PRELIMINARY

Am27LV020/Am27LV020B

2 Megabit (262,144 x 8-Bit) Low Voltage CMOS EPROM

Advanced Micro Devices

DISTINCTIVE CHARACTERISTICS

- **Single 3.3 V power supply**
  - — Regulated power supply 3.0 V–3.6 V
  - — Unregulated power supply 2.7 V–3.6 V (battery-operated systems)
- **Low power consumption:**
  - — 10 µA typical CMOS standby current
  - — 90 µW maximum standby power
  - — 54 mW power at 5 MHz maximum
- **Fast access time**
  - — 150 ns
- **JEDEC-approved pinout**
  - — Pin compatible with 5.0 V 2-Mbit EPROM
  - — Easy upgrade from 28-pin JEDEC EPROMs
- **100% Flashrite™ programming**
  - — Typical programming time of 32 seconds
- **Latch-up protected to 100 mA from –1 V to Vcc + 1 V**
- **High noise immunity**
- **Compact 32-pin DIP package requires no hardware change for upgrades to 8 Mbit**
- **Versatile features for simple interfacing**
  - — Both CMOS and TTL input/output compatibility
  - — Two line control functions

GENERAL DESCRIPTION

The Am27LV020 is a low voltage, low power megabit, ultraviolet erasable, progammable read-only memory organized as 256K words by 8 bits per word.

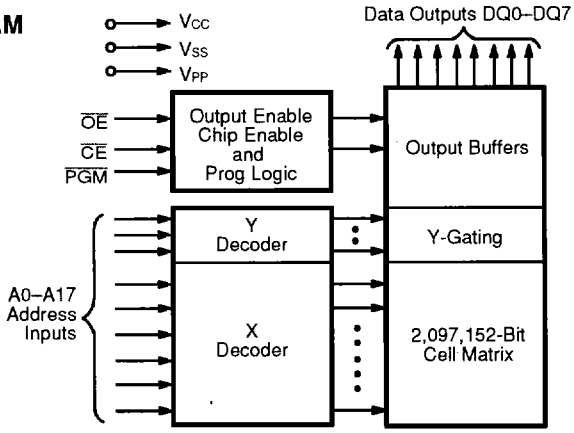
The Am27LV020 operates from a single power supply of 3.3 V and is offered with two power supply tolerances. The Am27LV020 has a Vcc tolerance range of 3.3 V ± 10% making it suitable for use in systems that have regulated power supplies. The Am27LV020B has a voltage supply range of 2.7 V–3.6 V making it an ideal part for battery operated systems.

Maximum power consumption of the Am27LV020 in standby mode is only 90 µW. If the device is constantly accessed at 5 MHz, then the maximum power consumption increases to 54 mW. These power ratings are significantly lower than typical EPROMs. Also, as power consumption is proportional to voltage squared, 3.3 V devices consume at least 57% less power than their 5.0 V counterparts. Due to its lower current and voltage, the Am27LV020 is well-suited for battery operated and portable systems as it extends the battery life in these systems. Typical applications are notebook and handheld computers as well as cellular phones.

The Am27LV020 is packaged in the industry standard 32-pin windowed ceramic DIP and LCC packages, as well as one-time programmable (OTP) packages. This device is pin-compatible with the 5.0 V devices.

The Am27LV020 uses AMD's Flashrite™ programming algorithm (100 µs pulses) resulting in typical programming times of 32 seconds. This device is manufactured on AMD's sub-micron process technology which provides high speed, low power and high noise immunity.

BLOCK DIAGRAM



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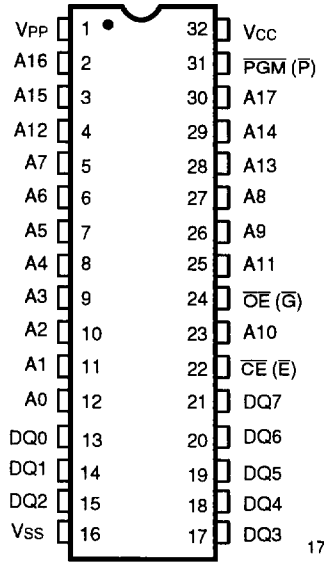
PRODUCT SELECTOR GUIDE

Family Part No.	Am27LV020			
Ordering Part No:				
Am27LV020 (3.0 V–3.6 V)	-150	-200	-250	-300
Am27LV020B (2.7 V–3.6 V)		-200	-250	-300
Max Access Time (ns)	150	200	250	300
$\overline{CE}$ ($\overline{E}$) Access (ns)	150	200	250	300
$\overline{OE}$ ($\overline{G}$) Access (ns)	65	75	100	120

CONNECTION DIAGRAMS

Top View

PDIP



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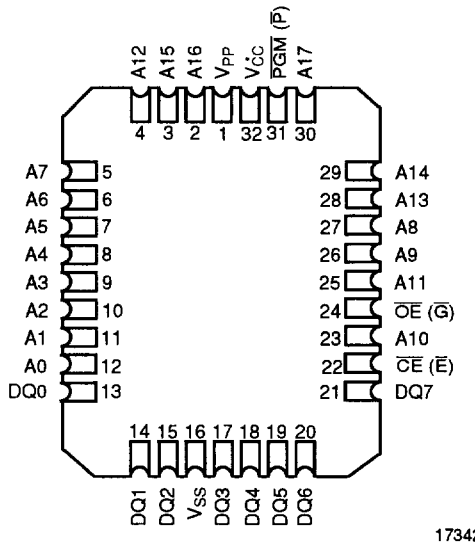
PLCC/LCC



17342A-3

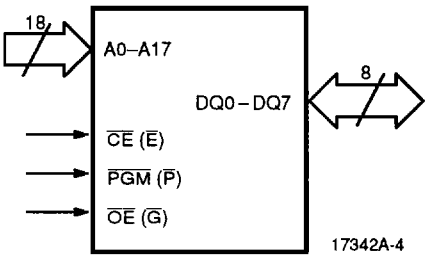
Notes:

1. *JEDEC nomenclature is in parenthesis.*
2. *The 32-pin DIP to 32-pin LCC configuration varies from the JEDEC 28-pin DIP to 32-pin LCC configuration.*

PIN DESCRIPTION

A0–A17	=	Address Inputs
$\overline{CE}$ ($\overline{E}$)	=	Chip Enable Input
VSS	=	Ground
DQ0–DQ7	=	Data Input/Outputs
$\overline{OE}$ ($\overline{G}$)	=	Output Enable Input
$\overline{PGM}$ ($\overline{P}$)	=	Program Enable Input
VCC	=	VCC Supply Voltage
VPP	=	Program Supply Voltage

LOGIC SYMBOL



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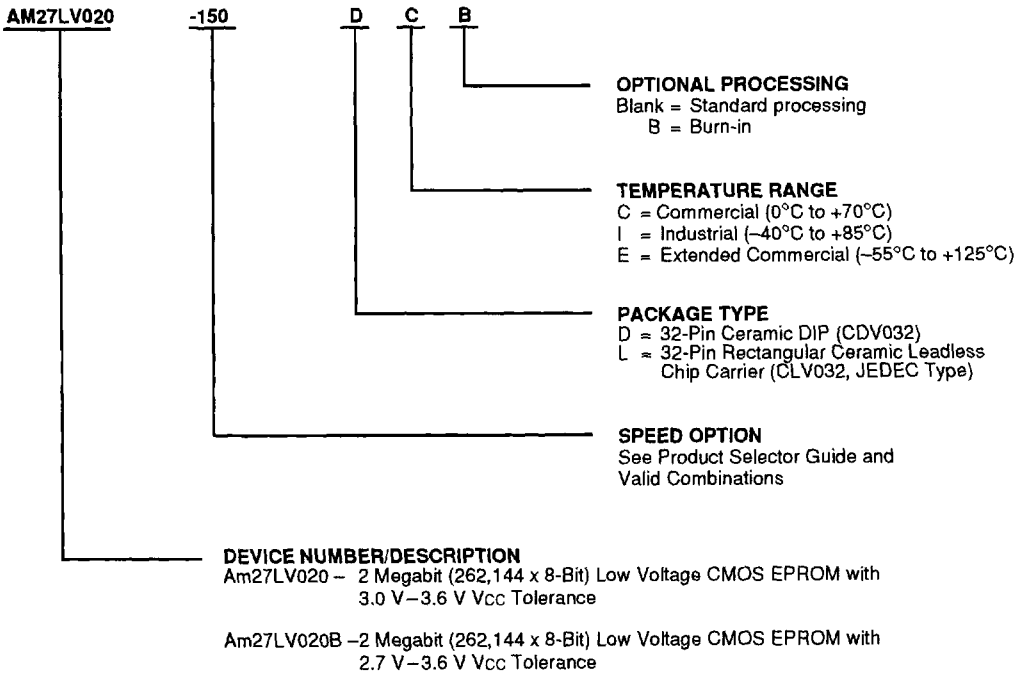
ORDERING INFORMATION
EPROM Products

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



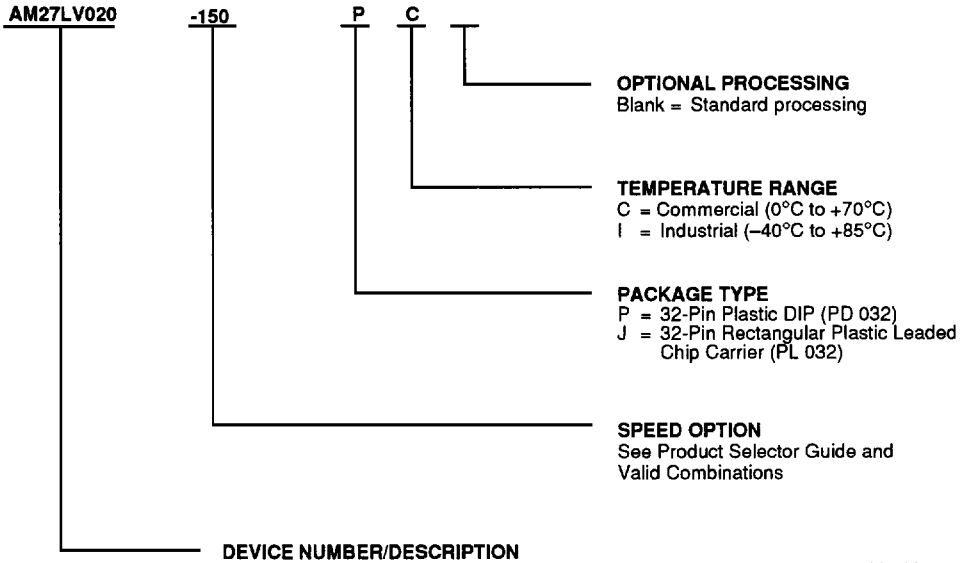
Valid Combinations	
AM27LV020-150	DC, DCB, DI, DIB, LC, LCB, LI, LIB
AM27LV020-200	DC, DCB, DE, DEB, DI, DIB, LC, LCB, LI, LIB, LE, LEB
AM27LV020-250	
AM27LV020-300	
AM27LV020B-200	
AM27LV020B-250	
AM27LV020B-300	

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 or 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:



Valid Combinations	
AM27LV020-150	PC, JC, PI, JI
AM27LV020-200	
AM27LV020-250	
AM27LV020-300	
AM27LV020B-200	
AM27LV020B-250	
AM27LV020B-300	

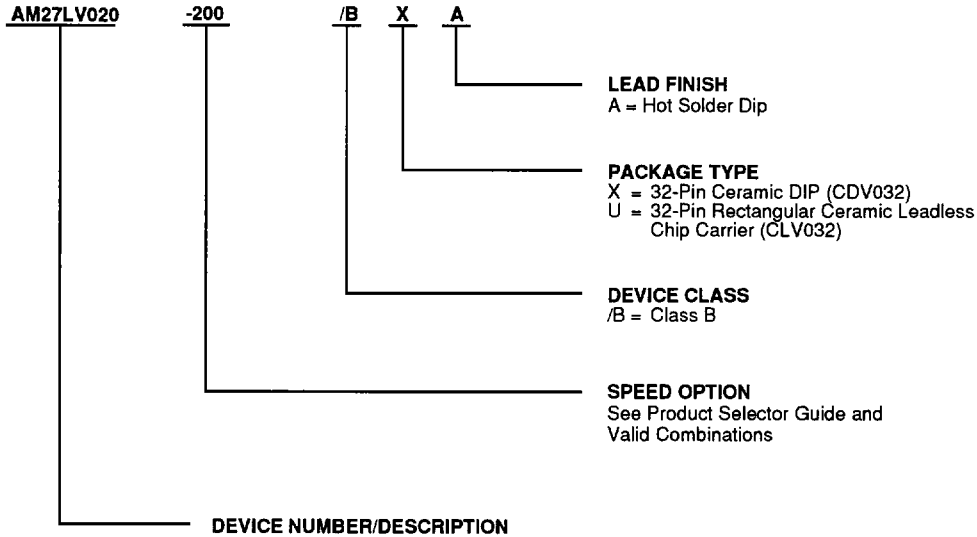
Valid Combinations

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 or to check on newly released combinations.

MILITARY ORDERING INFORMATION

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:



Valid Combinations	
AM27LV020-200	/BXA, /BUA
AM27LV020-250	
AM27LV020-300	
AM27LV020B-250	
AM27LV020B-300	

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, or 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 Am27LV020

In order to clear all locations of their programmed contents, it is necessary to expose the Am27LV020 to an ultraviolet light source. A dosage of 15 W seconds/cm^2 is required to completely erase an Am27LV020. This dosage can be obtained by exposure to an ultraviolet lamp —wavelength of 2537 Angstroms (Å) —with intensity of 12,000 µW/cm^2 for 15 to 20 minutes. The Am27LV020 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 Am27LV020, 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 2537Å, nevertheless the exposure to fluorescent light and sunlight will eventually erase the Am27LV020 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 Am27LV020

Upon delivery, or after each erasure, the Am27LV020 has all 2,097,152 bits in the "ONE", or HIGH state. "ZEROs" are loaded into the Am27LV020 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 pulse and by giving each address only as many pulses as are 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 Am27LV020. 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. Am27LV020 can be programmed using the same algorithm as the 5 V counterpart 27C020.

Program Inhibit

Programming of multiple Am27LV020s in parallel with different data is also easily accomplished. Except for $\overline{CE}$, all like inputs of the parallel Am27LV020 may be common. A TTL low-level program pulse applied to an Am27LV020 $\overline{CE}$ input with V_{PP} = 12.75 ± 0.25 V, $\overline{PGM}$ LOW, and $\overline{OE}$ HIGH will program that Am27LV020. A high-level $\overline{CE}$ input inhibits the other Am27LV020s 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 Am27LV020.

To activate this mode, the programming equipment must force 12.0 ± 0.5 V on address line A9 of the Am27LV020. Two identifier bytes may then be sequenced from the device outputs by toggling address line A_0 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 identifier code. For the Am27LV020, 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 Am27LV020 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 Am27LV020 has a CMOS standby mode which reduces the maximum V_{CC} current to 25 µA. It is placed in CMOS-standby when $\overline{CE}$ is at V_{CC} ± 0.3 V. The Am27LV020 also has a TTL-standby mode which reduces the maximum V_{CC} current to 0.6 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.

Mixed Power Supply System

Am27LV020 (in 3.0 V to 3.6 V regulated power supply) can be intefaced with 5 V system only when the I/O pins (DQ0–DQ7) are not driven by the 5 V system. $V_{IHmax} = V_{CCLV}$ + 2.2 V for address and clock pins and $V_{IHmax} = V_{CCLV}$ + 0.5 V for I/O pins should be followed to avoid CMOS latch-up condition.

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 their 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	X	D_{OUT}
Output Disable		V_{IL}	V_{IH}	X	X	X	X	High Z
Standby (TTL)		V_{IH}	X	X	X	X	X	High Z
Standby (CMOS)		V_{CC} ± 0.3 V	X	X	X	X	X	High 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}	High Z
Auto Select (Note 3)	Manufacturer Code	V_{IL}	V_{IL}	X	V_{IL}	V_H	X	01H
	Device Code	V_{IL}	V_{IL}	X	V_{IH}	V_H	X	97H

Notes:

1. *V_H = 12.0 V ± 0.5 V*
2. *X can be either V_{IL} or V_{IH}*
3. *A1–A8 = A10–A17 = 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}, and V_{CC} (Note 1) ..... −0.6 V to V_{CC} +0.6 V
- A9 and V_{PP} (Note 2) ..... −0.6 V to 13.5 V
- V_{CC} ..... −0.6 V to 7.0 V

Notes:

1. *During transitions, the input may overshoot V_{SS} to −2.0 V for periods of up to 20 ns. Maximum DC voltage on input and I/O may overshoot to V_{CC} + 2.0 V for periods of up to 20 ns.*
2. *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 device failure. Functionality at or above these limits is not implied. Exposure to absolute maximum ratings 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 Am27LV020 ..... +3.0 V to +3.6 V
- V_{CC} for Am27LV020B ..... +2.7 V to +3.6 V

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

DC CHARACTERISTICS over operating ranges unless otherwise specified (Notes 1, 4, 5 and 7) (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
TTL and CMOS Inputs for V_{CC} = 3.0 V to 3.6 V						
V_{OH}	Output HIGH Voltage	I_{OH} = –2.0 mA		2.4		V
V_{OL}	Output LOW Voltage	I_{OL} = 2.0 mA			0.4	V
V_{IH}	Input HIGH Voltage			2.0	V_{CC} + 0.3	V
V_{IL}	Input LOW Voltage			–0.3	+0.8	V
I_{LI}	Input Load Current	V_{IN} = 0 V to V_{CC}	C/I Devices		1.0	µA
			E/M Devices		1.0	
I_{LO}	Output Leakage Current	V_{OUT} = 0 V to V_{CC}	C/I Devices		5.0	µA
			E/M Devices		5.0	
I_{CC1}	V_{CC} Active Current (Notes 5 and 8)	$\overline{CE}$ = V_{IL}, f = 5 MHz I_{OUT} = 0 mA (Open Outputs)	C/I Devices		15	mA
			E/M Devices		20	
I_{CC2}	V_{CC} TTL Standby Current	$\overline{CE}$ = V_{IH}, $\overline{OE}$ = V_{IL}	TTL		0.6	mA
I_{CC3}	V_{CC} CMOS Standby Current	$\overline{CE}$ = V_{CC} ± 0.3 V	CMOS		25	µA
I_{PP1}	V_{PP} Supply Current (Read)	$\overline{CE}$ = $\overline{OE}$ = V_{IL}, V_{PP} = V_{CC}			100	µA

Parameter Symbol	Parameter Description	Test Conditions		Min	Max	Unit
CMOS for V_{CC} = 2.7 V to 3.6 V						
V_{OH}	Output HIGH Voltage	I_{OH} = –20 µA		V_{CC} – 0.1		V
V_{OL}	Output LOW Voltage	I_{OL} = 20 µA			0.1	V
V_{IH}	Input HIGH Voltage			0.7 V_{CC}	V_{CC} + 0.3	V
V_{IL}	Input LOW Voltage			–0.3	0.2 V_{CC}	V
I_{LI}	Input Load Current	V_{IN} = 0 V to +V_{CC}	C/I Devices		1.0	µA
			E/M Devices		1.0	
I_{LO}	Output Leakage Current	V_{OUT} = 0 V to +V_{CC}	C/I Devices		5.0	µA
			E/M Devices		5.0	
I_{CC1}	V_{CC} Active Current (Notes 5 and 8)	$\overline{CE}$ = V_{IL}, f = 5 MHz, I_{OUT} = 0 mA (Open Outputs)	C/I Devices		15	mA
			E/M Devices		20	
I_{CC3}	V_{CC} CMOS Standby Current	$\overline{CE}$ = V_{CC} ± 0.3 V			25	µA
I_{PP1}	V_{PP} Supply Current (Read)	$\overline{CE}$ = $\overline{OE}$ = V_{IL}, V_{PP} = V_{CC}			100	µA

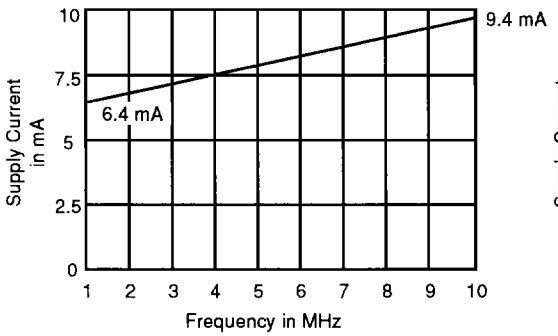


Figure 1. Typical Supply Current vs. Frequency
V_{CC} = 3.6 V, T = 25°C

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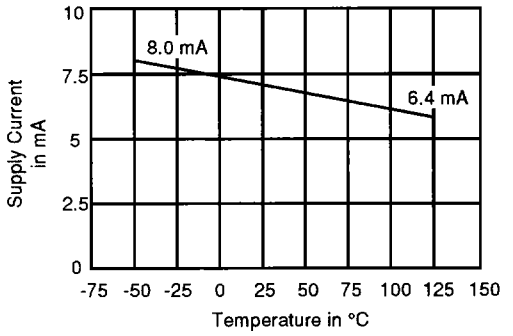


Figure 2. Typical Supply Current vs. Temperature
V_{CC} = 3.6 V, f = 5 MHz

17342A-6

CAPACITANCE (Notes 2, 3 and 7)

Parameter Symbol	Parameter Description	Test Conditions	CDV032		CLV032		PD032		PL032		Unit
			Typ	Max	Typ	Max	Typ	Max	Typ	Max	
C_{IN}	Input Capacitance	V_{IN} = 0 V	10	12	8	10	10	12	8	10	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0 V	12	15	9	12	12	15	9	12	pF

Notes:

1. *V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.*
2. *Typical values are for nominal supply voltages.*
3. *This parameter is only sampled and not 100% tested.*
4. ***Caution**: The Am27LV020 must not be removed from, or inserted into, a socket or board when V_{CC} or V_{PP} is applied.*
5. *I_{CC1} is tested with $\overline{OE}$ = V_{IH} to simulate open outputs.*
6. *T_A = +25°C, f = 1 MHz.*
7. *During transitions, the inputs may overshoot to –2.0 V for periods less than 20 ns.*
   Maximum DC voltage on output pins may overshoot to V_{CC} + 2.0 V for periods less than 20 ns.
8. *For typical supply current values at various frequencies, refer to Figure 1. For temperature, refer to Figure 2.*

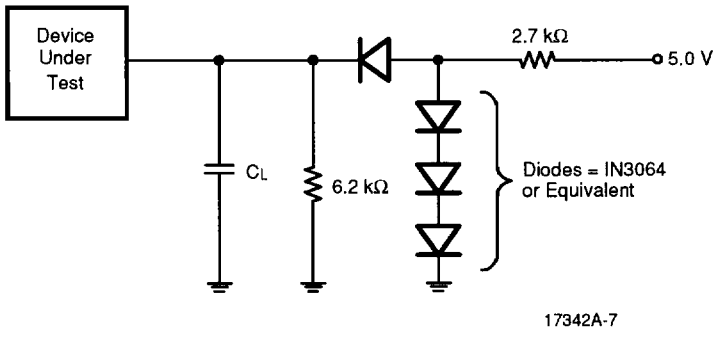
SWITCHING CHARACTERISTICS over operating ranges unless otherwise specified (Notes 1, 3 and 4) (for APL products, Group A, Subgroups 9, 10 and 11 are tested unless otherwise noted)

PRELIMINARY									
Parameter Symbols		Parameter Description	Test Conditions		Am27LV020/Am27LV020B				
JEDEC	Standard				-150	-200	-250	-300	Unit
t_{AVQV}	t_{ACC}	Address to Output Delay	$\overline{CE} = \overline{OE} = V_{IL}$	Min					ns
				Max	150	200	250	300	
t_{ELQV}	t_{CE}	Chip Enable Output Delay	$\overline{OE} = V_{IL}$	Min					ns
				Max	150	200	250	300	
t_{GLQV}	t_{OE}	Output Enable to Output Delay	$\overline{CE} = V_{IL}$	Min					ns
				Max	65	75	100	120	
t_{EHQZ}, t_{GHQZ}	t_{DF} (Note 2)	Chip Enable HIGH or Output Enable HIGH, whichever comes first, to Output Float		Min	0	0	0	0	ns
				Max	50	60	60	60	
t_{AXQX}	t_{OH}	Output Hold from Addresses, $\overline{CE}$, or $\overline{OE}$, whichever occurred first		Min	0	0	0	0	ns
				Max					

Notes:

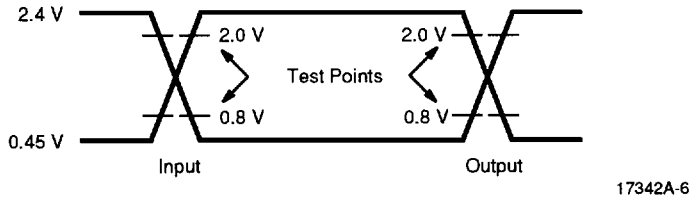
1. *V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.*
2. *This parameter is only sampled and not 100% tested.*
3. ***Caution**: The Am27LV020 must not be removed from, or inserted into a socket or board when V_{PP} or V_{CC} is applied.*
4. *Output Load: 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—Inputs: 0.8 V and 2.0 V,
   Outputs: 0.8 V and 2.0 V

SWITCHING TEST CIRCUIT



C_L = 100 pF including jig capacitance

SWITCHING TEST WAVEFORM



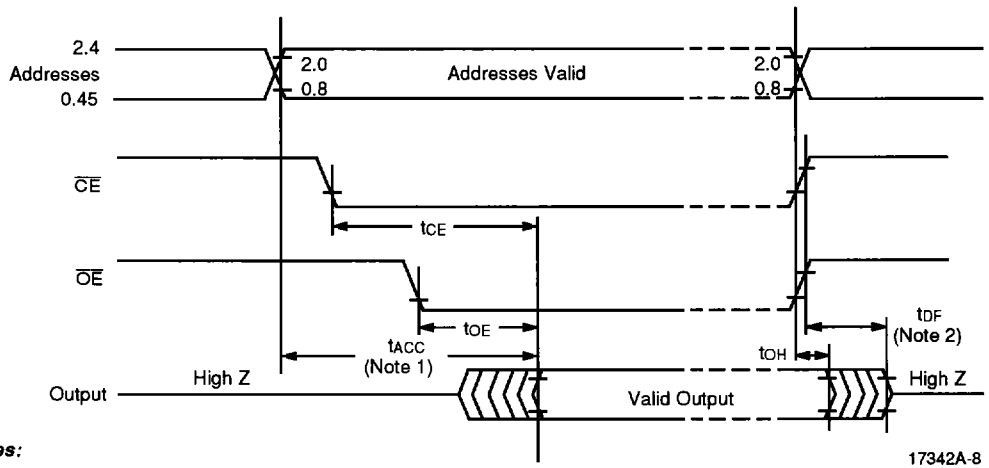
AC Testing: Inputs are driven at 2.4 V for a Logic "1" and 0.45 V for a Logic "0". Input pulse rise and fall times are ≤ 20 ns.

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 Impedance "Off" State

KS000010

SWITCHING WAVEFORM



17342A-8

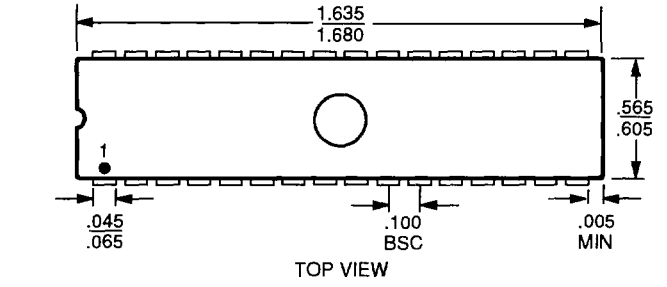
Notes:

1. $\overline{OE}$ *may be delayed up to* $t_{ACC} - t_{OE}$ *after the falling edge of addresses without impact on* t_{ACC}.
2. t_{DF} *is specified from* $\overline{OE}$ *or* $\overline{CE}$, *whichever occurs first.*

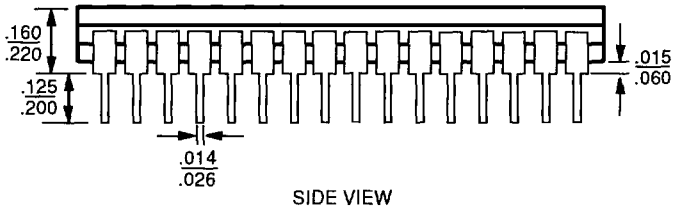
PHYSICAL DIMENSIONS*

CDV032

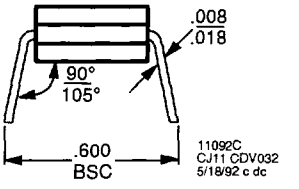
32-Pin Ceramic DIP (measured in inches)



TOP VIEW



SIDE VIEW



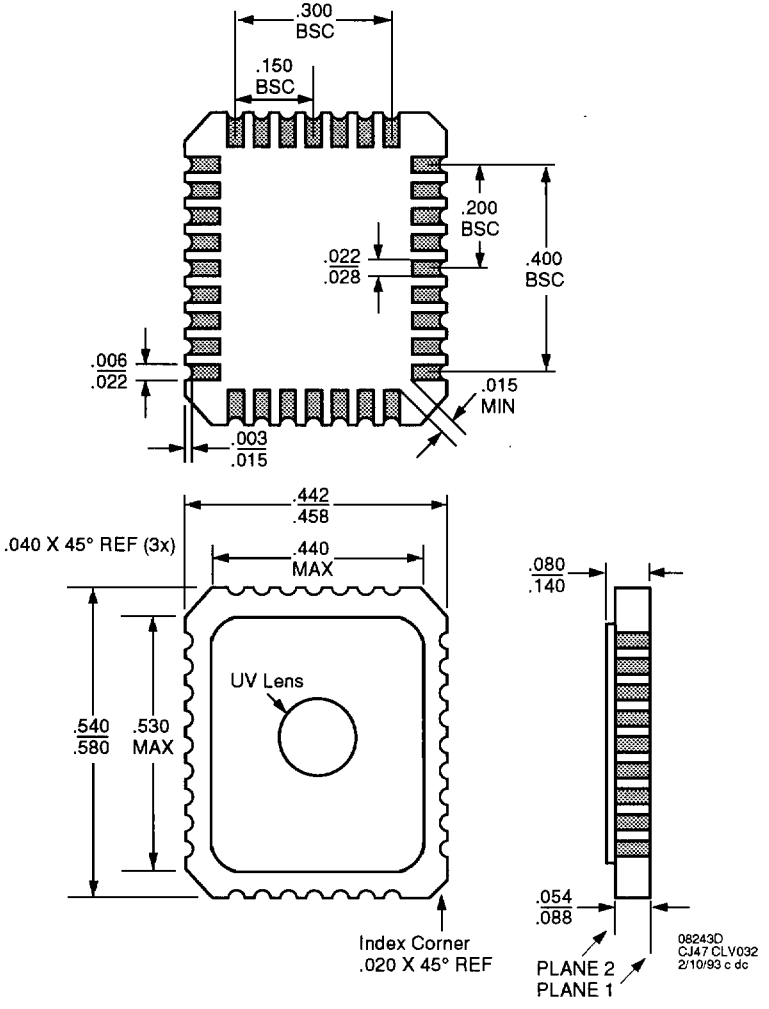
END VIEW

For reference only. BSC is an ANSI standard for Basic Space Centering.

PHYSICAL DIMENSIONS*

CLV032

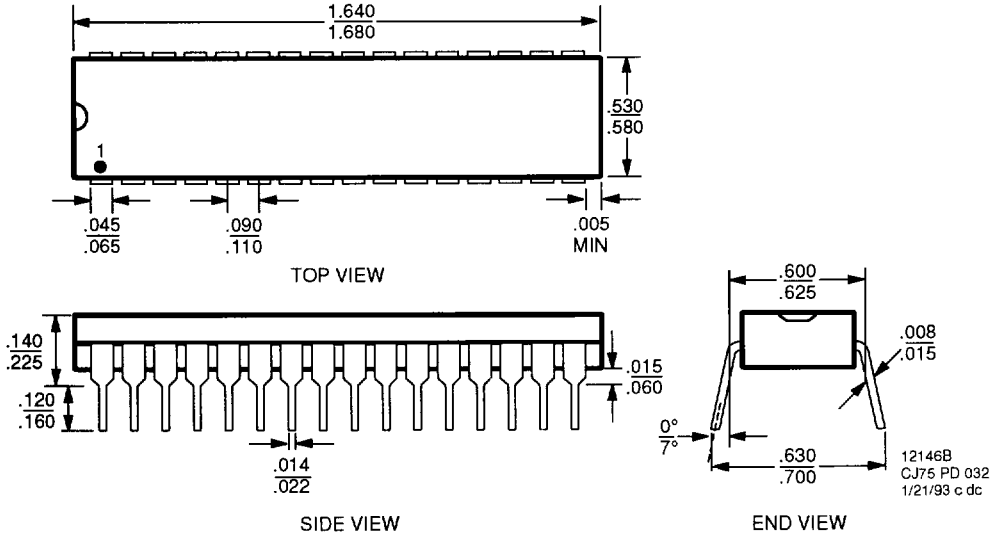
32-Pin Rectangular Ceramic Leadless Chip Carrier (measured in inches)



PHYSICAL DIMENSIONS*

PD 032

32-Pin Plastic DIP (measured in inches)



PHYSICAL DIMENSIONS*

PL 032

32-Pin Rectangular Plastic Leaded Chip Carrier (measured in inches)