Creation Date: July 29, 1998
Revision Date: October 6, 1998

Aptos SEMICONDUCTOR

PRELIMINARY

AP9A102B/AP9A102BL

5V, 256K x 4 Very High-Speed, Low-Power CMOS Static RAM with Optional 2V Data Retention

Features

- Fast access times: 6, 8, 10, 12 and 15 ns
- Fast output enable (t_{DOE}) for cache applications
- Drives a 50 pF load vs. 30 pF industry-standard load
- 2V/250 µA data retention ("L" version)
- Low active power: 467 mW (Max.) at 15 ns
- Low standby current: 11 mW (Max.)
- Fully static operation, no clock or refresh required
- TTL and CMOS-compatible inputs and outputs
- Single 5V ±10% power supply
- Packaged in industry-standard 28-pin SOJ
- Commercial and industrial temperature ranges

Functional Description

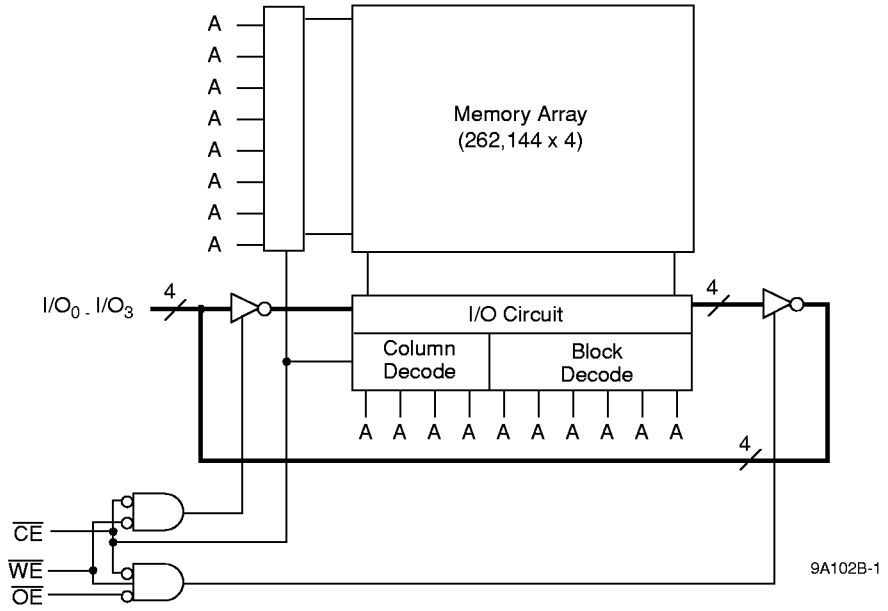
The Aptos AP9A102B/AP9A102BL is a high-speed, low-power, 256K x 4 CMOS static RAM. It is fabricated using Aptos' high-performance CMOS, 0.35µ technology. This highly reliable process, coupled with innovative circuit design techniques, yields access times as fast as 6 ns (Max).

When Chip Enable ($\overline{CE}$) is HIGH, the device assumes a standby mode at which the power dissipation can be reduced down to 11 mW (Max.) at CMOS input levels. At 2V V_{CC}, power is reduced to 0.5 mW (Max.) ("L" version).

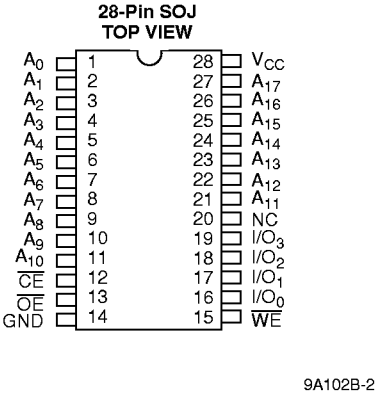
Easy memory expansion is provided by using asserted LOW $\overline{CE}$ and asserted LOW output enable inputs ($\overline{OE}$). The asserted LOW write enable ($\overline{WE}$) controls both writing and reading of the memory.

The AP9A102B/AP9A102BL is pin-compatible with other 5V, 256K x 4 SRAMs in the SOJ package.

Block Diagram



Pin Configuration



Selection Guide

	AP9A102B/L-6	AP9A102B/L-8	AP9A102B/L-10	AP9A102B/L-12	AP9A102B/L-15
Maximum Access Time (ns)	6	8	10	12	15
Maximum Operating Current (mA)	180	150	100	90	85
Maximum Standby Current (mA)	2	2	2	2	2

Aptos Semiconductor • 2254 North First Street, San Jose, CA 95131 • Phone: (408) 474-3000 FAX: (408) 474-0445

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 ..... -1.0 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] ..... ±50 mA

Power Dissipation ..... 1.0 W

Electrical Characteristics Over the Operating Range (0 °C ≤ T_A ≤ 70 °C, V_{CC} = 5V ± 10%) - *Commercial*

Symbol	Parameter	Test Conditions	9A102B/L-6		9A102B/L-8		9A102B/L-10		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = fmax.		180		150		100	mA
I_{CC2}	Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = 0		60		60		60	mA
I_{SB1}	TTL Standby Current -TTL Inputs	V_{CC} = Max., V_{IN} = V_{IH} or V_{IL}, $\overline{CE}$ ≥ V_{IH}, f=fmax.		30		30		15	mA
I_{SB2}	CMOS Standby Current -CMOS Inputs	V_{CC} = Max., $\overline{CE}$ ≥ V_{CC} -0.2V, V_{IN} ≥ V_{CC} -0.2V or V_{IN} ≤ 0.2 V, f = 0		2		2		2	mA
I_{LI}	Input Leakage Current	GND ≤ V_{IN} ≤ V_{CC}	-1	1	-1	1	-1	1	µA
I_{LO}	Output Leakage Current	GND ≤ V_{OUT} ≤ V_{CC}, Output Disabled	-1	1	-1	1	-1	1	µA
V_{OH}	Output High Voltage	V_{CC} = Min., I_{OH} = - 4.0 mA	2.4		2.4		2.4		V
V_{OL}	Output Low Voltage	V_{CC} = Min., I_{OL} = 8.0 mA		0.4		0.4		0.4	V
V_{IH}	Input High Voltage [3]		2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	V
V_{IL}	Input Low Voltage [3]		-0.5	0.8	-0.5	0.8	-0.5	0.8	V

Electrical Characteristics Over the Operating Range (0 °C ≤ T_A ≤ 70 °C, V_{CC} = 5V ± 10%) - *Commercial* (continued)

Symbol	Parameter	Test Conditions	9A102B/L-12		9A102B/L-15		Unit
			Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = fmax.		90		85	mA
I_{CC2}	Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = 0		60		60	mA
I_{SB1}	TTL Standby Current -TTL Inputs	V_{CC} = Max., V_{IN} = V_{IH} or V_{IL}, $\overline{CE}$ ≥ V_{IH}, f=fmax.		15		15	mA
I_{SB2}	CMOS Standby Current -CMOS Inputs	V_{CC} = Max., $\overline{CE}$ ≥ V_{CC} -0.2V, V_{IN} ≥ V_{CC} -0.2V or V_{IN} ≤ 0.2 V, f = 0		2		2	mA
I_{LI}	Input Leakage Current	GND ≤ V_{IN} ≤ V_{CC}	-1	1	-1	1	µA
I_{LO}	Output Leakage Current	GND ≤ V_{OUT} ≤ 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]		2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	V
V_{IL}	Input Low Voltage [3]		-0.5	0.8	-0.5	0.5	V

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

Symbol	Description	Test Conditions [4]	Min.	Max.	Unit
V_{DR}	V_{CC} for Data Retention	$V_{CC} = V_{DR} = 2.0V$, $\overline{CE} \geq V_{CC}-0.2$ V, $V_{IN} \geq V_{CC}-0.2$ V or $V_{IN} \leq 0.2$ V	2.0		V
I_{CCDR}	Data Retention Current			250	µA
t_{CDR}	Chip Deselect to Data Retention Time		0		ns
t_R	Operation Recovery Time		t_{RC}		ns

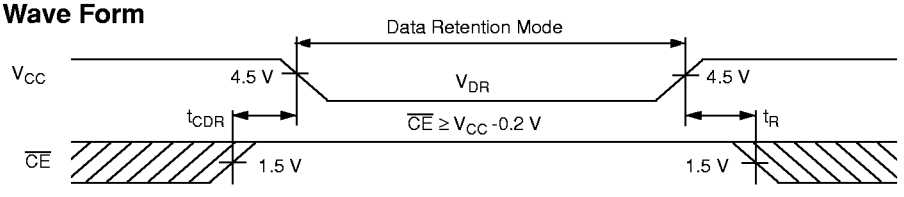
Electrical Characteristics Over the Operating Range (-40 °C ≤ T_A ≤ 85 °C, V_{CC} = 5V ± 10%) - *Industrial*

Symbol	Parameter	Test Conditions	9A102B/L-8		9A102B/L-10		9A102B/L-12		9A102B/L-15		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE} = V_{IL}$, f = fmax.		160		110		105		95	mA
I_{CC2}	Operating Current [2]	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE} = V_{IL}$, f = 0		70		70		70		70	mA
I_{SB1}	TTL Standby Current -TTL Inputs	V_{CC} = Max., $V_{IN} = V_{IH}$ or V_{IL}, $\overline{CE} \geq V_{IH}$, f = fmax.		35		25		25		25	mA
I_{SB2}	CMOS Standby Current -CMOS Inputs	V_{CC} = Max., $\overline{CE} \geq V_{CC}-0.2V$, $V_{IN} \geq V_{CC}$ -0.2 V or $V_{IN} \leq 0.2$ V, f = 0		5		5		5		5	mA
I_{LI}	Input Leakage Current	GND ≤ $V_{IN} \leq V_{CC}$	-5	5	-5	5	-5	5	-5	5	µA
I_{LO}	Output Leakage Current	GND ≤ $V_{OUT} \leq V_{CC}$, Output Disabled	-5	5	-5	5	-5	5	-5	5	µA
V_{OH}	Output High Voltage	V_{CC} = Min., I_{OH} = - 4.0 mA	2.4		2.4		2.4		2.4		V
V_{OL}	Output Low Voltage	V_{CC} = Min., I_{OL} = 8.0 mA		0.4		0.4		0.4		0.4	V
V_{IH}	Input High Voltage [3]		2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	V
V_{IL}	Input Low Voltage [3]		-0.5	0.8	-0.5	0.8	-0.5	0.8	-0.5	0.8	V

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

Symbol	Description	Test Conditions [4]	Min.	Max.	Unit
V_{DR}	V_{CC} for Data Retention		2.0		V
I_{CCDR}	Data Retention Current	$V_{CC} = V_{DR}$ = 2.0 V, $\overline{CE} \geq V_{CC}-0.2$ V, $V_{IN} \geq V_{CC}$ -0.2 V or $V_{IN} \leq 0.2$ V		5	mA
t_{CDR}	Chip Deselect to Data Retention Time		0		ns
t_R	Operation Recovery Time		t_{RC}		ns

Data Retention Wave Form



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} +0.5V (DC).
5. Tested initially and after any design or process changes that may effect these parameters.

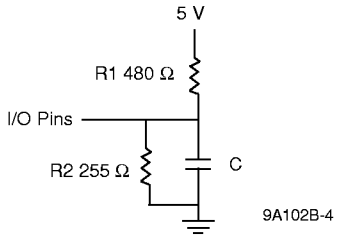
Capacitance [5]

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

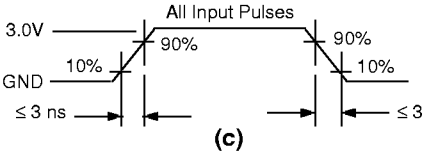
AC Test Loads and Waveforms

(a) C_1= 50 pF INCLUDING JIG AND SCOPE

(b) C_2=5 pF INCLUDING JIG AND SCOPE



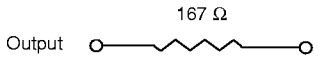
9A102B-4



9A102B-5

(c)

Equivalent to: Thevenin Equivalent



9A102B-6

Switching Characteristics Over the Operating Range [6, 7]

Parameter	Description	9A102B/L-6		9A102B/L-8		9A102B/L-10		9A102B/L-12		9A102B/L-15		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle [8]												
t_{RC}	Read Cycle Time	6		8		10		12		15		ns
t_{AA}	Address Access Time		6		8		10		12		15	ns
t_{OHA}	Output Hold Time	3		3		3		3		3		ns
t_{ACE}	$\overline{CE}$ Access Time		6		8		10		12		15	ns
t_{DOE}	$\overline{OE}$ Access Time		3		3		4		5		7	ns
t_{LZOE} [9]	$\overline{OE}$ to Low-Z Output	0		0		0		0		0		ns
t_{HZOE} [9]	$\overline{OE}$ to High-Z Output		3		3		4		5		6	ns
t_{LZCE} [9]	$\overline{CE}$ to Low-Z Output	3		3		3		3		3		ns
t_{HZCE} [9]	$\overline{CE}$ to High-Z Output		3		3		4		6		8	ns
t_{PU}	$\overline{CE}$ to Power Up	0		0		0		0		0		ns
t_{PD}	$\overline{CE}$ to Power Down		6		8		10		12		15	ns
Write Cycle [10]												
t_{WC}	Write Cycle Time	6		8		10		12		15		ns
t_{SCE}	$\overline{CE}$ to Write End	6		7		8		8		10		ns
t_{AW}	Address Set-up Time to Write End	6		7		8		8		10		ns
t_{HA}	Address Hold to Write End	0		0		0		0		0		ns
t_{SA}	Address Set-up Time to Write Start	0		0		0		0		0		ns
t_{PWE1} [11]	$\overline{WE}$ Pulse Width ($\overline{OE}$ =HIGH)	5		7		8		8		10		ns
t_{PWE2}	$\overline{WE}$ Pulse Width ($\overline{OE}$ =LOW)	6		8		10		12		12		ns
t_{SD}	Data Set-up to Write End	4		5		6		6		7		ns
t_{HD}	Data Hold from Write End	0		0		0		0		0		ns
t_{HZWE} [9]	$\overline{WE}$ LOW to High-Z Output		2		3		5		6		7	ns
t_{LZWE} [9]	$\overline{WE}$ HIGH to Low-Z Output	2		2		2		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 $\overline{CE}$ LOW 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. $\overline{OE}$, $\overline{CE}$ = V_{IL}.
13. Address is valid prior to, or coincident with, $\overline{CE}$ LOW 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_{17}: Address Inputs

These 18 address inputs select one of the 256K, 4-bit words in the RAM.

$\overline{CE}$: Chip Enable Input

$\overline{CE}$ is asserted LOW. The Chip Enable is asserted LOW to read from or write to the device. If Chip Enable 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 $\overline{CE}$ is asserted (LOW) 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 (HIGH).

$\overline{WE}$: Write Enable Input

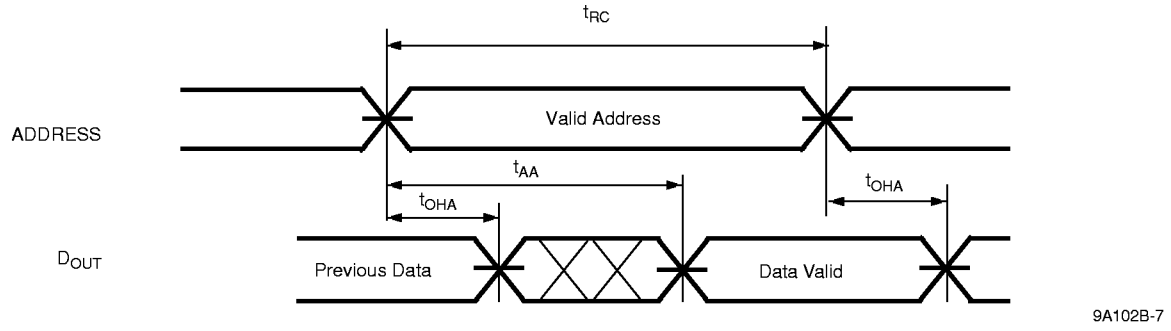
The Write Enable input is asserted LOW and controls read and write operations. When $\overline{CE}$ and $\overline{WE}$ are both asserted (LOW) input data present on the I/O pins will be written into the selected memory location.

I/O_0 - I/O_3: Common Input/Output Pins

GND: Ground

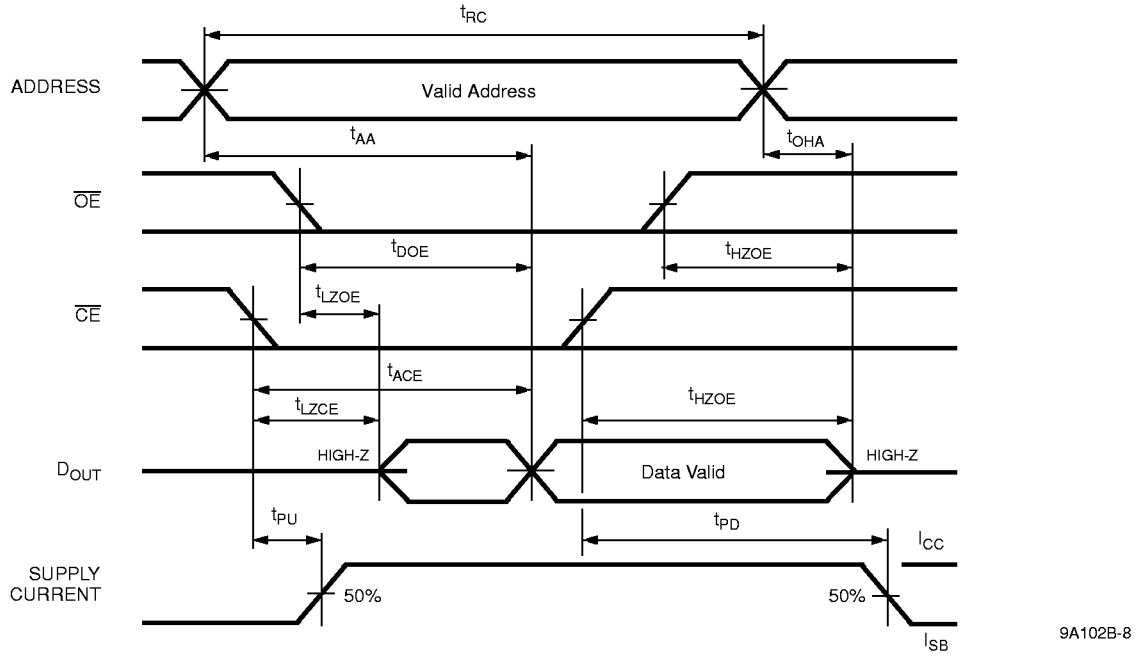
Switching Waveforms

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



9A102B-7

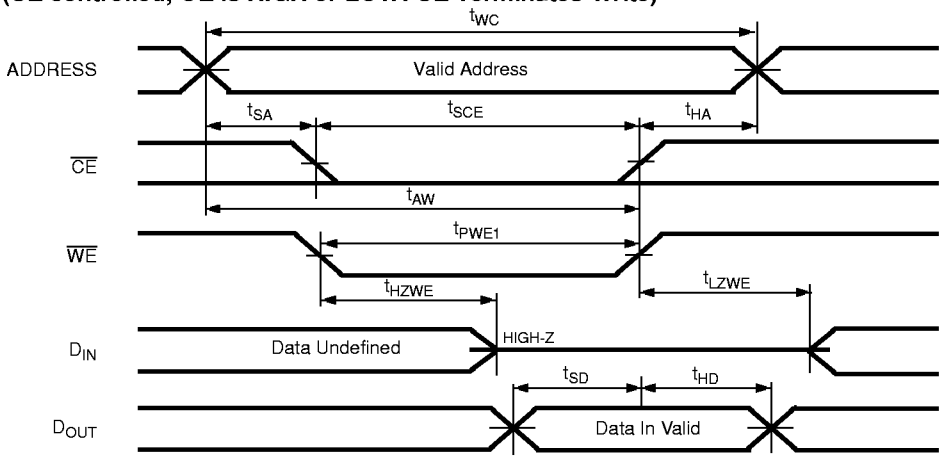
Read Cycle No. 2 ($\overline{WE}$ = HIGH) [8, 13, 14]



9A102B-8

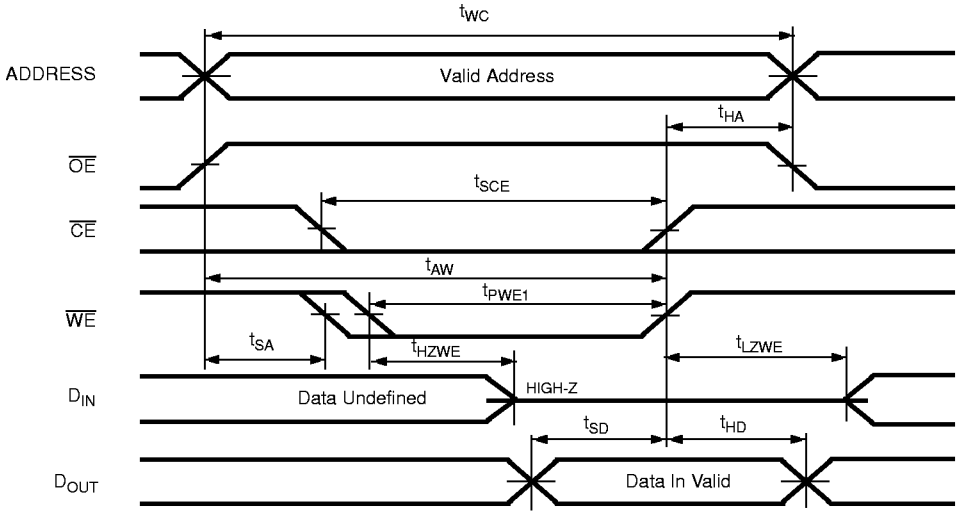
Switching Waveforms (continued)

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



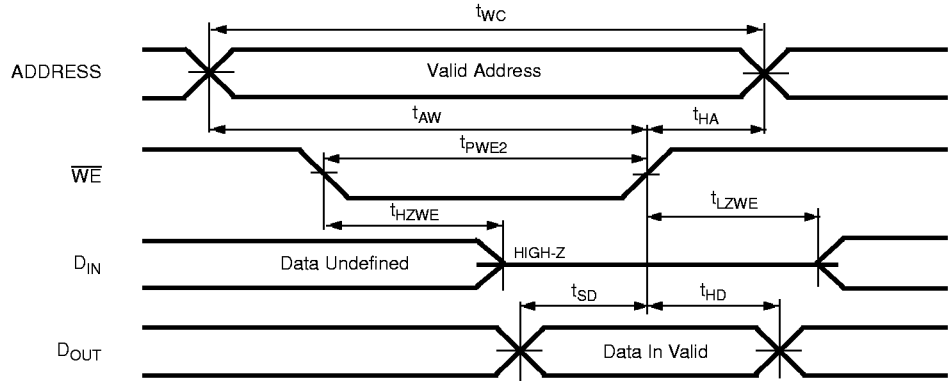
9A102B-9

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



9A102B-10

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



9A102B-11

Truth Table

Mode	$\overline{WE}$	$\overline{CE}$	$\overline{OE}$	I/O	I_{CC}
Not Selected (Power Down)	X	H	X	High-Z	I_{SB1}, I_{SB2}
Output Disabled	H	L	H	High-Z	I_{CC1}, I_{CC2}
Read	H	L	L	D_{OUT}	I_{CC1}, I_{CC2}
Write	L	L	X	D_{IN}	I_{CC1}, I_{CC2}

Ordering Information [15]

Standard - AP9A102B

Speed	Part Number	Package Name	Package Type	Temperature Range
6	AP9A102B-6VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
8	AP9A102B-8VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102B-8VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial
10	AP9A102B-10VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102B-10VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial
12	AP9A102B-12VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102B-12VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial
15	AP9A102B-15VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102B-15VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial

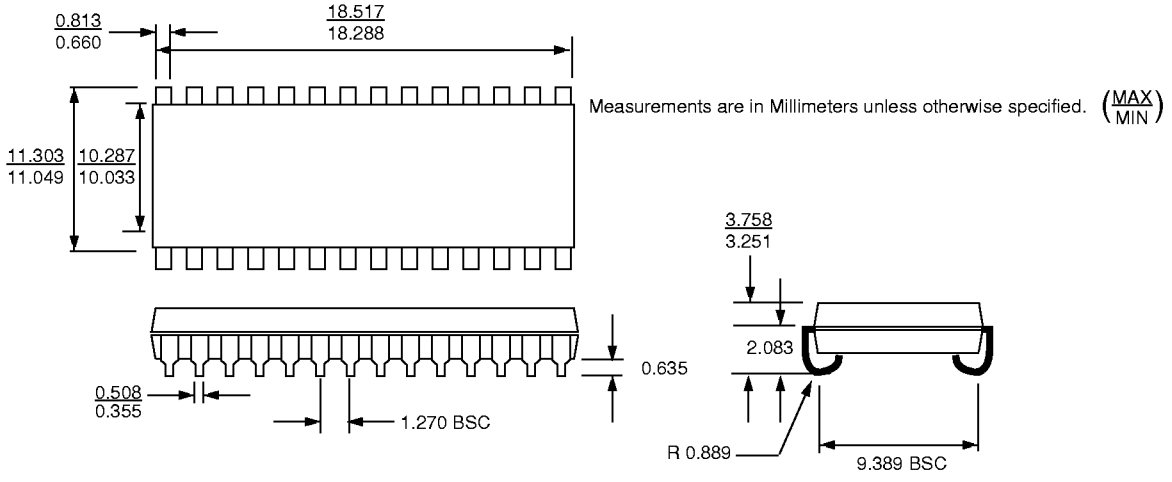
With Optional 2V Data Retention - AP9A102BL

Speed	Part Number	Package Name	Package Type	Temperature Range
6	AP9A102BL-6VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
8	AP9A102BL-8VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102BL-8VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial
10	AP9A102BL-10VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102BL-10VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial
12	AP9A102BL-12VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102BL-12VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial
15	AP9A102BL-15VC	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A102BL-15VI	V28.2	28-Pin (400-Mil) Small Outline J-Bend	Industrial

Document # DS-00012-Rev B

Package Diagram

V28.2 - 28-Pin (400-Mil) Small Outline J-Bend (SOJ)



Note:

15. For additional package options, please contact factory.