Aptos SEMICONDUCTOR

AP9A109

128K x 8 High Speed CMOS Static RAM

Features

- Fast access times: 10, 12, 15 and 20ns
- Fast output enable (t_{DOE}) for cache applications
- Low active power -500 mW (Typical)
- Drives a 50 pF load vs. 30 pF industry-standard load
- Low standby power
- Fully static operation, no clock or refresh required
- TTL-compatible inputs and outputs
- Single +5V power supply
- Packaged in industry standard 32-Pin SOJ

Functional Description

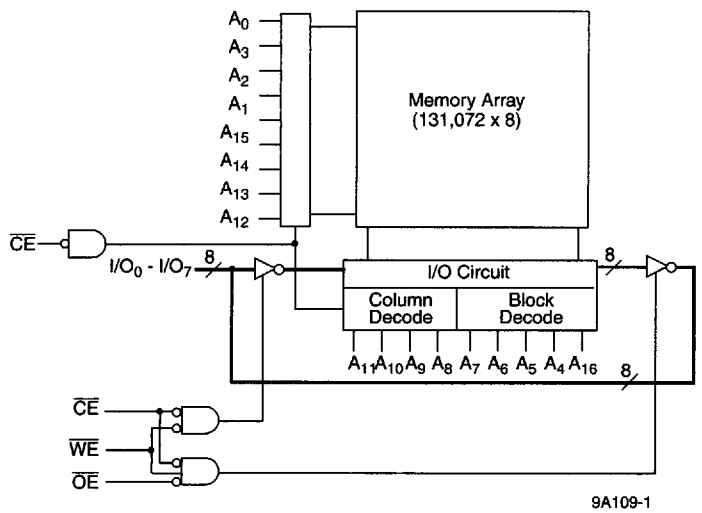
The Aptos AP9A109 is a high speed, low power, 128K word by 8-bit CMOS static RAM. It is fabricated using Aptos' high-performance CMOS, double metal technology. This highly reliable process coupled with innovative circuit design techniques, yields access times as fast as 10 ns (Max).

When Chip Enable ($\overline{CE}$) is HIGH the device assumes a standby mode at which the power dissipation can be reduced down to 75 mW (max.) at CMOS input levels.

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 AP9A109 is pin-compatible with other 128K x 8 center power and ground SRAMs in the SOJ package.

Block Diagram



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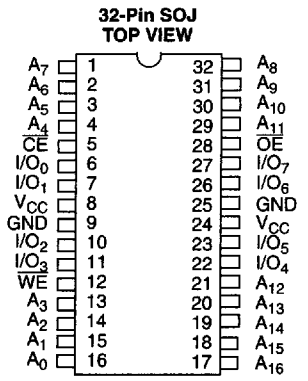
Pin Configuration



9A109-2

Selection Guide

	AP9A109-10	AP9A109-12	AP9A109-15	AP9A109-20
Maximum Access Time (ns)	10	12	15	20
Maximum Operating Current (mA)	140	120	115	110
Maximum Standby Current (mA)	15	15	15	15

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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 ..... -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

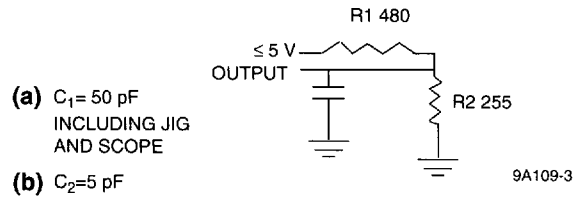
Electrical Characteristics Over the Operating Range (0 °C ≤ T_A ≤ 70 °C, V_{CC} = 5V ±10%) *-Commercial*

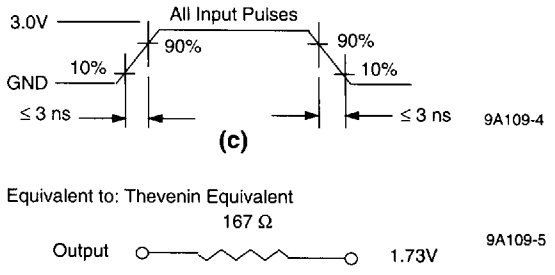
Symbol	Parameter	Test Conditions	9A109-10		9A109-12		9A109-15		9A109-20		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = fmax.		140		120		115		110	mA
I_{CC2}	Operating Current	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = 0		90		90		90		90	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		30		30	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		15		15		15		15	mA
I_{LI}	Input Leakage Current	GND ≤ V_{IN} ≤ V_{CC}	-1	1	-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	-1	1	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		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 [2]		-0.5	0.8	-0.5	0.8	-0.5	0.8	-0.5	0.8	V

Capacitance [3]

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

AC Test Loads and Waveforms [4, 5]





Notes:

1. No more than one output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
2. V_{IL} = -3.0 V for pulse width less than 3 ns.
3. Tested initially and after any design or process changes that may effect these parameters.
4. Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 - 3.0 V and output loading specified in AC Test Loads and Waveforms *Figure (a)*.
5. Tested with the load in AC Test Loads and Waveforms *Figure (b)*. Transition is measured ±500mV from steady state voltage.

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

Symbol	Parameter	Test Conditions	9A109-12		9A109-15		9A109-20		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	
I_{CC1}	Dynamic Operating Current	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = fmax.		150		140		130	mA
I_{CC2}	Operating Current	V_{CC} = Max., I_{OUT} = 0 mA, $\overline{CE}$ = V_{IL}, f = 0		100		100		100	mA
I_{SB1}	TTL Standby Current -TTL Inputs	V_{CC} = Max., V_{IN} = V_{IH} or V_{IL}, $\overline{CE}$ ≥ V_{IH}, f=fmax.		40		40		40	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		20		20		20	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		2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	V
V_{IL}	Input Low Voltage [2]		-0.5	0.8	-0.5	0.8	-0.5	0.8	V

Switching Characteristics Over the Operating Range [6, 7, 8, 9]

Parameter	Description	9A109-10		9A109-12		9A109-15		9A109-20		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle										
t_{RC}	Read Cycle Time	10		12		15		20		ns
t_{AA}	Address Access Time		10		12		15		20	ns7
t_{OHA}	Output Hold Time	3		3		3		3		ns
t_{ACE}	$\overline{CE}$ Access Time		10		12		15		20	ns
t_{DOE}	$\overline{OE}$ Access Time		4		5		7		8	ns
t_{LZOE}	$\overline{OE}$ to Low-Z Output	0		0		0		0		ns
t_{HZOE} [5]	$\overline{OE}$ to High-Z Output		4		5		6		7	ns
t_{LZCE}	$\overline{CE}$ to Low-Z Output	3		3		3		3		ns
t_{HZCE}	$\overline{CE}$ to High-Z Output		4		6		8		9	ns
t_{PU}	$\overline{CE}$ to Power Up	0		0		0		0		ns
t_{PD}	$\overline{CE}$ to Power Down		10		12		15		20	ns
Write Cycle [10]										
t_{WC}	Write Cycle Time	10		12		15		20		ns
t_{SCE}	$\overline{CE}$ to Write End	8		8		10		12		ns
t_{AW}	Address to Set-up Time to Write End	8		8		10		12		ns
t_{HA}	Address Hold to Write End	0		0		0		0		ns
t_{SA}	Address Set-up Time	0		0		0		0		ns
t_{PWE1} [11]	$\overline{WE}$ Pulse Width ($\overline{OE}$ =HIGH)	8		8		10		12		ns
t_{PWE2}	$\overline{WE}$ Pulse Width ($\overline{OE}$ =LOW)	10		12		12		15		ns
t_{SD}	Data Set-up to Write End	6		6		7		10		ns
t_{HD}	Data Hold from Write End	0		0		0		0		ns
t_{HZWE} [5]	$\overline{WE}$ LOW to High-Z Output		6		6		7		9	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low-Z Output	2		2		2		2		ns

Notes:

6. $\overline{WE}$ is HIGH for a Read Cycle.
7. The device is continuously selected. $\overline{OE}$, $\overline{CE}$ = V_{IL}.
8. Address is valid prior to or coincident with $\overline{CE}$ LOW transitions.
9. I/O will assume the High-Z state if $\overline{OE} \geq V_{IH}$.
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 signal can be deasserted to terminate the write. The Data Input Set-up and Hold timing are referenced to the rising or falling edge of the signal that terminates the write.
11. Tested with $\overline{OE}$ High.

Pin Descriptions

A_0 - A_{16}: Address Inputs

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

$\overline{CE}$: 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-impedance 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-impedance state when $\overline{OE}$ is deasserted.

$\overline{WE}$: Write Enable Input

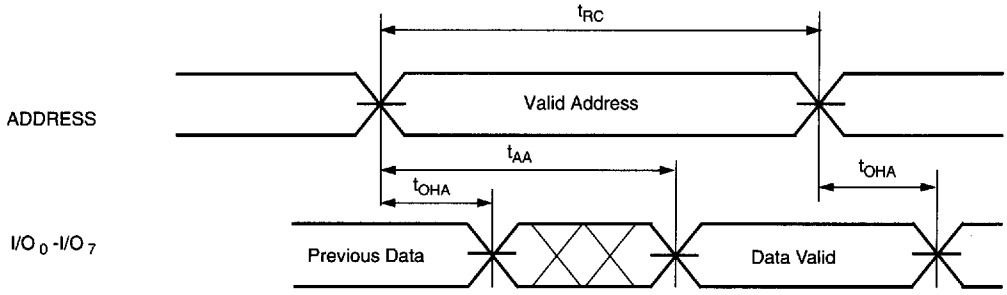
The Write Enable input is asserted LOW and controls read and write operations. When $\overline{CE}$ and $\overline{WE}$ are both asserted (LOW) input data present on the I/O pins will be written into the selected memory location.

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

GND: Ground

Switching Waveforms

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



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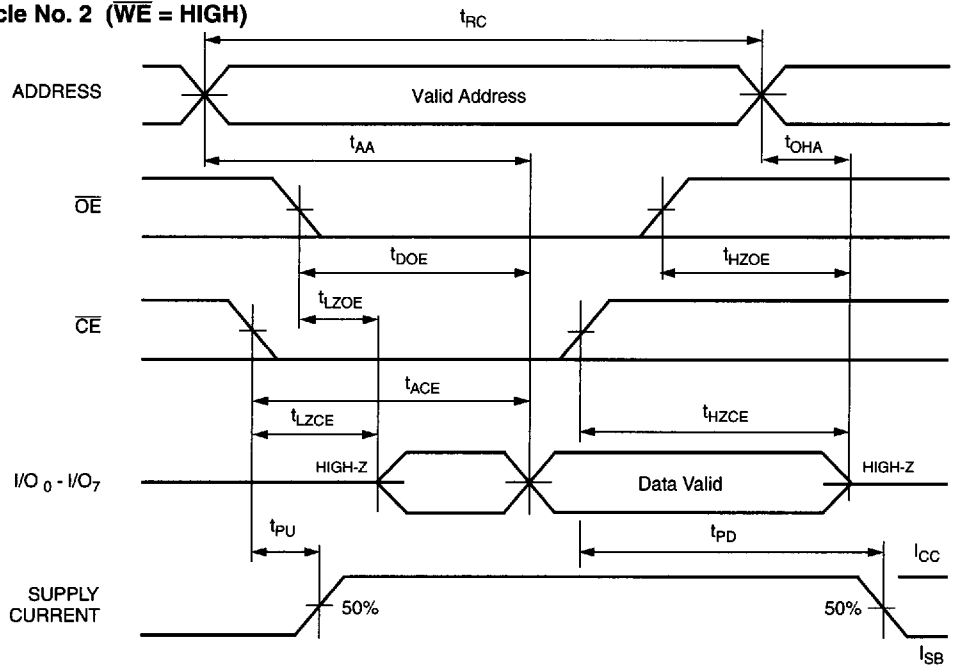
Read Cycle No. 2 ($\overline{WE}$ = HIGH)



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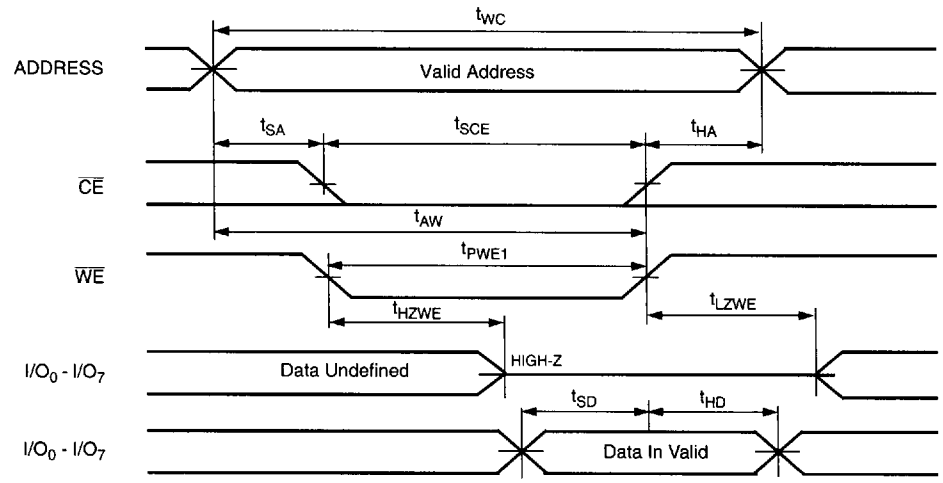
Switching Waveforms (continued)

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



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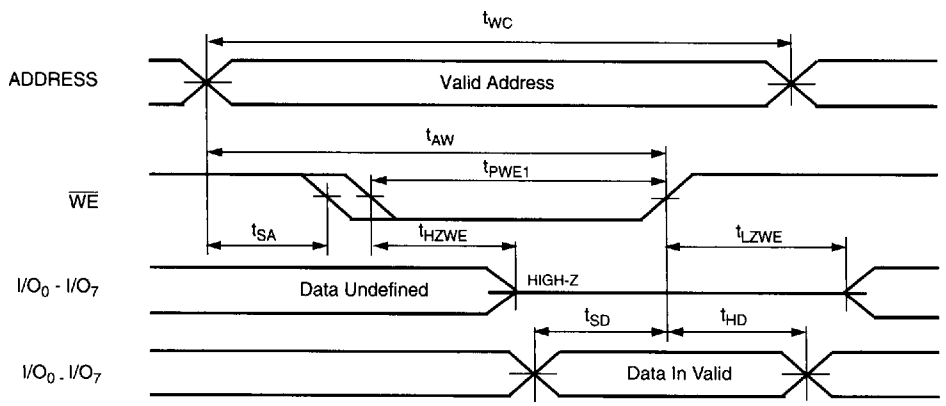
Write Cycle No.2 ($\overline{WE}$ controlled, $\overline{OE}$ is HIGH, $\overline{CE}$ is LOW : $\overline{WE}$ Terminates Write)



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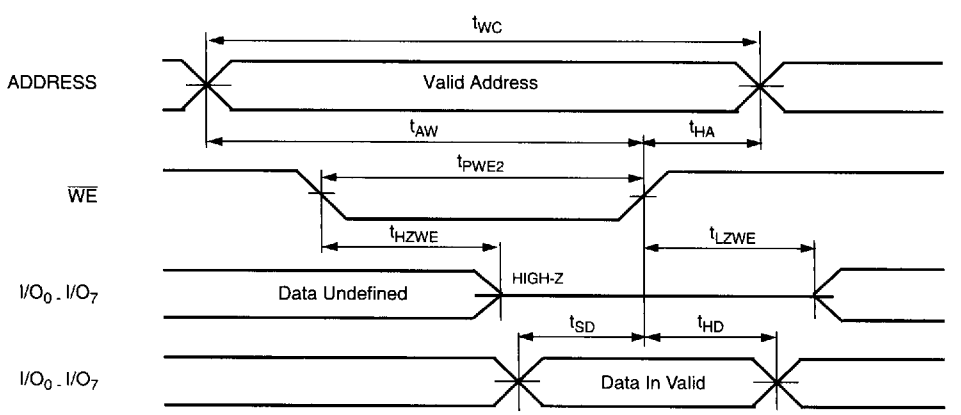
Write Cycle No.3 ($\overline{WE}$ controlled, $\overline{OE}$ is LOW, $\overline{CE}$ is LOW: $\overline{WE}$ Terminates Write)



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Truth Table

Mode	$\overline{WE}$	$\overline{CE}$	$\overline{OE}$	I/O	I_{CC}
Standby	X	H	X	High-Z	I_{SB1}, I_{SB2}
Selected/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

Speed	Part Number	Package Name	Package Type	Temperature Range
10	AP9A109-10VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
12	AP9A109-12VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A109-12VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial
15	AP9A109-15VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A109-15VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial
20	AP9A109-20VC	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Commercial
	AP9A109-20VI	V32.1	32-Pin (400-Mil) Small Outline J-Bend	Industrial

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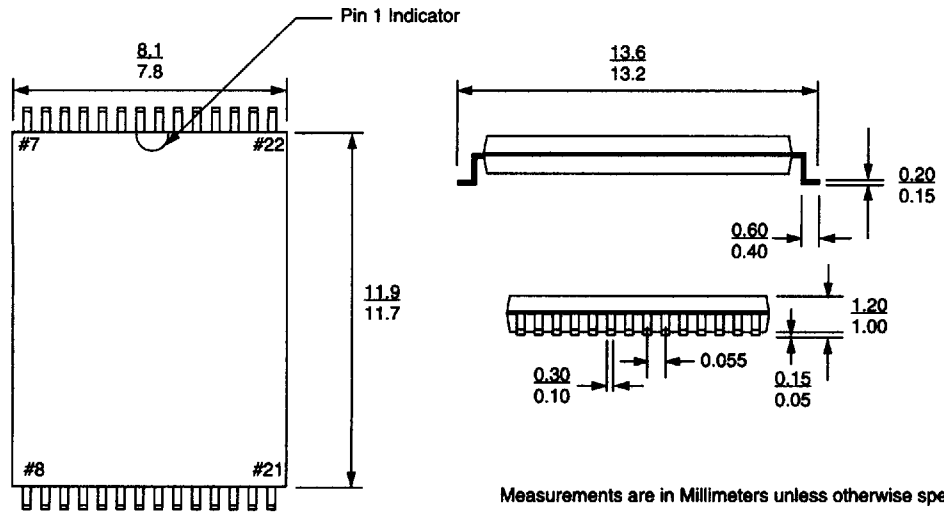
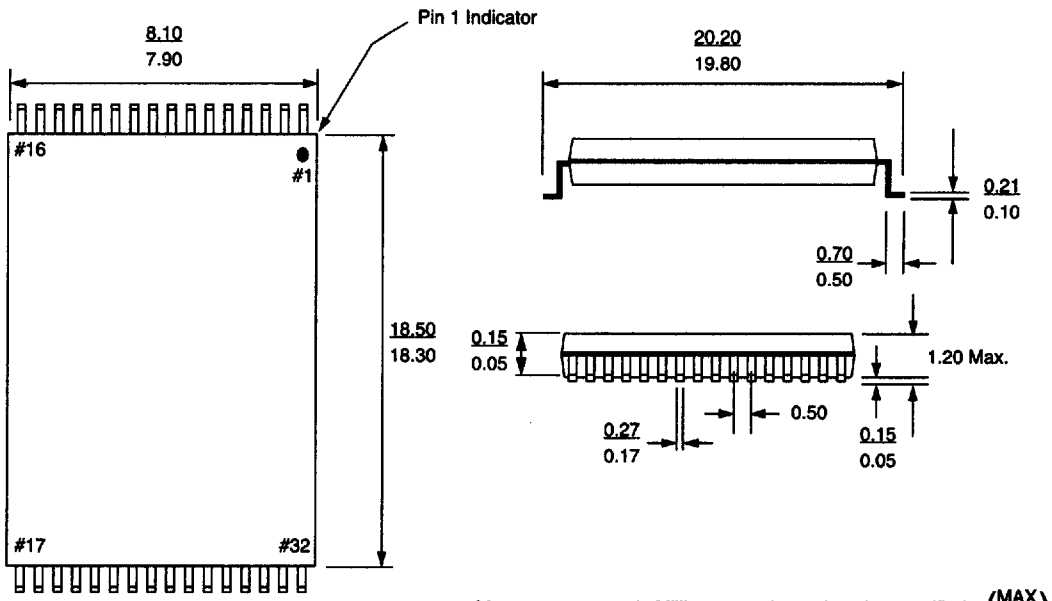
T28.1 - 28-Pin Thin Small Outline Package (TSOP)



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

T32.1 - 32-Pin Thin Small Outline Package (TSOP)



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

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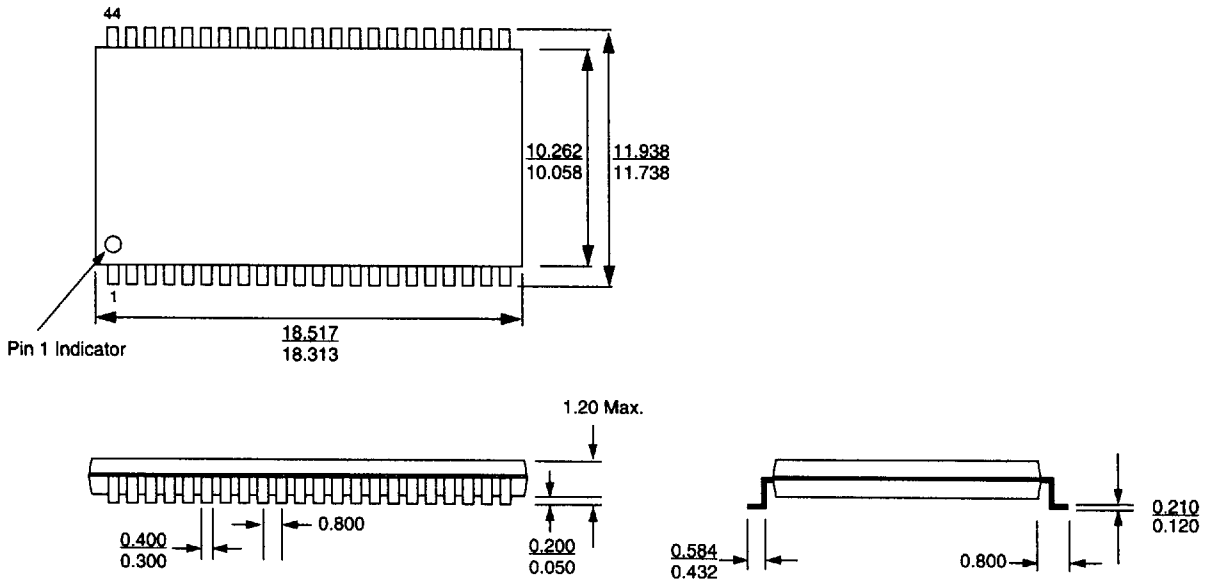
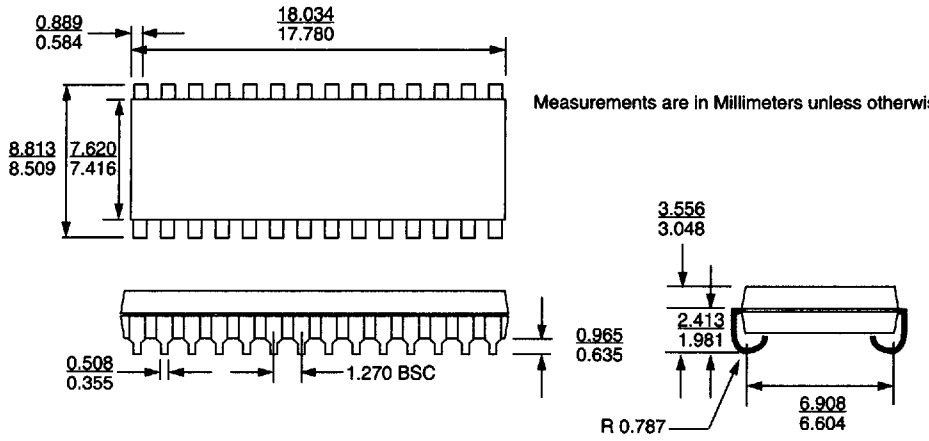
T44.1 - 44-Pin (400-Mil) Thin Small Outline Package (TSOP)



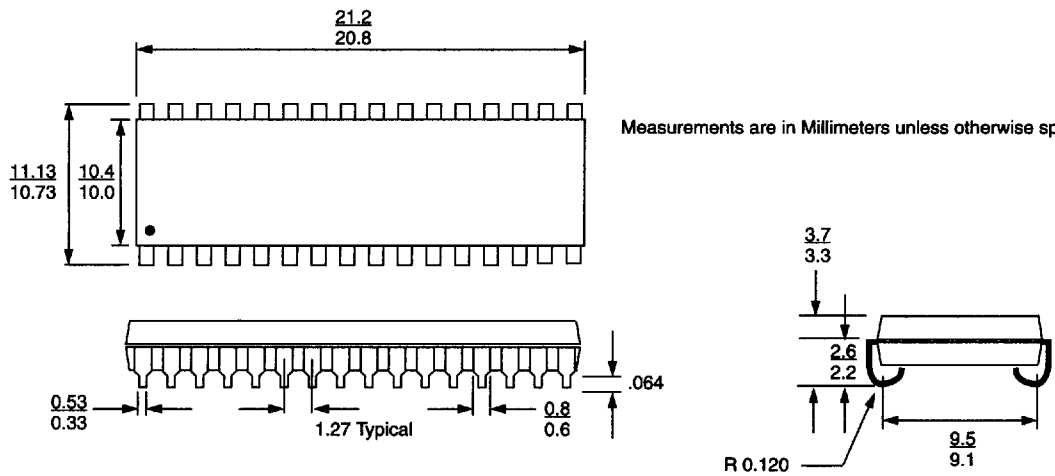
Measurements are in Millimeters unless otherwise specified. (MAX/MIN)

V28.1 - 28-Pin (300-Mil) Small Outline J-Bend (SOJ)



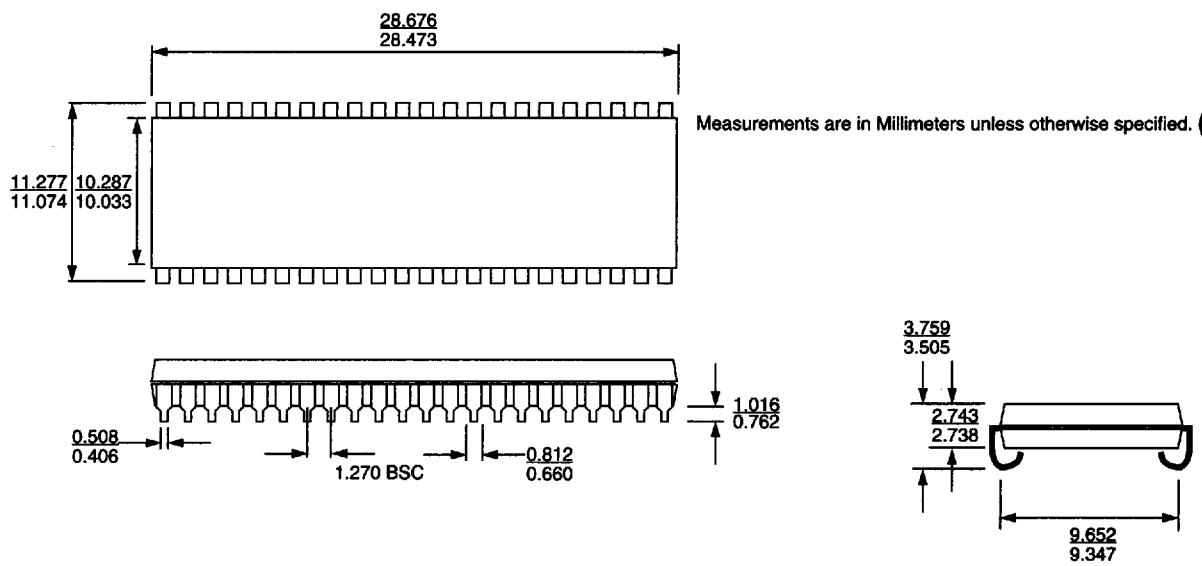
Measurements are in Millimeters unless otherwise specified. (MAX/MIN)

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



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

V44.1 - 44-Pin (400-Mil) Small Outline J-Bend (SOJ)



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