Am27C010

1 Megabit (131,072 x 8-Bit) CMOS EPROM

**Advanced
Micro
Devices**

DISTINCTIVE CHARACTERISTICS

- **Fast access time**
  - — 90 ns
- **Low power consumption**
  - — 20 µA typical CMOS standby current
- **JEDEC-approved pinout**
- **Single +5 V power supply**
- **±10% power supply tolerance available**
- **100% Flashrite™ programming**
  - — Typical programming time of 16 seconds

- **Latch-up protected to 100 mA from –1 V to Vcc + 1 V**
- **High noise immunity**
- **Versatile features for simple interfacing**
  - — Both CMOS and TTL input/output compatibility
  - — Two line control functions
- **Compact 32-pin DIP, PDIP, TSOP, LCC and PLCC packages**
- **DESC SMD No. 5962-89614**

GENERAL DESCRIPTION

The Am27C010 is a 1 Megabit ultraviolet erasable programmable read-only memory. It is organized as 128K words by 8 bits per word, operates from a single +5 V supply, has a static standby mode, and features fast single address location programming. Products are available in windowed ceramic DIP and LCC packages as well as plastic one time programmable (OTP) PDIP, TSOP, and PLCC packages.

Typically, any byte can be accessed in less than 90 ns, allowing operation with high-performance microprocessors without any WAIT states. The Am27C010 offers separate Output Enable ($\overline{OE}$) and Chip Enable ($\overline{CE}$)

controls, thus eliminating bus contention in a multiple bus microprocessor system.

AMD's CMOS process technology provides high speed, low power, and high noise immunity. Typical power consumption is only 100 mW in active mode, and 100 µW in standby mode.

All signals are TTL levels, including programming signals. Bit locations may be programmed singly, in blocks, or at random. The Am27C010 supports AMD's Flashrite™ programming algorithm (100 µs pulses) resulting in a typical programming time of 16 seconds.
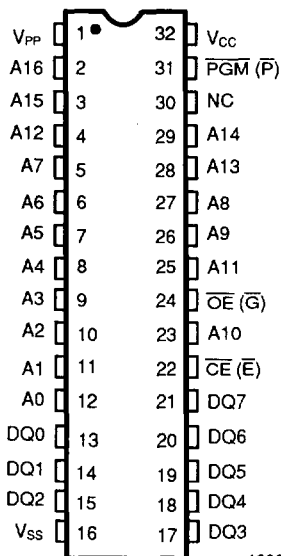
BLOCK DIAGRAM

10205D-1
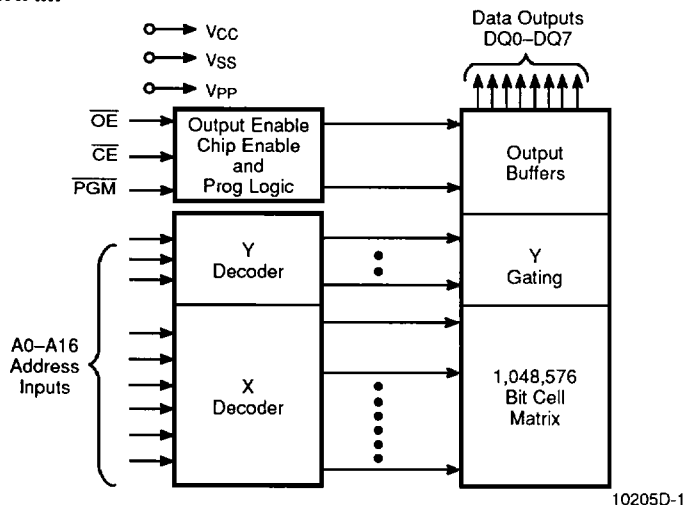
PRODUCT SELECTOR GUIDE

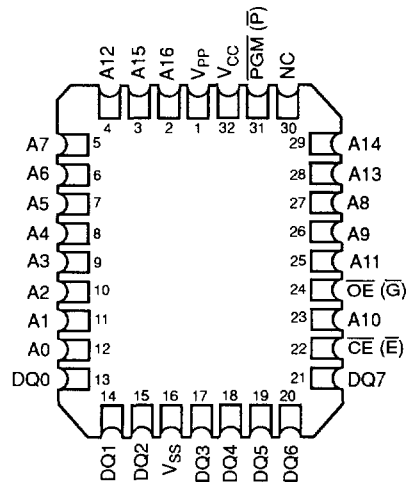| Family Part No.	Am27C010					
Ordering Part No: Vcc ± 5%	-95	-105				-255
Vcc ± 10%	-90		-120	-150	-200	
Max Access Time (ns)	90	100	120	150	200	250
$\overline{CE}$ ($\overline{E}$) Access Time (ns)	90	100	120	150	200	250
$\overline{OE}$ ($\overline{G}$) Access Time (ns)	40	50	50	65	75	100

CONNECTION DIAGRAMS
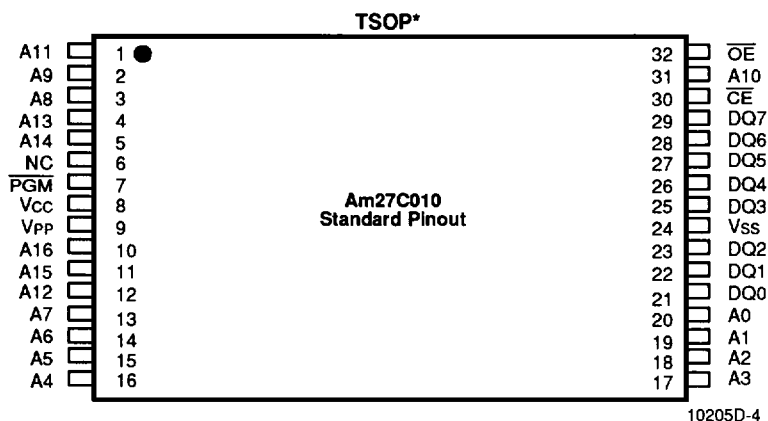## Top View

DIP

10205D-2

PLCC/LCC

10205D-3

Notes:

1. JEDEC nomenclature is in parentheses.

2. The 32-pin DIP to 32-Pin LCC configuration varies from the JEDEC 28-pin DIP to 32-pin LCC configuration.

TSOP*

A11	1 ●	32	OE
A9	2	31	A10
A8	3	30	CE
A13	4	29	DQ7
A14	5	28	DQ6
NC	6	27	DQ5
PGM	7	26	DQ4
Vcc	8	25	DQ3
VPP	9	24	Vss
A16	10	23	DQ2
A15	11	22	DQ1
A12	12	21	DQ0
A7	13	20	A0
A6	14	19	A1
A5	15	18	A2
A4	16	17	A3

Am27C010
Standard Pinout

10205D-4

Contact local AMD sales office for package availability

PIN DESIGNATIONS

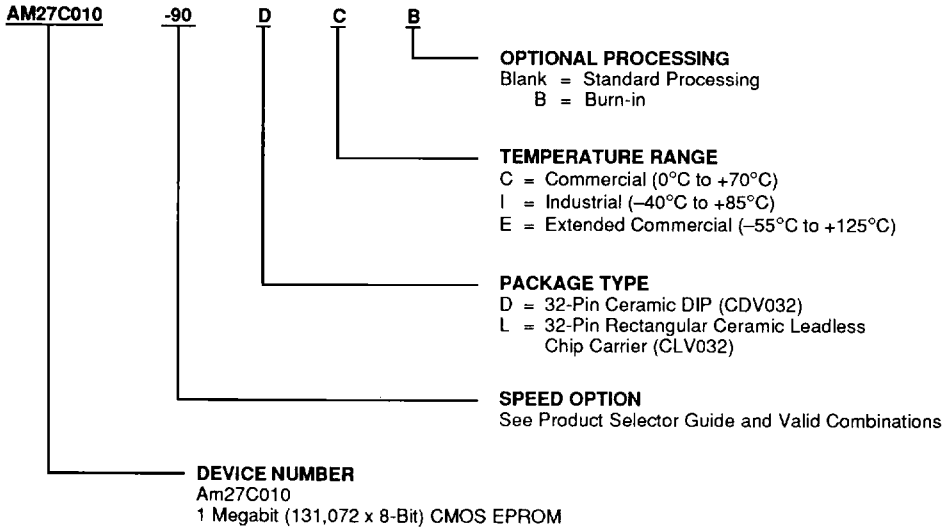|		
A0–A16	=	Address Inputs
$\overline{CE}$ ($\overline{E}$)	=	Chip Enable
DQ0–DQ7	=	Data Inputs/Outputs
$\overline{OE}$ ($\overline{G}$)	=	Output Enable Input
$\overline{PGM}$ ($\overline{P}$)	=	Program Enable Input
Vcc	=	Vcc Supply Voltage
VPP	=	Program Supply Voltage
Vss	=	Ground

LOGIC SYMBOL

10205D-5
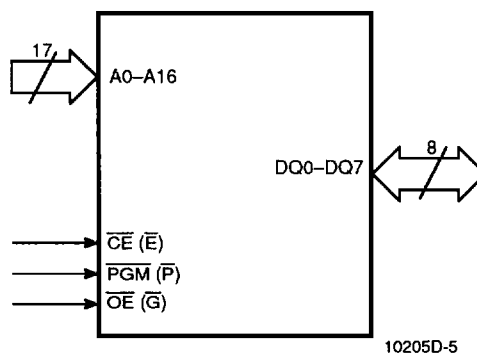
ORDERING INFORMATION

EPROM Products

AMD Standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of:

```
AM27C010    -90    D    C    B
```

OPTIONAL PROCESSING
Blank = Standard Processing
B = Burn-in

TEMPERATURE RANGE
C = Commercial (0°C to +70°C)
I = Industrial (–40°C to +85°C)
E = Extended Commercial (–55°C to +125°C)

PACKAGE TYPE
D = 32-Pin Ceramic DIP (CDV032)
L = 32-Pin Rectangular Ceramic Leadless
Chip Carrier (CLV032)

SPEED OPTION
See Product Selector Guide and Valid Combinations

DEVICE NUMBER
Am27C010
1 Megabit (131,072 x 8-Bit) CMOS EPROM

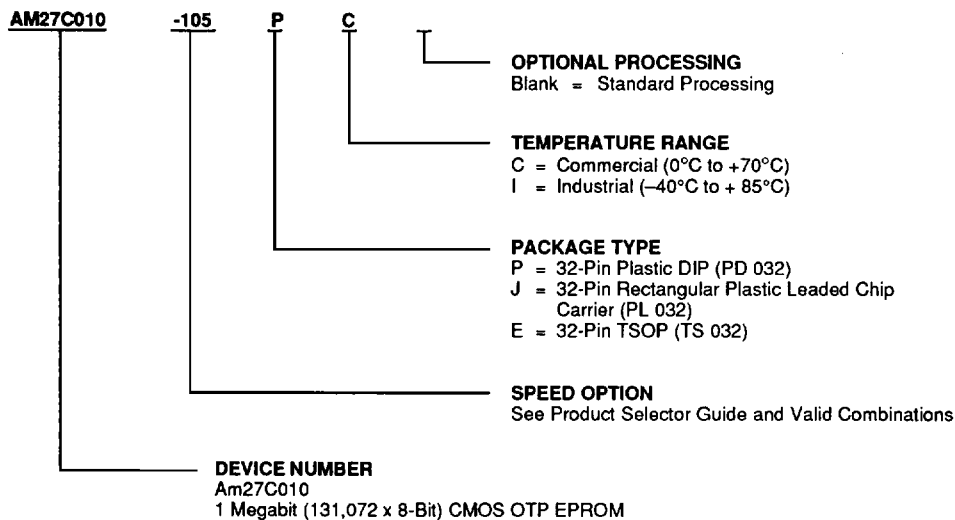| Valid Combinations	
AM27C010-90	DC, DCB, DI, DIB, LC, LCB, LI, LIB
AM27C010-95	
AM27C010-105	
AM27C010-120	DC, DCB, DE, DEB, DI, DIB, LC, LCB, LI, LIB, LE, LEB
AM27C010-150	
AM27C010-200	
AM27C010-255	

Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

ORDERING INFORMATION

OTP Products

AMD Standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of:

AM27C010   -105   P   C

OPTIONAL PROCESSING
Blank = Standard Processing

TEMPERATURE RANGE
C = Commercial (0°C to +70°C)
I = Industrial (–40°C to + 85°C)

PACKAGE TYPE
P = 32-Pin Plastic DIP (PD 032)
J = 32-Pin Rectangular Plastic Leaded Chip
    Carrier (PL 032)
E = 32-Pin TSOP (TS 032)

SPEED OPTION
See Product Selector Guide and Valid Combinations

DEVICE NUMBER
Am27C010
1 Megabit (131,072 x 8-Bit) CMOS OTP EPROM

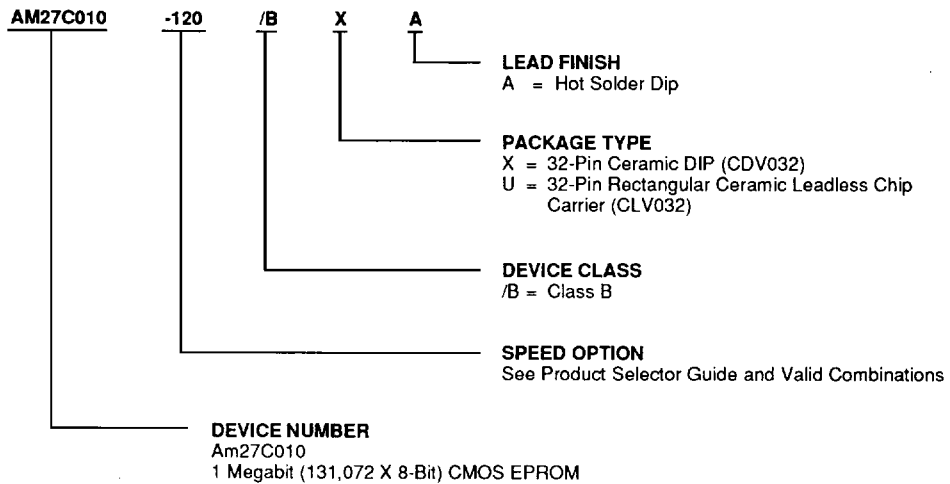| Valid Combinations	
AM27C010-105	
AM27C010-120	PC, JC, EC,
AM27C010-150	PI, JI, EI
AM27C010-200	
AM27C010-255	

Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

ORDERING INFORMATION

Military APL Products

AMD products for Aerospace and Defense applications are available in several packages and operating ranges. APL (Approved Products List) products are fully compliant with MIL-STD-883 requirements. The order number (Valid Combination) is formed by a combination of:

```
AM27C010    -120    /B    X    A
```

LEAD FINISH
A = Hot Solder Dip

PACKAGE TYPE
X = 32-Pin Ceramic DIP (CDV032)
U = 32-Pin Rectangular Ceramic Leadless Chip
    Carrier (CLV032)

DEVICE CLASS
/B = Class B

SPEED OPTION
See Product Selector Guide and Valid Combinations

DEVICE NUMBER
Am27C010
1 Megabit (131,072 X 8-Bit) CMOS EPROM

Valid Combinations	
AM27C010-120	
AM27C010-150	/BXA, /BUA
AM27C010-200	
AM27C010-250	

Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

Group A Tests
Group A tests consist of Subgroups
1, 2, 3, 7, 8, 9, 10, 11.

FUNCTIONAL DESCRIPTION

Erasing the Am27C010

In order to clear all locations of their programmed contents, it is necessary to expose the Am27C010 to an ultraviolet light source. A dosage of 15 W seconds/cm² is required to completely erase an Am27C010. This dosage can be obtained by exposure to an ultraviolet lamp—wavelength of 2537 Å—with intensity of 12,000 μW/cm² for 15 to 20 minutes. The Am27C010 should be directly under and about one inch from the source and all filters should be removed from the UV light source prior to erasure.

It is important to note that the Am27C010 and similar devices will erase with light sources having wavelengths shorter than 4000 Å. Although erasure times will be much longer than with UV sources at 2537 Å, exposure to fluorescent light and sunlight will eventually erase the Am27C010 and exposure to them should be prevented to realize maximum system reliability. If used in such an environment, the package window should be covered by an opaque label or substance.

Programming the Am27C010

Upon delivery or after each erasure the Am27C010 has all 1,048,576 bits in the "ONE" or HIGH state. "ZEROs" are loaded into the Am27C010 through the procedure of programming.

The programming mode is entered when 12.75 V ± 0.25 V is applied to the V_{PP} pin, $\overline{CE}$ and $\overline{PGM}$ are at V_{IL}, and $\overline{OE}$ is at V_{IH}.

For programming, the data to be programmed is applied 8 bits in parallel to the data output pins.

The Flashrite algorithm reduces programming time by using 100 μs programming pulses and by giving each address only as many pulses as is necessary in order to reliably program the data. After each pulse is applied to a given address, the data in that address is verified. If the data does not verify, additional pulses are given until it verifies or the maximum is reached. This process is repeated while sequencing through each address of the Am27C010. This part of the algorithm is done at V_{CC} = 6.25 V to assure that each EPROM bit is programmed to a sufficiently high threshold voltage. After the final address is completed, the entire EPROM memory is verified at V_{CC} = V_{PP} = 5.25 V.

Please refer to Section 6 for programming flow chart and characteristics.

Program Inhibit

Programming of multiple Am27C010 in parallel with different data is also easily accomplished. Except for $\overline{CE}$, all like inputs of the parallel Am27C010 may be common. A TTL low-level program pulse applied to an Am27C010 $\overline{CE}$ input and V_{PP} = 12.75 V ± 0.25 V, $\overline{PGM}$ Low and $\overline{OE}$ High will program that Am27C010. A high-level $\overline{CE}$ input inhibits the other Am27C010 devices from being programmed.

Program Verify

A verify should be performed on the programmed bits to determine that they were correctly programmed. The verify should be performed with $\overline{OE}$ and $\overline{CE}$ at V_{IL}, $\overline{PGM}$ at V_{IH}, and V_{PP} between 12.5 V and 13.0 V.

Auto Select Mode

The auto select mode allows the reading out of a binary code from an EPROM that will identify its manufacturer and type. This mode is intended for use by programming equipment for the purpose of automatically matching the device to be programmed with its corresponding programming algorithm. This mode is functional in the 25°C ± 5°C ambient temperature range that is required when programming the Am27C010.

To activate this mode, the programming equipment must force 12.0 V ± 0.5 V on address line A9 of the Am27C010. Two identifier bytes may then be sequenced from the device outputs by toggling address line A0 from V_{IL} to V_{IH}. All other address lines must be held at V_{IL} during auto select mode.

Byte 0 (A0 = V_{IL}) represents the manufacturer code, and byte 1 (A0 = V_{IH}), the device code. For the Am27C010, these two identifier bytes are given in the Mode Select Table. All identifiers for manufacturer and device codes will possess odd parity, with the MSB (DQ7) defined as the parity bit.

Read Mode

The Am27C010 has two control functions, both of which must be logically satisfied in order to obtain data at the outputs. Chip Enable ($\overline{CE}$) is the power control and should be used for device selection. Output Enable ($\overline{OE}$) is the output control and should be used to gate data to the output pins, independent of device selection. Assuming that addresses are stable, address access time (t_{ACC}) is equal to the delay from $\overline{CE}$ to output (t_{CE}). Data is available at the outputs t_{OE} after the falling edge of $\overline{OE}$, assuming that $\overline{CE}$ has been LOW and addresses have been stable for at least $t_{ACC} - t_{OE}$.

Standby Mode

The Am27C010 has a CMOS standby mode which reduces the maximum V_{CC} current to 100 μA. It is placed in CMOS-standby when $\overline{CE}$ is at V_{CC} ± 0.3 V. The Am27C010 also has a TTL-standby mode which reduces the maximum V_{CC} current to 1.0 mA. It is placed in TTL-standby when $\overline{CE}$ is at V_{IH}. When in standby mode, the outputs are in a high-impedance state, independent of the $\overline{OE}$ input.

Output OR-Tieing

To accommodate multiple memory connections, a two-line control function is provided to allow for:

■ Low memory power dissipation

■ Assurance that output bus contention will not occur

It is recommended that $\overline{CE}$ be decoded and used as the primary device-selecting function, while $\overline{OE}$ be made a common connection to all devices in the array and connected to the READ line from the system control bus. This assures that all deselected memory devices are in low-power standby mode and that the output pins are only active when data is desired from a particular memory device.

System Applications

During the switch between active and standby conditions, transient current peaks are produced on the rising and falling edges of Chip Enable. The magnitude of these transient current peaks is dependent on the output capacitance loading of the device. At a minimum, a 0.1-µF ceramic capacitor (high frequency, low inherent inductance) should be used on each device between V_{CC} and V_{SS} to minimize transient effects. In addition, to overcome the voltage drop caused by the inductive effects of the printed circuit board traces on EPROM arrays, a 4.7-µF bulk electrolytic capacitor should be used between V_{CC} and V_{SS} for each eight devices. The location of the capacitor should be close to where the power supply is connected to the array.

MODE SELECT TABLE

Mode \ Pins		$\overline{CE}$	$\overline{OE}$	$\overline{PGM}$	A0	A9	V_{PP}	Outputs
Read		V_{IL}	V_{IL}	X	X	X	V_{CC}	D_{OUT}
Output Disable		X	V_{IH}	X	X	X	V_{CC}	Hi-Z
Standby (TTL)		V_{IH}	X	X	X	X	V_{CC}	Hi-Z
Standby (CMOS)		$V_{CC} \pm 0.3$ V	X	X	X	X	V_{CC}	Hi-Z
Program		V_{IL}	V_{IH}	V_{IL}	X	X	V_{PP}	D_{IN}
Program Verify		V_{IL}	V_{IL}	V_{IH}	X	X	V_{PP}	D_{OUT}
Program Inhibit		V_{IH}	X	X	X	X	V_{PP}	Hi-Z
Auto Select (Note 3)	Manufacturer Code	V_{IL}	V_{IL}	X	V_{IL}	V_H	V_{CC}	01H
	Device Code	V_{IL}	V_{IL}	X	V_{IH}	V_H	V_{CC}	0E

Notes:

1. $V_H = 12.0$ V $\pm$ 0.5 V

2. X = Either V_{IH} or V_{IL}

3. A1–A8 = A10–A16 = V_{IL}

4. See DC Programming Characteristics for V_{PP} voltage during programming.

ABSOLUTE MAXIMUM RATINGS

Storage Temperature
    OTP Products . . . . −65°C to +125°C
    All Other Products . . . . −65°C to +150°C

Ambient Temperature
with Power Applied . . . . −55°C to +125°C

Voltage with Respect To V_{SS}
    All pins except A9, V_{PP}, V_{CC} . −0.6 V to V_{CC} + 0.5 V
    A9 and V_{PP} . . . . −0.6 V to +13.5 V
    V_{CC} . . . . −0.6 V to +7.0 V

Notes:
1. Minimum DC voltage on input or I/O pins is −0.5 V. During transitions, the inputs may overshoot V_{SS} to −2.0 V for periods of up to 20 ns. Maximum DC voltage on input and I/O pins is V_{CC} + 0.5 V which may overshoot to V_{CC} + 2.0 V for periods up to 20 ns.

2. For A9 and V_{PP} the minimum DC input is −0.5 V. During transitions, A9 and V_{PP} may overshoot V_{SS} to −2.0 V for periods of up to 20 ns. A9 and V_{PP} must not exceed 13.5 V for any period of time .

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure of the device to absolute maximum rating conditions for extended periods may affect device reliability.

OPERATING RANGES

Commercial (C) Devices
    Case Temperature (T_C) . . . . 0°C to +70°C

Industrial (I) Devices
    Case Temperature (T_C) . . . . −40°C to +85°C

Extended Commercial (E) Devices
    Case Temperature (T_C) . . . . . . −55°C to +125°C

Military (M) Devices
    Case Temperature (T_C) . . . . . . −55°C to +125°C

Supply Read Voltages
    V_{CC} for Am27C010-XX5 . . . . . +4.75 V to +5.25 V
    V_{CC} for Am27C010-XX0 . . . . . +4.50 V to +5.50 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

DC CHARACTERISTICS over operating range unless otherwise specified.
(Notes 1, 2 and 4) (for APL Products, Group A, Subgroups 1, 2, 3, 7 and 8 are tested
unless otherwise noted)

Parameter Symbol	Parameter Description	Test Conditions		Min	Max	Unit
V_{OH}	Output HIGH Voltage	$I_{OH} = -400 \mu A$		2.4		V
V_{OL}	Output LOW Voltage	$I_{OL} = 2.1$ mA			0.45	V
V_{IH}	Input HIGH Voltage			2.0	$V_{CC} + 0.5$	V
V_{IL}	Input LOW Voltage			−0.5	+0.8	V
I_{LI}	Input Load Current	$V_{IN} = 0$ V to V_{CC}			1.0	μA
I_{LO}	Output Leakage Current	$V_{OUT} = 0$ V to V_{CC}			10	μA
I_{CC1}	Vcc Active Current (Note 3)	$\overline{CE} = V_{IL}, f = 5$ MHz, $I_{OUT} = 0$ mA	C/I Devices		30	mA
			E/M Devices		60	
I_{CC2}	Vcc TTL Standby Current	$\overline{CE} = V_{IH}$			1.0	mA
I_{CC3}	Vcc CMOS Standby Current	$\overline{CE} = V_{CC} \pm 0.3$ V			100	μA
I_{PP1}	Vpp Current During Read	$\overline{CE} = \overline{OE} = V_{IL}, V_{PP} = V_{CC}$			100	μA

Notes:

1. V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.

2. **Caution:** The Am27C010 must not be removed from (or inserted into) a socket when V_{CC} or V_{PP} is applied.

3. I_{CC1} is tested with $\overline{OE}/V_{PP} = V_{IH}$ to simulate open outputs.

4. Minimum DC Input Voltage is −0.5 V. During transitions, the inputs may overshoot to −2.0 V for periods less than 20 ns. Maximum DC Voltage on output pins is $V_{CC} + 0.5$ V, which may overshoot to $V_{CC} + 2.0$ V for periods less than 20 ns.
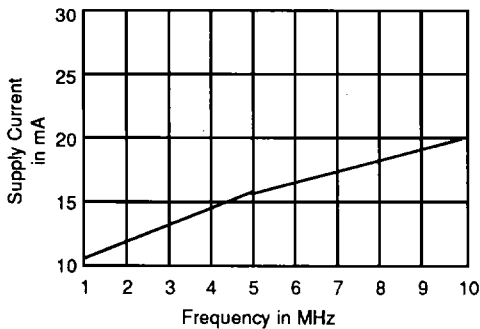

**Figure 1. Typical Supply Current
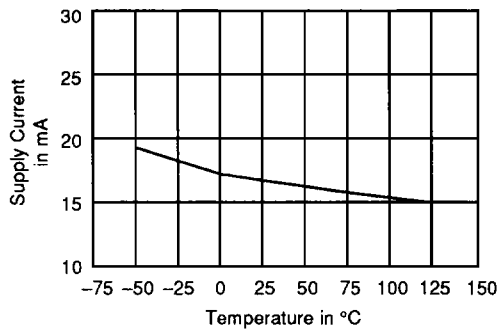vs. Frequency
Vcc = 5.5 V, T = 25°C**

10205D-6

**Figure 2. Typical Supply Current
vs. Temperature
Vcc = 5.5 V, f = 5 MHz**

10205D-7

CAPACITANCE

Parameter Symbol	Parameter Description	Test Conditions	CLV032		CDV032		PL 032		PD 032		TS 032		Unit
			Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	
C_{IN}	Input Capacitance	$V_{IN} = 0$	9	12	9	12	8	12	8	12	10	12	pF
C_{OUT}	Output Capacitance	$V_{OUT} = 0$	11	14	13	15	11	14	11	14	12	14	pF

Notes:

1. *This parameter is only sampled and not 100% tested.*
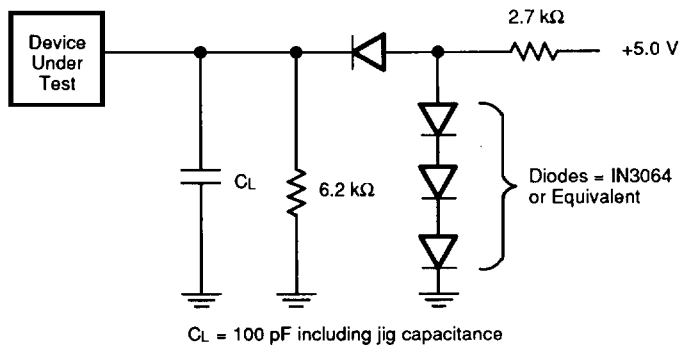
2. $T_A = +25°C$, $f = 1$ MHz

SWITCHING CHARACTERISTICS over operating range unless otherwise specified (Notes 1, 3 and 4) (for APL Products, Group A, Subgroups 9,10 and 11 are tested unless otherwise noted)

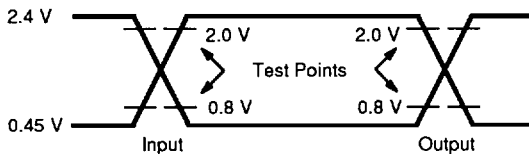| Parameter Symbols		Parameter Description	Test Conditions		Am27C010						Unit
JEDEC	Standard				-95 -90	-105	-120	-150	-200	-255 -250	
t_{AVQV}	t_{ACC}	Address to Output Delay	$\overline{CE} = \overline{OE} = V_{IL}$	Min	–	–	–	–	–	–	
				Max	90	100	120	150	200	250	ns
t_{ELQV}	t_{CE}	Chip Enable to Output Delay	$\overline{OE} = V_{IL}$	Min	–	–	–	–	–	–	
				Max	90	100	120	150	200	250	ns
t_{GLQV}	t_{OE}	Output Enable to Output Delay	$\overline{CE} = V_{IL}$	Min	–	–	–	–	–	–	
				Max	40	50	50	65	75	75	ns
t_{EHQZ} t_{GHQZ}	t_{DF} (Note 2)	Chip Enable HIGH or Output Enable HIGH, whichever comes first, to Output Float		Min	–	–	–	–	–	–	
				Max	25	25	35	35	40	40	ns
t_{AXQX}	t_{OH}	Output Hold from Addresses, $\overline{CE}$, or $\overline{OE}$, whichever occurred first		Min	0	0	0	0	0	0	
				Max	–	–	–	–	–	–	ns

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 not 100% tested.*

3. **Caution:** *The Am27C010 must not be removed from (or inserted into) a socket or board when* V_{PP} *or* V_{CC} *is applied.*

4. *Output Load: 1 TTL gate and* $C_L = 100$ *pF*
   Input Rise and Fall Times: 20 ns
   Input Pulse Levels: 0.45 V to 2.4 V
   Timing Measurement Reference Level: 0.8 V and 2 V for inputs and outputs

SWITCHING TEST CIRCUIT

Device Under Test

2.7 kΩ

+5.0 V

C_L

6.2 kΩ

Diodes = IN3064 or Equivalent

C_L = 100 pF including jig capacitance

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SWITCHING TEST WAVEFORM

2.4 V

2.0 V   2.0 V

Test Points

0.8 V   0.8 V

0.45 V

Input   Output

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AC Testing: Inputs are driven at 2.4 V for a logic "1" and 0.45 V for a logic "0". Input pulse rise and fall times are ≤ 20 ns.

KEY TO SWITCHING WAVEFORMS

WAVEFORM	INPUTS	OUTPUTS
	Must Be Steady	Will Be Steady
	May Change from H to L	Will Be Changing from H to L
	May Change from L to H	Will Be Changing from L to H
	Don't Care, Any Change Permitted	Changing State Unknown
	Does Not Apply	Center Line is High Impedence "Off" State

KS000010

SWITCHING WAVEFORMS
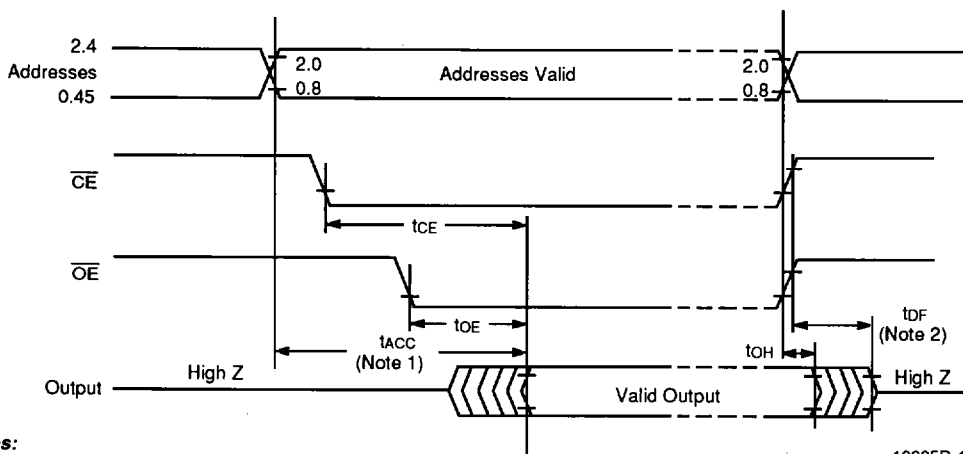
Notes:

1. $\overline{OE}$ may be delayed up to $t_{ACC} - t_{OE}$ after the falling edge of the addresses without impact on t_{ACC}.

2. t_{DF} is specified from $\overline{OE}$ or $\overline{CE}$, whichever occurs first.

10205D-10