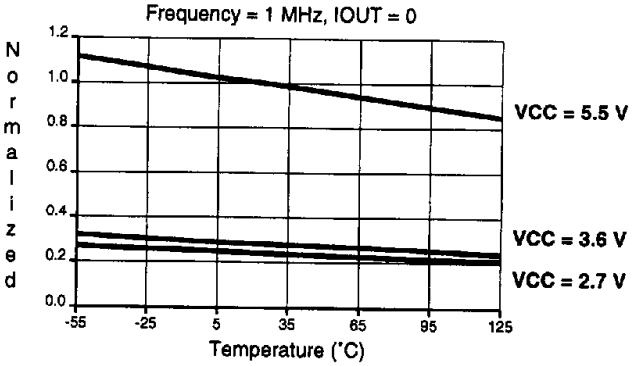
NORMALIZED SUPPLY CURRENT vs. VOLTAGE



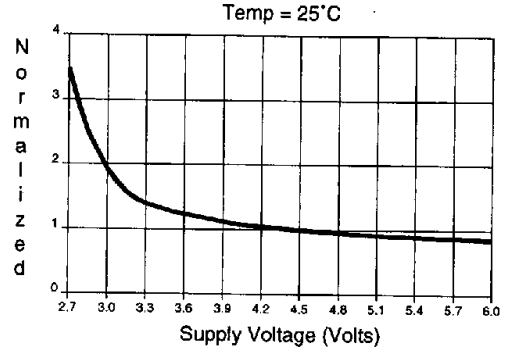
NORMALIZED ACCESS TIME vs. TEMPERATURE



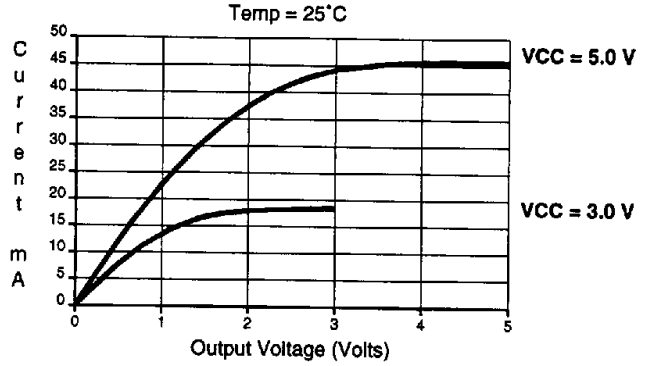
NORMALIZED SUPPLY CURRENT vs. TEMP.



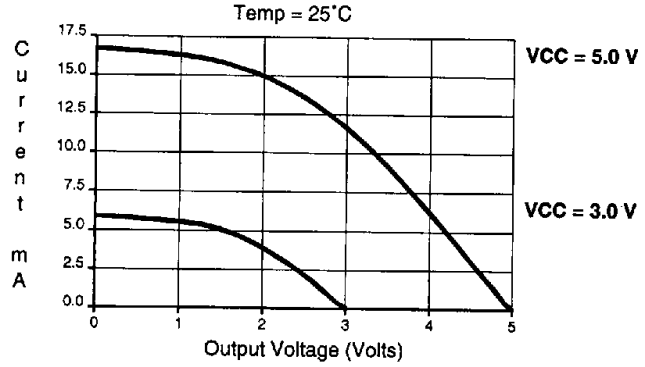
NORMALIZED ACCES TIME vs. SUPPLY VOLTAGE



OUTPUT SINK CURRENT vs. OUTPUT VOLTAGE



OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE



DELTA ACCESS TIME vs. LOAD CAPACITANCE