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Revision Date: October 16, 1998

Aptos SEMICONDUCTOR

PRELIMINARY

AP9B108/AP9B108L

3.3V, 128K x 8 High-Speed, Low-Power, CMOS Static RAM with Optional 2V Data Retention

Features

- Fast access times: 12 and 15 ns
- Drives a 50 pF load vs. 30 pF industry-standard load
- 2V/100 µA data retention ("L" version)
- Low active power: 234 mW (Max.) at 15ns
- Low standby power: 7.2 mW (Max.)
- Fully static operation, no clock or refresh required
- TTL and CMOS-compatible inputs and outputs
- Single 3.0 V to 3.6 V power supply
- Packaged in industry-standard 32-Pin, 300 and 400-Mil SOJ and TSOP (Type I)
- Commercial and industrial temperature ranges

Functional Description

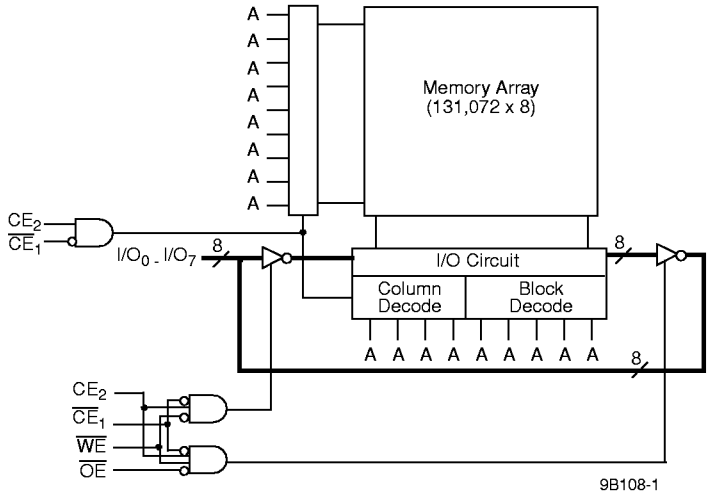
The Aptos AP9B108/AP9B108L is a high-speed, low-power, 128K x 8 CMOS static RAM. It is fabricated using Aptos' high-performance, 0.35µ, CMOS process technology. This highly reliable process coupled with innovative circuit design techniques, yields high performance at low power consumption.

When Chip Enable ($\overline{CE}_1$) is HIGH, or CE_2 is LOW, the device assumes a standby mode at which the power dissipation can be reduced down to 7.2 mW (Max.) at CMOS input levels. At 2V V_{CC}, power is reduced to 0.2 mW (Max.) ("L" version).

Easy memory expansion is provided by using asserted LOW $\overline{CE}_1$, asserted HIGH CE_2, and asserted LOW Output Enable inputs ($\overline{OE}$). The asserted LOW Write Enable ($\overline{WE}$) controls both writing and reading of the memory.

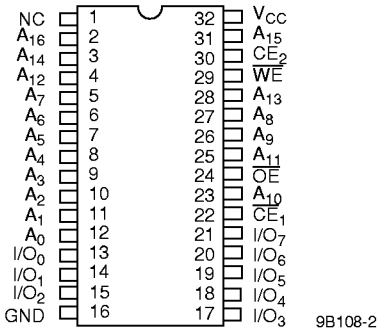
The AP9B108/AP9B108L is pin-compatible with other 3.3V 128K x 8 SRAMs in the SOJ and TSOP package.

Block Diagram

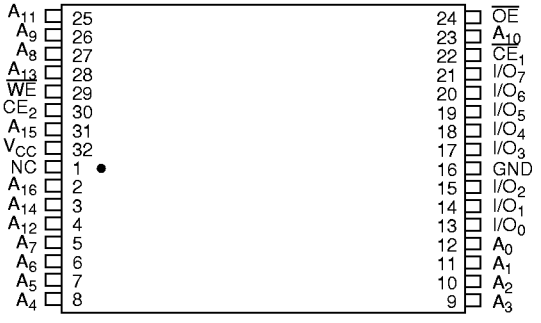


Pin Configurations

32-Pin SOJ
TOP VIEW



32-Pin TSOP
TOP VIEW



Selection Guide

	AP9B108/L-12	AP9B108/L-15
Maximum Access Time (ns)	12	15
Maximum Operating Current (mA)	70	65
Maximum Standby Current (mA)	2	2

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Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... -65 °C to +150 °C

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

V_{CC} Supply Relative to GND ..... -0.5 V to +7.0 V

Voltage on Any Pin Relative to GND ..... -0.5 V to V_{CC} +0.5 V

Short Circuit Output Current [1] ..... ±20 mA

Power Dissipation ..... 1.0 W

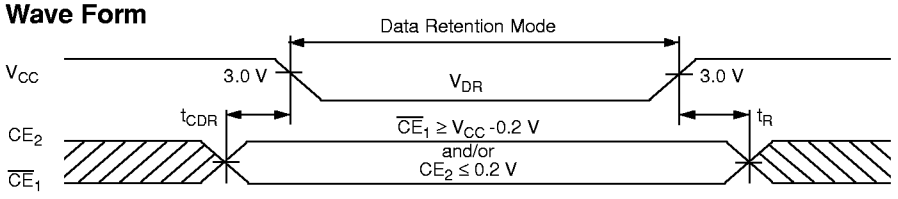
Electrical Characteristics Over the Operating Range ($0°C \le T_A \le 70°C$, V_{CC} = 3.0 V Min. to 3.6 V Max.) *-Commercial*

Symbol	Parameter	Test Conditions	9B108/L-12		9B108/L-15		Unit
			Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}_1 = V_{IL}$ and $CE_2 = V_{IH}$, f = fmax		70		65	mA
I_{CC2}	Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}_1 = V_{IL}$ and $CE_2 = V_{IH}$, f = 0		50		50	mA
I_{SB1}	TTL Standby Current -TTL Inputs	V_{CC} = Max., $V_{IN} = V_{IH}$ or V_{IL}, $\overline{CE}_1 \ge V_{IH}$ or $CE_2 = V_{IL}$, f = fmax		20		20	mA
I_{SB2}	CMOS Standby Current -CMOS Inputs	V_{CC} = Max., $\overline{CE}_1 \ge V_{CC}$ -0.2 V, or $CE_2 \le 0.2$ V, $V_{IN} \ge V_{CC}$ -0.2 V or $V_{IN} \le 0.2$ V, f = 0		2		2	mA
I_{LI}	Input Leakage Current	$GND \le V_{IN} \le V_{CC}$	-1	1	-1	1	µA
I_{LO}	Output Leakage Current	$GND \le V_{OUT} \le V_{CC}$, Output Disabled	-1	1	-1	1	µA
V_{OH}	Output High Voltage	V_{CC} = Min., I_{OH} = - 4.0 mA	2.4		2.4		V
V_{OL}	Output Low Voltage	V_{CC} = Min., I_{OL} = 8.0 mA		0.4		0.4	V
V_{IH}	Input High Voltage [3]		2.0	V_{CC} +0.3	2.0	V_{CC} +0.3	V
V_{IL}	Input Low Voltage [3]		-0.3	0.8	-0.3	0.8	V

Data Retention Characteristics ("L" Version) *-Commercial*

Symbol	Description	Test Conditions [4]	Min.	Max.	Unit
V_{DR}	V_{CC} for Data Retention	$V_{CC} = V_{DR}$ = 2.0 V, $\overline{CE}_1 \ge V_{CC}$-0.2 V or $CE_2 \le 0.2$ V, $V_{IN} \ge V_{CC}$ -0.2 V or $V_{IN} \le 0.2$ V	2.0		V
I_{CCDR}	Data Retention Current			100	µA
t_{CDR}	Chip Deselect to Data Retention Time		0		ns
t_R	Operation Recovery Time		t_{RC}		ns

Data Retention Wave Form



Capacitance [5]

Symbol	Description	Max.	Unit
C_{IN}	Input Capacitance	5	pF
C_{IO}	I/O Capacitance	5	pF

Notes:

1. No more than one output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
2. I_{CC} is dependent upon output loading and cycle rates. Specified values are with outputs open.
3. V_{IL} undershoot = -1.0V where $t=t_{RC}/4$ per cycle. V_{IH} overshoot = V_{CC} +1.0V where $t=t_{RC}/4$ per cycle.
4. No input may exceed V_{CC} +0.3V (DC).
5. Tested initially and after any design or process changes that may effect these parameters.

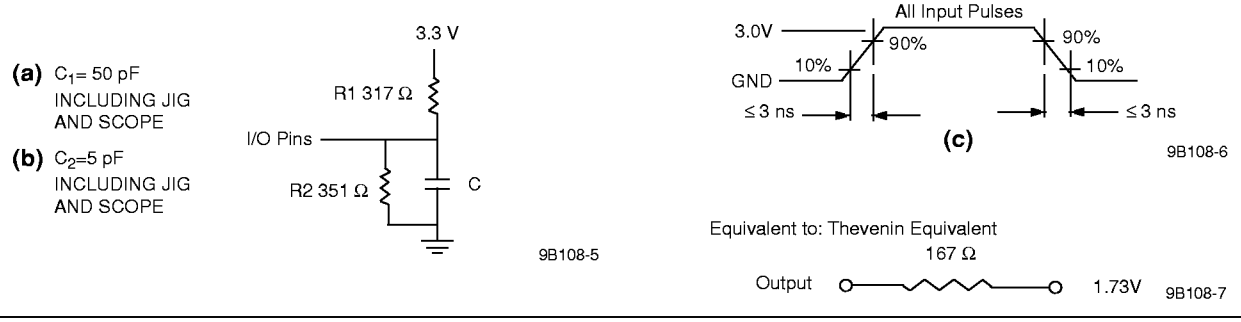
Electrical Characteristics Over the Operating Range (-40°C ≤ T_A ≤ 85°C, V_{CC} = 3.0V Min. to 3.6V Max.) -*Industrial*

Symbol	Parameter	Test Conditions	9B108/L-12		9B108/L-15		Unit
			Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}_1$ = V_{IL} and CE_2 = V_{IH}, f = fmax		80		75	mA
I_{CC2}	Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}_1$ = V_{IL} and CE_2 = V_{IH}, f = 0		60		60	mA
I_{SB1}	TTL Standby Current -TTL Inputs	V_{CC} = Max., V_{IN} = V_{IH} or V_{IL}, $\overline{CE}_1$ ≥ V_{IH} or CE_2 = V_{IL}, f = fmax		25		25	mA
I_{SB2}	CMOS Standby Current -CMOS Inputs	V_{CC} = Max., $\overline{CE}_1$ ≥ V_{CC} -0.2 V, or CE_2 ≤ 0.2 V, V_{IN} ≥ V_{CC} -0.2 V or V_{IN} ≤ 0.2 V, f = 0		5		5	mA
I_{LI}	Input Leakage Current	GND ≤ V_{IN} ≤ V_{CC}	-5	5	-5	5	µA
I_{LO}	Output Leakage Current	GND ≤ V_{OUT} ≤ V_{CC}, Output Disabled	-5	5	-5	5	µA
V_{OH}	Output High Voltage	V_{CC} = Min., I_{OH} = - 4.0 mA	2.4		2.4		V
V_{OL}	Output Low Voltage	V_{CC} = Min., I_{OL} = 8.0 mA		0.4		0.4	V
V_{IH}	Input High Voltage [3]		2.0	V_{CC} +0.3	2.0	V_{CC} +0.3	V
V_{IL}	Input Low Voltage [3]		-0.3	0.8	-0.3	0.8	V

Data Retention Characteristics ("L" Version) -*Industrial*

Symbol	Description	Test Conditions [4]	Min.	Max.	Unit
V_{DR}	V_{CC} for Data Retention	V_{CC} = V_{DR} = 2.0 V, $\overline{CE}_1$ ≥ V_{CC}-0.2 V or CE_2 ≤ 0.2 V, V_{IN} ≥ V_{CC} -0.2V or V_{IN} ≤ 0.2 V	2.0		V
I_{CCDR}	Data Retention Current			1	mA
t_{CDR}	Chip Deselect to Data Retention Time		0		ns
t_R	Operation Recovery Time		t_{RC}		ns

AC Test Loads and Waveforms



Switching Characteristics Over the Operating Range [6, 7]

Parameter	Description	9B108/L-12		9B108/L-15		Unit
		Min.	Max.	Min.	Max.	
Read Cycle [8]						
t_{RC}	Read Cycle Time	12		15		ns
t_{AA}	Address Access Time		12		15	ns
t_{OHA}	Output Hold Time	3		3		ns
t_{ACE1}, t_{ACE2}	$\overline{CE}_1$, CE_2 Access Time		12		15	ns
t_{DOE}	$\overline{OE}$ Access Time		5		7	ns
t_{LZOE} [9]	$\overline{OE}$ to Low-Z Output	0		0		ns
t_{HZOE} [9]	$\overline{OE}$ to High-Z Output		5		6	ns
t_{LZCE1}, t_{LZCE2} [9]	$\overline{CE}_1$, CE_2 to Low-Z Output	3		3		ns
t_{HZCE1}, t_{HZCE2} [9]	$\overline{CE}_1$, CE_2 to High-Z Output		6		8	ns
t_{PU}	$\overline{CE}_1$, CE_2 to Power Up	0		0		ns
t_{PD}	$\overline{CE}_1$, CE_2 to Power Down		12		15	ns
Write Cycle [10]						
t_{WC}	Write Cycle Time	12		15		ns
t_{SCE1}, t_{SCE2}	$\overline{CE}_1$, CE_2 to Write End	8		10		ns
t_{AW}	Address Set-up Time to Write End	8		10		ns
t_{HA}	Address Hold to Write End	0		0		ns
t_{SA}	Address Set-up Time to Write Start	0		0		ns
t_{PWE1} [11]	$\overline{WE}$ Pulse Width ($\overline{OE}$ =HIGH)	8		10		ns
t_{PWE2}	$\overline{WE}$ Pulse Width ($\overline{OE}$ =LOW)	12		12		ns
t_{SD}	Data Set-up to Write End	6		7		ns
t_{HD}	Data Hold from Write End	0		0		ns
t_{HZWE} [9]	$\overline{WE}$ LOW to High-Z Output		6		7	ns
t_{LZWE} [9]	$\overline{WE}$ HIGH to Low-Z Output	2		2		ns

Notes:

6. Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 V to 3.0 V and output loading specified in AC Test Loads and Waveforms *Figure (a)* unless otherwise noted.
7. I/O will assume the High-Z state if $\overline{OE} \geq V_{IH}$.
8. $\overline{WE}$ is HIGH for a Read Cycle.
9. Tested with the load in AC Test Loads and Waveforms *Figure (b)*. Transition is measured ±500mV from steady state voltage.
10. The internal write time is defined by the overlap of $\overline{CE}_1$ LOW, CE_2 HIGH and $\overline{WE}$ LOW. All signals must be in valid states to initiate a Write, but any can be deasserted to terminate the Write. The Data Input Set-up and Hold timing is referenced to the rising or falling edge of the signal that terminates the write.
11. Tested with $\overline{OE}$ HIGH for a minimum of 4 ns before $\overline{WE}$ = LOW to place I/O in High-Z state.
12. The device is continuously selected. $\overline{OE}$, $\overline{CE}_1 = V_{IL}$, $CE_2 = V_{IH}$.
13. Address is valid prior to, or coincident with, $\overline{CE}_1$ LOW and CE_2 HIGH transitions.
14. At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} and t_{HZOE} is less than t_{LZOE}.

Pin Descriptions

A_0 - A_{16}: Address Inputs

These 17 address inputs select one of the 131,072 8-bit words in the RAM.

$\overline{CE}_1$: Chip Enable 1 Input

$\overline{CE}_1$ is asserted LOW. The Chip Enable is asserted LOW to read from or write to the device. If Chip Enable 1 is deasserted, the device is deselected and is in a standby power mode. The I/O pins will be in the High-Z state when the device is deselected.

CE_2: Chip Enable 2 Input

CE_2 is asserted HIGH. The Chip Enable 2 is asserted HIGH to read from or write to the device. If CE_2 is deasserted, the device is deselected and is in a standby power mode. The I/O pins will be in the High-Z state when the device is deselected.

$\overline{OE}$: Output Enable Input

The Output Enable input is asserted (LOW). If the Output Enable is asserted (LOW) while $\overline{CE}_1$ is asserted (LOW), CE_2 is asserted (HIGH) and $\overline{WE}$ is deasserted (HIGH), data from the SRAM will be present on the I/O pins. The I/O pins will be in the High-Z state when $\overline{OE}$ is deasserted.

$\overline{WE}$: Write Enable Input

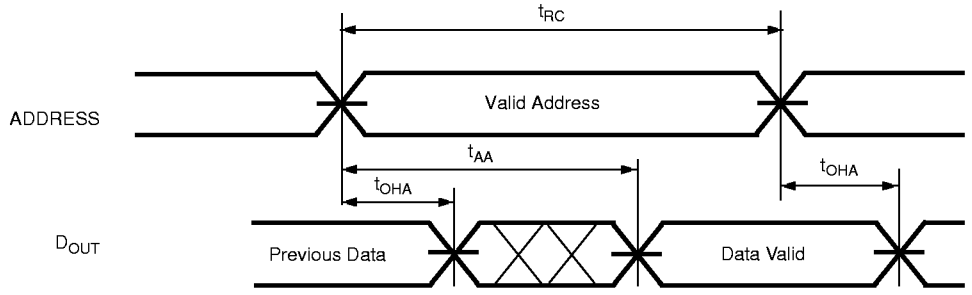
The Write Enable input is asserted LOW and controls read and write operations. When $\overline{CE}_1$ and $\overline{WE}$ are both asserted (LOW) and CE_2 is asserted (HIGH) input data present on the I/O pins will be written into the selected memory location.

I/O_0 - I/O_7: Common Input/Output Pins

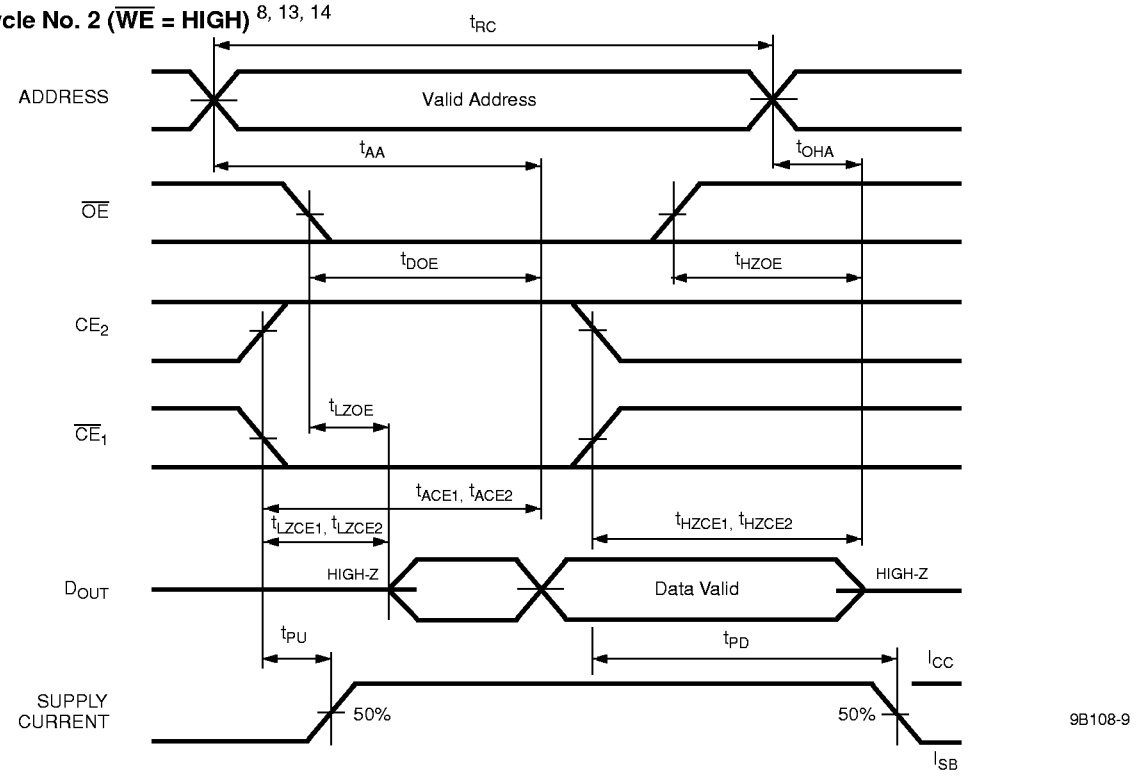
GND: Ground

Switching Waveforms

Read Cycle No. 1 ($\overline{CE}_1$ = LOW, CE_2 = HIGH, $\overline{OE}$ = LOW, $\overline{WE}$ = HIGH) [8, 12]

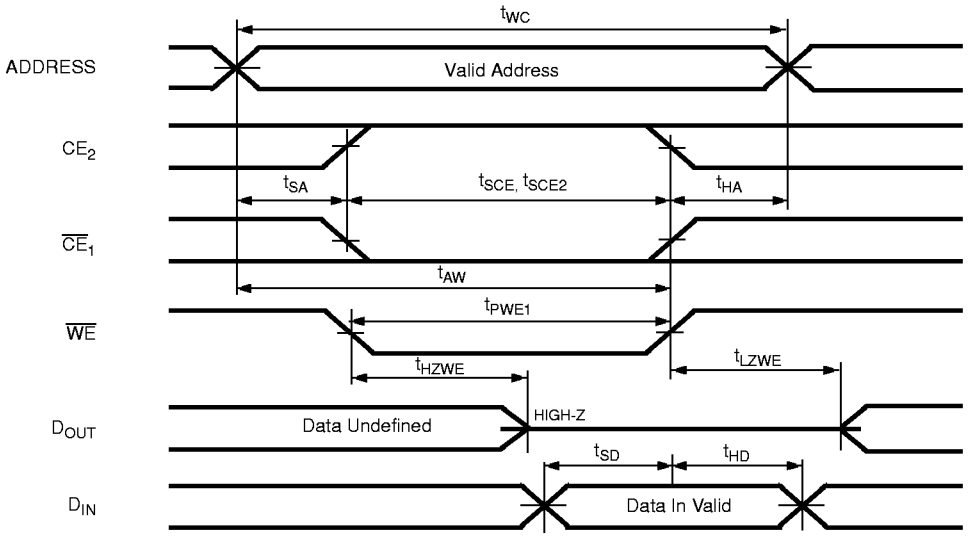


Read Cycle No. 2 ($\overline{WE}$ = HIGH) [8, 13, 14]



Switching Waveforms (continued)

Write Cycle No.1 ($\overline{CE}_1$, or CE_2 controlled, $\overline{OE}$ is HIGH or LOW: $\overline{CE}_1$ or CE_2 Terminates Write) [10]



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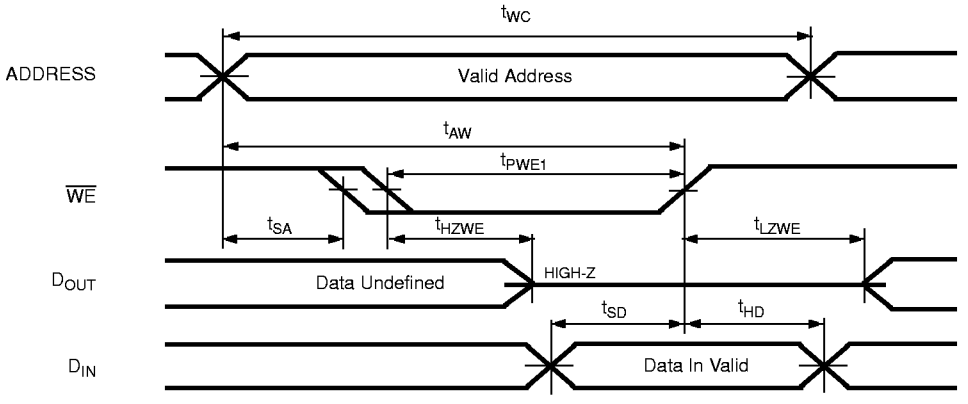
Write Cycle No.2 ($\overline{WE}$ controlled, $\overline{OE}$ is HIGH, $\overline{CE}_1$ is LOW, and CE_2 is HIGH: $\overline{WE}$ Terminates Write) [10]



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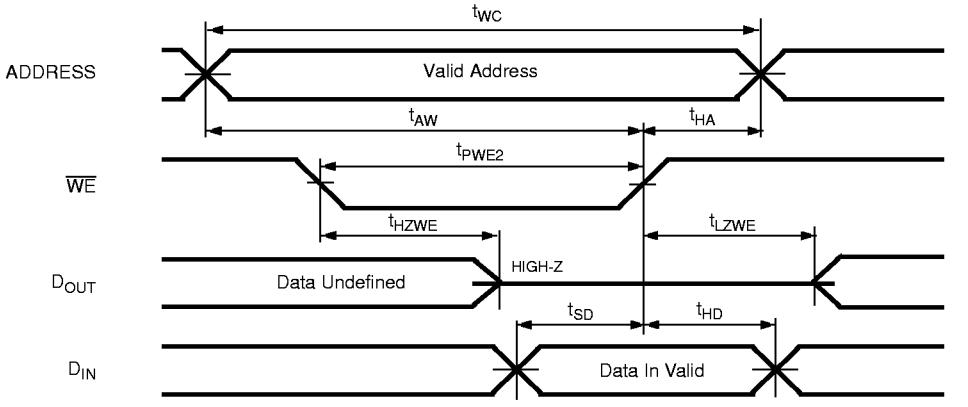
Write Cycle No.3 ($\overline{WE}$ controlled, $\overline{OE}$ is LOW, CE_2 is HIGH, $\overline{CE}_1$ is LOW: $\overline{WE}$ Terminates Write) [10]



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Truth Table

Mode	$\overline{WE}$	$\overline{CE_1}$	CE_2	$\overline{OE}$	I/O	I_{CC}
Standby	X	H	X	X	High-Z	I_{SB1}, I_{SB2}
Standby	X	X	L	X	High-Z	I_{SB1}, I_{SB2}
Selected/Output Disabled	H	L	H	H	High-Z	I_{CC1}, I_{CC2}
Read	H	L	H	L	D_{OUT}	I_{CC1}, I_{CC2}
Write	L	L	H	X	D_{IN}	I_{CC1}, I_{CC2}

Ordering Information

Standard - AP9B108

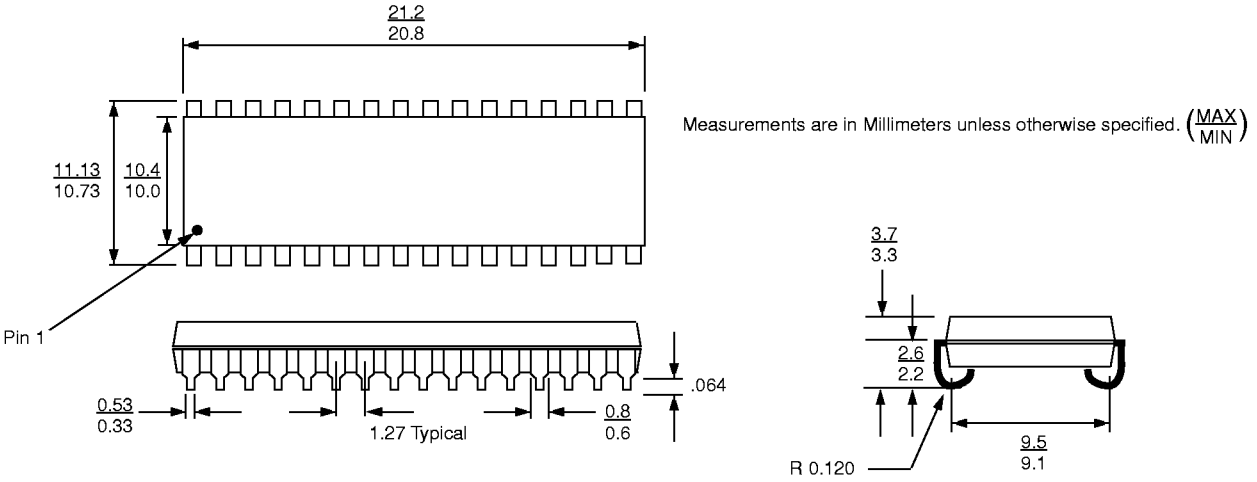
Speed	Part Number	Package Name	Package Type	Temperature Range
12	AP9B108-12VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9B108-12V3C	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Commercial
	AP9B108-12VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial
	AP9B108-12V3I	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Industrial
	AP9B108-12TC	T32.2	32-Pin Thin Small Outline Package	Commercial
	AP9B108-12TI	T32.2	32-Pin Thin Small Outline Package	Industrial
15	AP9B108-15VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9B108-15V3C	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Commercial
	AP9B108-15VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial
	AP9B108-15V3I	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Industrial
	AP9B108-15TC	T32.2	32-Pin Thin Small Outline Package	Commercial
	AP9B108-15TI	T32.2	32-Pin Thin Small Outline Package	Industrial

With Optional 2V Data Retention - AP9B108L

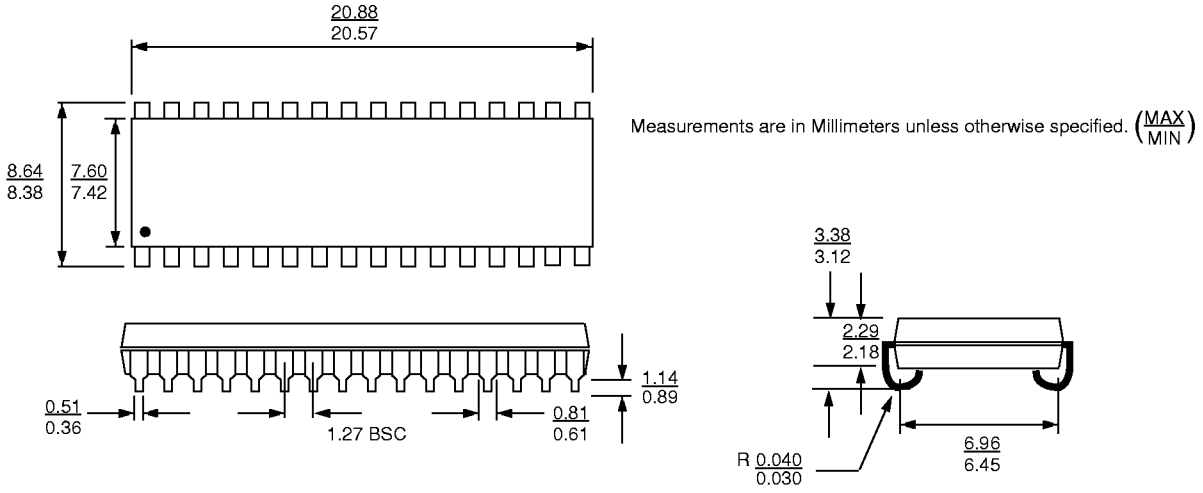
Speed	Part Number	Package Name	Package Type	Temperature Range
12	AP9B108L-12VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9B108L-12V3C	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Commercial
	AP9B108L-12VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial
	AP9B108L-12V3I	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Industrial
	AP9B108L-12TC	T32.2	32-Pin Thin Small Outline Package	Commercial
	AP9B108L-12TI	T32.2	32-Pin Thin Small Outline Package	Industrial
15	AP9B108L-15VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9B108L-15V3C	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Commercial
	AP9B108L-15VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial
	AP9B108L-15V3I	V32.2	32-Pin (300-Mil) Small Outline J-Bend	Industrial
	AP9B108L-15TC	T32.2	32-Pin Thin Small Outline Package	Commercial
	AP9B108L-15TI	T32.2	32-Pin Thin Small Outline Package	Industrial

Package Diagrams

V32.1 - 32-Pin (400-Mil) Small Outline J-Bend (SOJ)

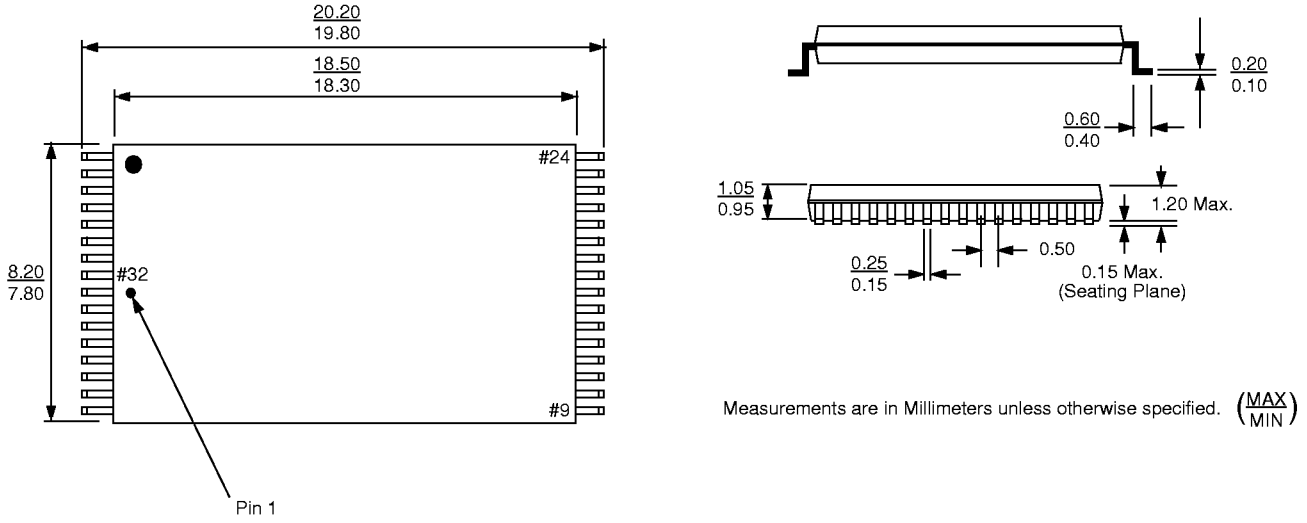


V32.2 - 32-Pin (300-Mil) Small Outline J-Bend (SOJ)



Package Diagrams (continued)

T32.2 - 32-Pin Thin Small Outline Package (TSOP)



Measurements are in Millimeters unless otherwise specified. (MAX/MIN)