Am2167

16,384x1 Static RAM

Advanced Micro Devices

DISTINCTIVE CHARACTERISTICS

- High speed — access times as fast as 35 ns maximum
- Automatic power down when deselected
- Low power dissipation
  - Am2167: 660 mW active, 110 mW power down
- High output drive
  - Up to seven standard TTL loads or six Schottky TTL loads
- TTL-compatible interface levels
- No power-on current surge

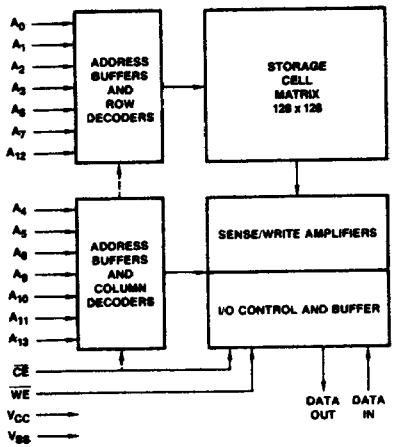
GENERAL DESCRIPTION

The Am2167 is a high-performance, 16,384-bit, static, read/write, random-access memory. It is organized as 16,384 words by one bit per word. All interface signal levels are identical to TTL specifications, providing good noise immunity and simplified system design. All inputs are purely capacitive MOS loads. The outputs will drive up to six standard Schottky TTL loads or up to seven standard TTL loads.

Only a single +5-volt power supply is required. When deselected ($\overline{CE} \geq V_{IH}$), the Am2167 automatically enters a power-down mode which reduces power dissipation by 80%.

Data In and Data Out use separate pins and are the same polarity allowing them to be connected together for operation in a common data bus environment. Data Out is a three-state output allowing similar devices to be wire-OR'd together.

BLOCK DIAGRAM



BD000170

PRODUCT SELECTOR GUIDE

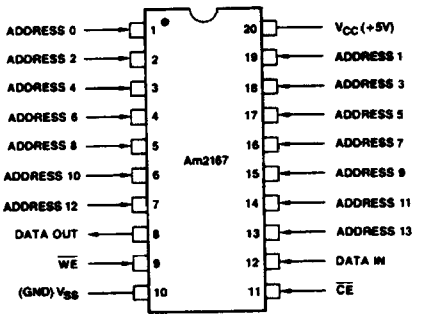
Part Number	Am2167-35	Am2167-45	Am2167-55	Am2167-70
Maximum Access Time (ns)	35	45	55	70
Maximum Active Current (mA)	120	120 (160 mil)	120 (160 mil)	120 (160 mil)
Maximum Standby Current (mA)	20	20 (30 mil)	20 (30 mil)	20 (30 mil)
Full Military Operating Range Version	No	Yes	Yes	Yes

Publication # 03211 Rev. F Amendment /0
Issue Date: January 1989

CONNECTION DIAGRAMS

Top View

DIPs



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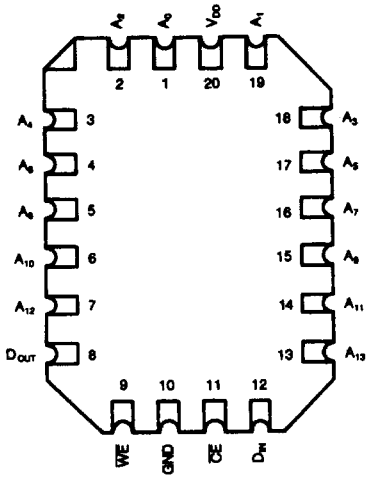

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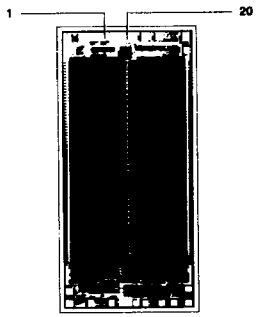
Note: Pin 1 is marked for orientation.

METALLIZATION AND PAD LAYOUT

Address Designators	
External	**Internal**
A_0	A_1
A_1	A_6
A_2	A_2
A_3	A_5
A_4	A_3
A_5	A_0
A_6	A_4
A_7	A_{13}
A_8	A_{10}
A_9	A_6
A_{10}	A_{11}
A_{11}	A_9
A_{12}	A_{12}
A_{13}	A_7



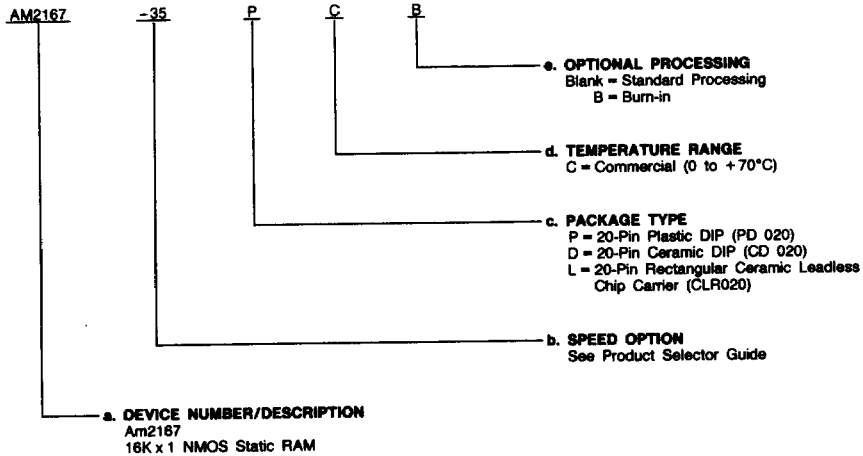
Die Size: 0.121" x 0.249"

ORDERING INFORMATION

Standard Products

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

a. Device Number
b. Speed Option (if applicable)
c. Package Type
d. Temperature Range
e. Optional Processing



Valid Combinations	
AM2167-35	PC, PCB, DC, DCB, LC, LCB
AM2167-45	PD, PCB, DC, DCB
AM2167-55	
AM2167-70	

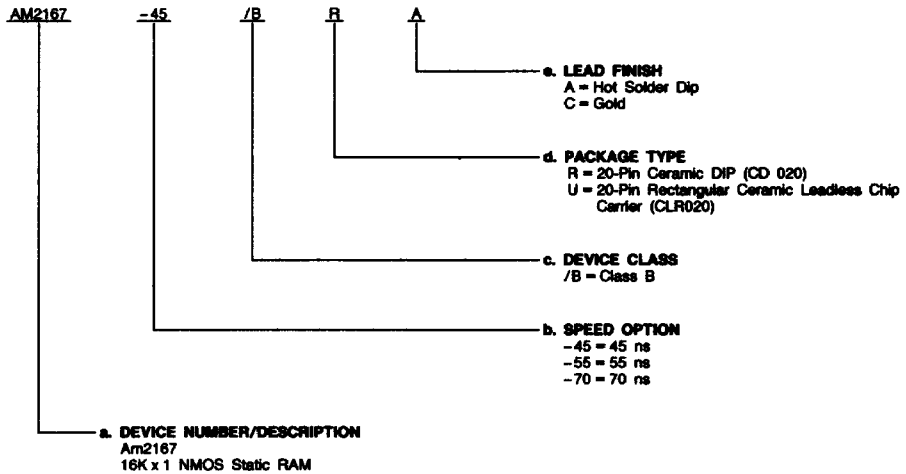
Valid Combinations

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, to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

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-883C requirements. The order number (Valid Combination) is formed by a combination of: **a. Device Number**
b. Speed Option (if applicable)
c. Device Class
d. Package Type
e. Lead Finish



Valid Combinations	
AM2167-45	/BRA, /BUA
AM2167-55	
AM2167-70	

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 for newly released valid combinations.

Group A Tests

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

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PIN DESCRIPTION

$A_0 - A_{13}$ Address (Inputs)
The address input lines select the RAM location to be read or written.

$\overline{CE}$ Chip Enable (Input, Active LOW)
The Chip Enable selects the memory device.

$\overline{WE}$ Write Enable (Input, Active LOW)
When Write Enable is LOW and Chip Enable is also LOW, data is written into the location specified on the address pins.

D_{IN} Data (Input)
This pin issued for entering data during write operation.

D_{OUT} Data (Output, Three State)
This pin is three state during write operation. It becomes active when $\overline{CE}$ is LOW and $\overline{WE}$ is HIGH.

V_{CC} Power Supply

V_{SS} Ground

ABSOLUTE MAXIMUM RATINGS

Storage Temperature ..... −65 to +150°C
Ambient Temperature with
Power Applied ..... −55 to +125°C
Supply Voltage ..... −0.5 V to +7.0 V
Signal Voltages with
Respect to Ground ..... −3.5 V to +7.0 V
Power Dissipation ..... 1.2 W
DC Output Current ..... 50 mA

Maximum rating are to be for system design reference, parameters given may not be 100% tested by AMD.

The products described by this specification include internal circuitry designed to protect input devices from damaging accumulations of static charge. It is suggested nevertheless, that conventional precautions be observed during storage, handling and use in order to avoid exposure to excessive voltages.

OPERATING RANGES (Note 4)

Commercial (C) Devices
Ambient Temperature (T_A) ..... 0 to +70°C
Supply Voltage (V_{CC}) ..... +4.5 V to +5.5 V

Military (M) Devices
Ambient Temperature (T_A) ..... −55 to +125°C
Supply Voltage (V_{CC}) ..... +4.5 to +5.5 V

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

DC CHARACTERISTICS over operating ranges unless otherwise specified (for APL Products, Group A, Subgroups 1, 2, 3 are tested unless otherwise noted) (Note 4)

Parameter Symbol	Parameter Description	Test Conditions		Am2167-35 Min.	Am2167-35 Max.	Am2167-45, Am2167-55, Am2167-70 Min.	Am2167-45, Am2167-55, Am2167-70 Max.	Unit
I_{OH}	Output HIGH Current	V_{OH} = 2.4 V	V_{CC} = 4.5 V	−4		−4		mA
I_{OL}	Output LOW Current	V_{OL} = 0.4 V	COM'L	16		16		mA
			MIL	12		12		
V_{IH}	Input HIGH Voltage			2.2	6.0	2.2	6.0	V
V_{IL}	Input LOW Voltage			−2.5	0.8	−2.5	0.8	V
I_{IX}	Input Load Current	$V_{SS} \leq V_I \leq V_{CC}$		−10	10	−10	10	µA
I_{OZ}	Output Leakage Current	GND $\leq V_O \leq V_{CC}$ Output Disabled		−50	50	−50	50	µA
C_I	Input Capacitance	Test Frequency = 1.0 MHz T_A = 25°C, All pins at 0 V, V_{CC} = 5 V (Note 9)			5		5	pF
C_O	Output Capacitance				6		6	
I_{CC}	V_{CC} Operating Supply Current	Max V_{CC}, CE $\leq V_{IL}$ Output Open	COM'L		120		120	mA
			MIL		N/A		160	
I_{SB}	Automatic $\overline{CE}$ Power Down Current	MAX V_{CC}, (CE $\geq V_{IH}$) (Note 3)	COM'L		20		20	mA
			MIL		N/A		30	

Notes:
1. Test conditions assume signal transition times of 10 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3.0 V and output loading of the specified I_{OL}/I_{OH} and 30 pF load capacitance. Output timing reference is 1.5 V.
2. The internal write time of the memory is defined by the overlap of $\overline{CE}$ LOW and $\overline{WE}$ LOW. Both signals must be LOW to initiate a write and either signal can terminate a write by going HIGH. The data input setup and hold timing should be referenced to the rising edge of the signal that terminates the write.
3. A pull-up resistor to V_{CC} on the $\overline{CE}$ input is required to keep the device deselected during V_{CC} power up. Otherwise I_{SB} will exceed values given.
4. For test and correlation purposes, ambient temperature is defined as the "Instant-on" case temperature.
5. The device must be selected during the previous cycle. Otherwise t_{AA} and t_{RC} are equivalent to t_{ACS}.
6. Transition is measured ±500 mV from steady state voltage with load specified in Figure 2 for t_{HZ}, t_{LZ}, t_{OW} and t_{WZ}.
7. $\overline{WE}$ is HIGH for read cycle.
8. Address valid prior to or coincident with $\overline{CE}$ transition LOW.
9. Parameter not 100% tested. Guaranteed by characterization.

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

No.	Parameter Symbol	Parameter Description		Am2167-35		Am2167-45		Am2167-55		Am2167-70		Unit
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
READ CYCLE												
1	t_{RC}	Address Valid to Address Do Not Care Time (Read Cycle Time) (Note 5)		30		40		50		70		ns
2	t_{AA}	Address Valid to Data Out Valid Delay (Address Access Time) (Note 5)			30		40		50		70	ns
3	t_{ACS}	Chip Enable LOW to Data Out Valid (Chip Enable Access Time)			35		45		55		70	ns
4	t_{LZ}	Chip Enable LOW to Data Out On (Notes 6, 9)		5		5		5		5		ns
5	t_{HZ}	Chip Enable HIGH to Data Out Off (Notes 6, 9)		0	20	0	25	0	30	0	40	ns
6	t_{OH}	Output hold time from address change	COM'L	3		3		3		3		ns
			MIL	1		1		1		1		ns
7	t_{PD}	Chip Enable HIGH to Power Down Delay (Note 9)			25		30		30		55	ns
8	t_{PU}	Chip Enable LOW to Power Up Delay (Note 9)		0		0		0		0		ns
WRITE CYCLE												
9	t_{WC}	Address Valid to Address Do Not Care (Write Cycle Time)		30		40		50		70		ns
10	t_{WP}	Write Enable LOW to Write Enable HIGH (Note 2)		20		20		25		40		ns
11	t_{WR}	Write Enable HIGH to Address		0		0		0		0		ns
12	t_{WZ}	Write Enable LOW to Output in HIGH Z (Notes 6 & 9)		0	20	0	20	0	25	0	35	ns
13	t_{DW}	Data In Valid to Write Enable HIGH		15		15		20		30		ns
14	t_{DH}	Data Hold Time		5		5		5		5		ns
15	t_{AS1}	Address Valid to Write Enable LOW ($\overline{WE}$ Controlled Write)		5		5		5		5		ns
	t_{AS2}	Address Valid to Write Enable LOW ($\overline{CE}$ Controlled Write)		0		0		0		0		ns
16	t_{CW}	Chip Enable LOW to Write Enable HIGH (Note 2)		30		40		50		55		ns
17	t_{OW}	Write Enable HIGH to Output in LOW Z (Notes 6 & 9)		0		0		0		0		ns
18	t_{AW}	Address Valid to End of Write		30		40		50		70		ns

Notes: See notes following DC Characteristics table.

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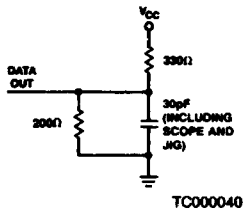
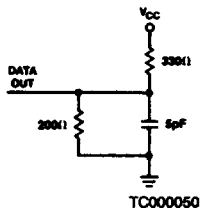
SWITCHING TEST CIRCUITS



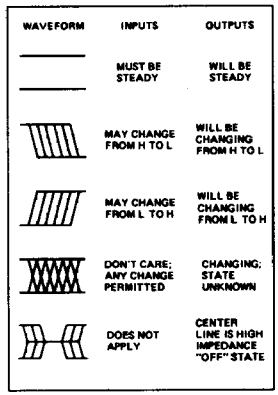
A. Output Load



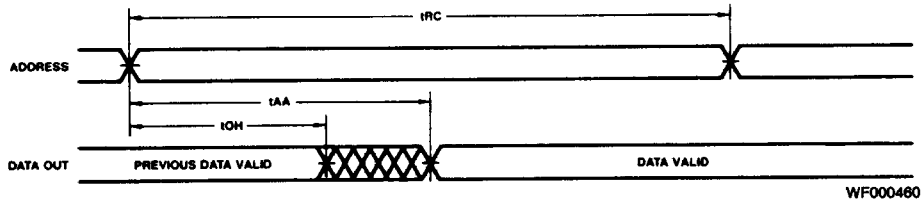
B. Output Load for t_{HZ}, t_{LZ}, t_{OW}, t_{WZ}

SWITCHING WAVEFORMS

KEY TO SWITCHING WAVEFORMS

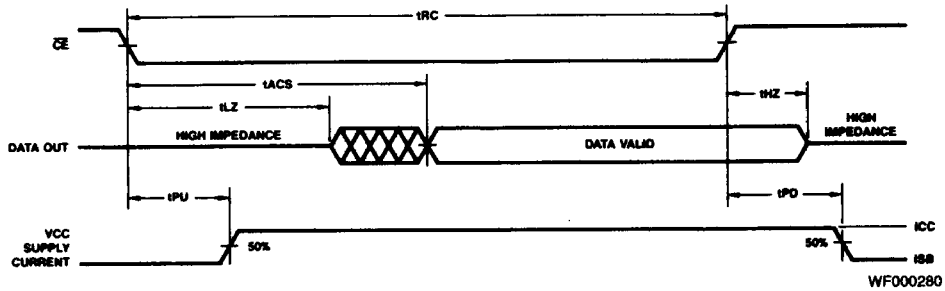


KS000010



WF000460

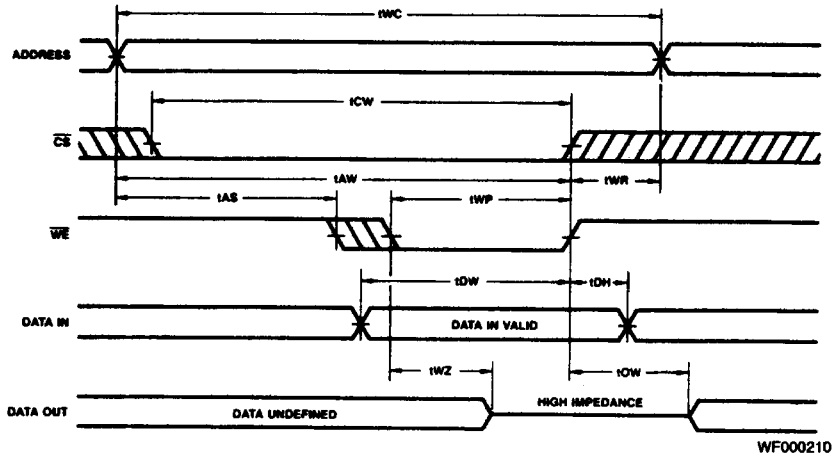
Read Cycle No. 1 (Notes 5, 7)



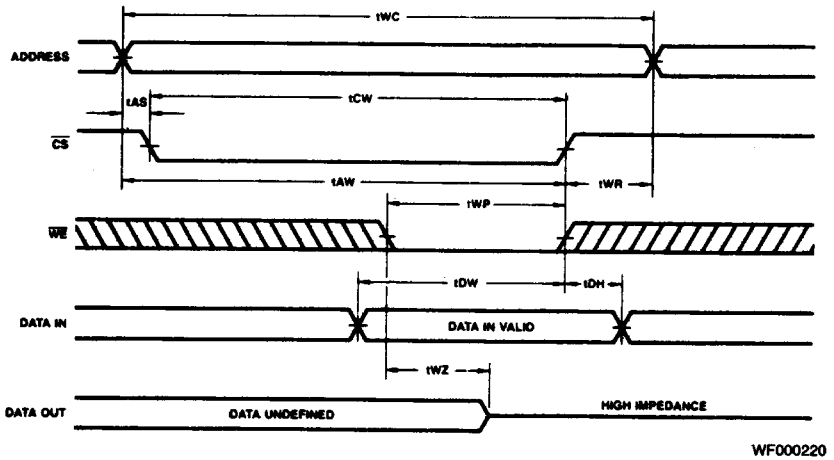
WF000280

Read Cycle No. 2 (Notes 7, 8)

Notes: See notes following DC Characteristics table.



Write Cycle No. 1 ($\overline{WE}$ Controlled)

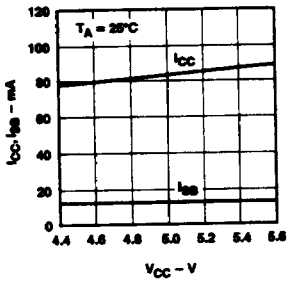


Write Cycle No. 2 ($\overline{CE}$ Controlled)

Note: If $\overline{CE}$ goes high simultaneously with $\overline{WE}$ HIGH, the output remains in a high-impedance state.

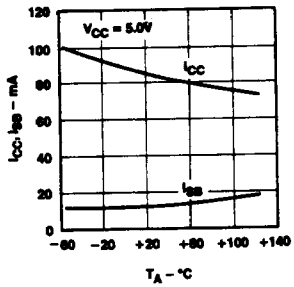
TYPICAL PERFORMANCE CURVES

Supply Current versus Supply Voltage



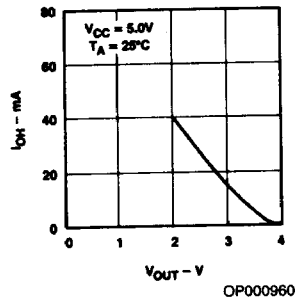
OP000940

Supply Current versus Ambient Temperature



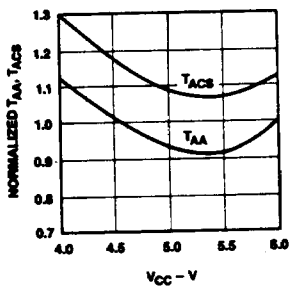
OP000950

Output Source Current versus Output Voltage



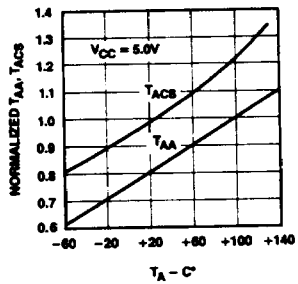
OP000960

Normalized Access Time versus Supply Voltage



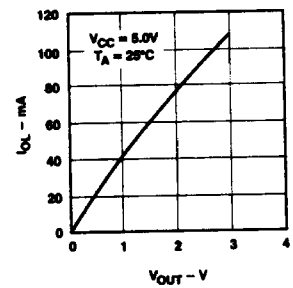
OP000970

Normalized Access Time versus Ambient Temperature



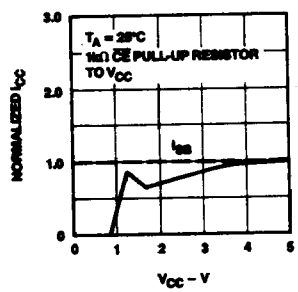
OP000980

Output Sink Current versus Output Voltage



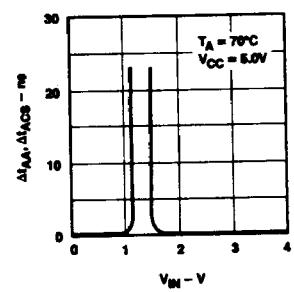
OP000990

Typical Power-On Current versus Power Supply



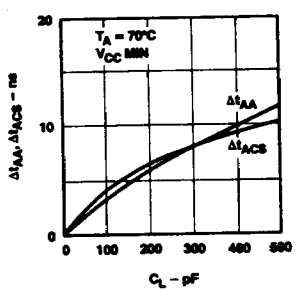
OP001000

Access Time Change versus Input Voltage



OP001010

Access Time Change versus Output Loading



OP001020