

128K x 8 Static RAM

Features

- High speed
 - $t_{AA} = 12 \text{ ns}$
- Low active power
 - 495 mW (max. 12 ns)
- Low CMOS standby power
 - 55 mW (max.) 4 mW
- 2.0V Data Retention
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with $\overline{CE}_1$, $\overline{CE}_2$, and $\overline{OE}$ options

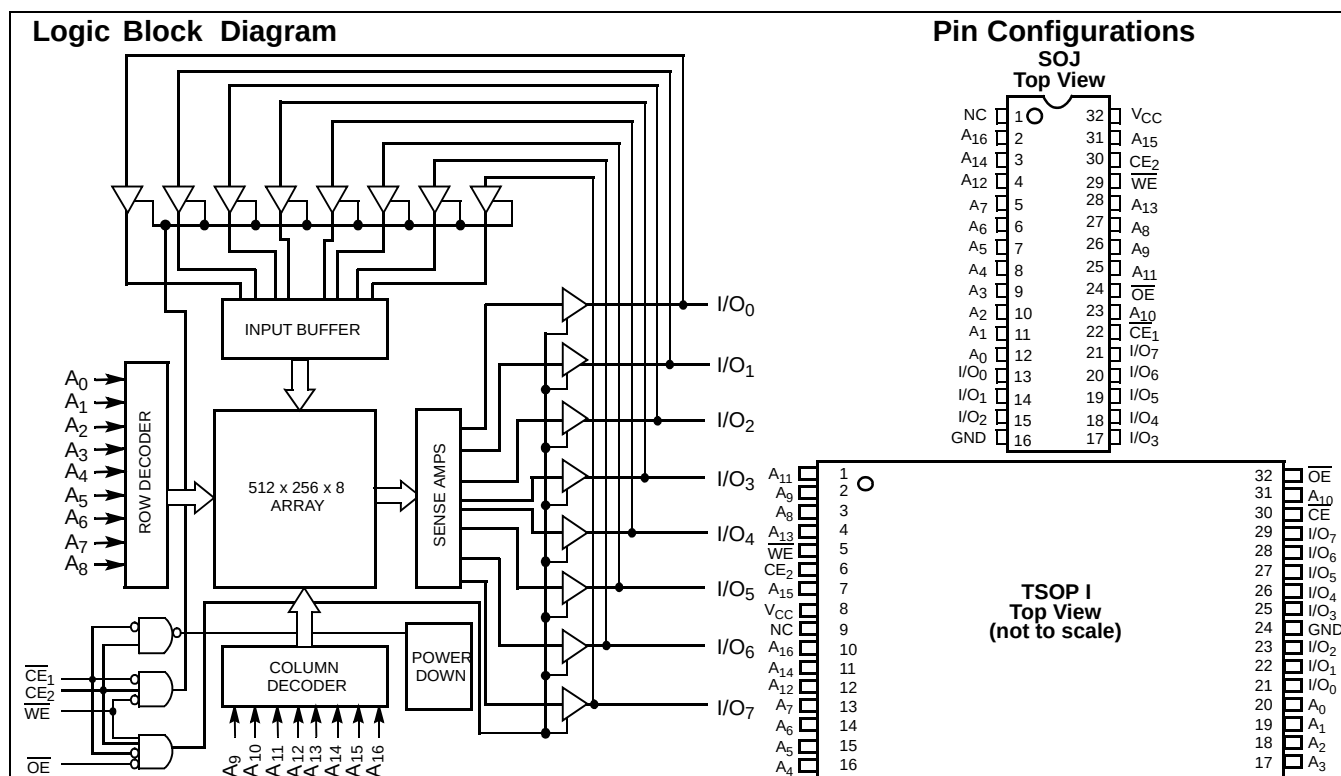
Functional Description^[1]

The CY7C109BN/CY7C1009BN is a high-performance CMOS static RAM organized as 131,072 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ($\overline{CE}_1$), an active HIGH Chip Enable ($\overline{CE}_2$), an active LOW Output Enable ($\overline{OE}$), and three-state drivers. Writing to the device is accomplished by taking Chip Enable One ($\overline{CE}_1$) and Write Enable (WE) inputs LOW and Chip Enable Two ($\overline{CE}_2$) input HIGH. Data on the eight I/O pins (I/O₀ through I/O₇) is then written into the location specified on the address pins (A₀ through A₁₆).

Reading from the device is accomplished by taking Chip Enable One ($\overline{CE}_1$) and Output Enable ($\overline{OE}$) LOW while forcing Write Enable (WE) and Chip Enable Two ($\overline{CE}_2$) HIGH. Under these conditions, the contents of the memory location specified by the address pins will appear on the I/O pins.

The eight input/output pins (I/O₀ through I/O₇) are placed in a high-impedance state when the device is deselected ($\overline{CE}_1$ HIGH or $\overline{CE}_2$ LOW), the outputs are disabled ($\overline{OE}$ HIGH), or during a write operation ($\overline{CE}_1$ LOW, $\overline{CE}_2$ HIGH, and WE LOW).

The CY7C109BN is available in standard 400-mil-wide SOJ and 32-pin TSOP type I packages. The CY7C1009BN is available in a 300-mil-wide SOJ package. The CY7C1009BN and CY7C109BN are functionally equivalent in all other respects.



Note:

1. For guidelines on SRAM system design, please refer to the 'System Design Guidelines' Cypress application note, available on the internet at www.cypress.com.

Selection Guide

		7C109B-12 7C1009B-12	7C109B-15 7C1009B-15	7C109B-20 7C1009B-20	Unit
Maximum Access Time		12	15	20	ns
Maximum Operating Current		90	80	75	mA
Maximum CMOS Standby Current		10	10	10	mA
	L	2	2	2	mA

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

Supply Voltage on V_{CC} to Relative GND^[2] -0.5V to +7.0V

DC Voltage Applied to Outputs
in High Z State^[2] -0.5V to $V_{CC} + 0.5V$

DC Input Voltage^[2] -0.5V to $V_{CC} + 0.5V$

Current into Outputs (LOW) 20 mA

Static Discharge Voltage >2001V
(per MIL-STD-883, Method 3015)

Latch-Up Current >200 mA

Operating Range

Range	Ambient Temperature	V_{CC}
Commercial	0°C to +70°C	5V ± 10%
Industrial	-40°C to +85°C	5V ± 10%

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	7C109BN-12 7C1009BN-12		7C109BN-15 7C1009BN-15		7C109BN-20 7C1009BN-20		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$	2.4		2.4		2.4		V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$		0.4		0.4		0.4	V
V_{IH}	Input HIGH Voltage		2.2	$V_{CC} + 0.3$	2.2	$V_{CC} + 0.3$	2.2	$V_{CC} + 0.3$	V
V_{IL}	Input LOW Voltage ^[2]		-0.3	0.8	-0.3	0.8	-0.3	0.8	V
I_{IX}	Input Leakage Current	$GND \leq V_I \leq V_{CC}$	-1	+1	-1	+1	-1	+1	μA
I_{OZ}	Output Leakage Current	$GND \leq V_I \leq V_{CC}$, Output Disabled	-5	+5	-5	+5	-5	+5	μA
I_{OS}	Output Short Circuit Current ^[3]	$V_{CC} = \text{Max.}, V_{OUT} = GND$		-300		-300		-300	mA
I_{CC}	V_{CC} Operating Supply Current	$V_{CC} = \text{Max.}, I_{OUT} = 0 \text{ mA}$, $f = f_{MAX} = 1/t_{RC}$		90		80		75	mA
I_{SB1}	Automatic CE Power-Down Current —TTL Inputs	Max. V_{CC} , $\overline{CE}_1 \geq V_{IH}$ or $\overline{CE}_2 \leq V_{IL}$, $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$, $f = f_{MAX}$		45		40		30	mA
I_{SB2}	Automatic CE Power-Down Current —CMOS Inputs	Max. V_{CC} , $\overline{CE}_1 \geq V_{CC} - 0.3V$, or $\overline{CE}_2 \leq 0.3V$, $V_{IN} \geq V_{CC} - 0.3V$, or $V_{IN} \leq 0.3V$, $f = 0$		10		10		10	mA
		L		2		2		2	mA

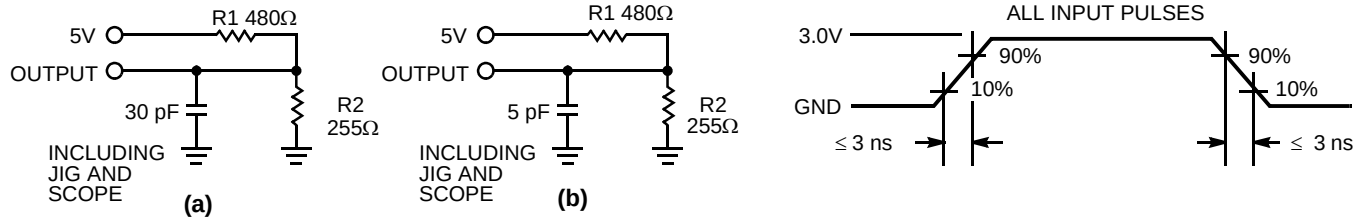
Capacitance^[4]

Parameter	Description	Test Conditions	Max.	Unit
C_{IN}	Input Capacitance	$T_A = 25^\circ\text{C}$, $f = 1 \text{ MHz}$, $V_{CC} = 5.0V$	9	pF
C_{OUT}	Output Capacitance		8	pF

Notes:

- Minimum voltage is -2.0V for pulse durations of less than 20 ns.
- Not more than one output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
- Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms



Equivalent to: THÉVENIN EQUIVALENT

OUTPUT $\frac{167\Omega}{1.73V}$

Switching Characteristics^[5] Over the Operating Range

Parameter	Description	7C109BN-12 7C1009BN-12		7C109BN-15 7C1009BN-15		7C109BN-20 7C1009BN-20		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle								
t _{RC}	Read Cycle Time	12		15		20		ns
t _{AA}	Address to Data Valid		12		15		20	ns
t _{OHA}	Data Hold from Address Change	3		3		3		ns
t _{ACE}	$\overline{CE}_1$ LOW to Data Valid, CE ₂ HIGH to Data Valid		12		15		20	ns
t _{DOE}	$\overline{OE}$ LOW to Data Valid		6		7		8	ns
t _{LZOE}	$\overline{OE}$ LOW to Low Z	0		0		0		ns
t _{HZOE}	$\overline{OE}$ HIGH to High Z ^[6, 7]		6		7		8	ns
t _{LZCE}	$\overline{CE}_1$ LOW to Low Z, CE ₂ HIGH to Low Z ^[7]	3		3		3		ns
t _{HZCE}	$\overline{CE}_1$ HIGH to High Z, CE ₂ LOW to High Z ^[6, 7]		6		7		8	ns
t _{PU}	$\overline{CE}_1$ LOW to Power-Up, CE ₂ HIGH to Power-Up	0		0		0		ns
t _{PD}	$\overline{CE}_1$ HIGH to Power-Down, CE ₂ LOW to Power-Down		12		15		20	ns
Write Cycle ^[8]								
t _{WC}	Write Cycle Time ^[9]	12		15		20		ns
t _{SCE}	$\overline{CE}_1$ LOW to Write End, CE ₂ HIGH to Write End	10		12		15		ns
t _{AW}	Address Set-Up to Write End	10		12		15		ns
t _{HA}	Address Hold from Write End	0		0		0		ns
t _{SA}	Address Set-Up to Write Start	0		0		0		ns
t _{PWE}	$\overline{WE}$ Pulse Width	10		12		12		ns
t _{SD}	Data Set-Up to Write End	7		8		10		ns
t _{HD}	Data Hold from Write End	0		0		0		ns
t _{LZWE}	$\overline{WE}$ HIGH to Low Z ^[7]	3		3		3		ns
t _{HZWE}	$\overline{WE}$ LOW to High Z ^[6, 7]		6		7		8	ns

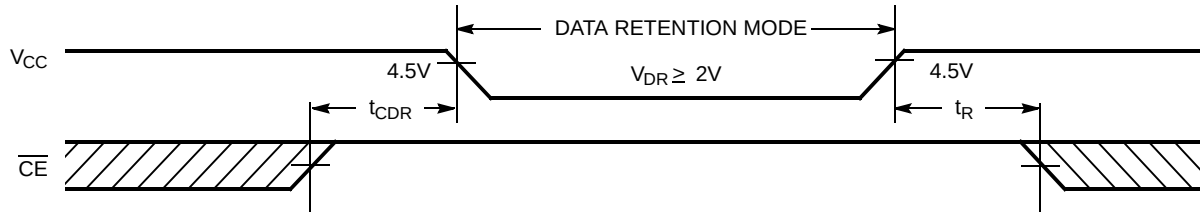
Notes:

- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
- t_{HZOE} , t_{HZCE} , and t_{HZWE} are specified with a load capacitance of 5 pF as in part (b) of AC Test Loads. Transition is measured ± 500 mV from steady-state voltage.
- At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} , t_{HZOE} is less than t_{LZOE} , and t_{HZWE} is less than t_{LZWE} for any given device.
- The internal write time of the memory is defined by the overlap of $\overline{CE}_1$ LOW, CE_2 HIGH, and $\overline{WE}$ LOW. $\overline{CE}_1$ and $\overline{WE}$ must be LOW and CE_2 HIGH to initiate a write, and the transition of any of these signals can terminate the write. The input data set-up and hold timing should be referenced to the leading edge of the signal that terminates the write.
- The minimum write cycle time for Write Cycle No. 3 ($\overline{WE}$ controlled, $\overline{OE}$ LOW) is the sum of t_{HZWE} and t_{SD} .

Data Retention Characteristics Over the Operating Range (Low Power version only)

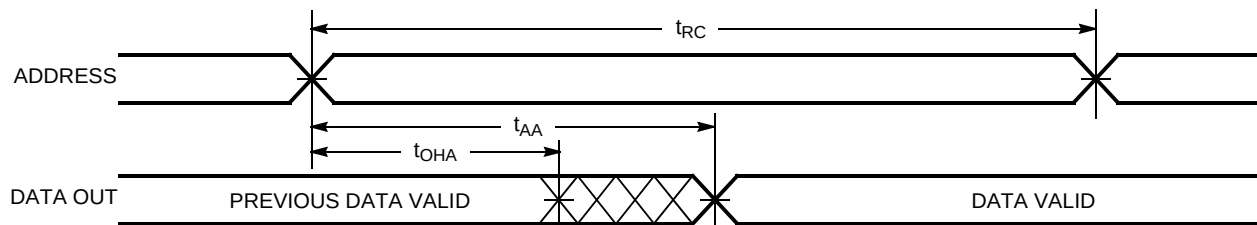
Parameter	Description	Conditions	Min.	Max	Unit
V_{DR}	V_{CC} for Data Retention	No input may exceed $V_{CC} + 0.5V$	2.0		V
I_{CCDR}	Data Retention Current	$V_{CC} = V_{DR} = 2.0V$, $CE_1 \geq V_{CC} - 0.3V$ or $CE_2 \leq 0.3V$, $V_{IN} \geq V_{CC} - 0.3V$ or $V_{IN} \leq 0.3V$		150	μA
t_{CDR}	Chip Deselect to Data Retention Time		0		ns
t_R	Operation Recovery Time		200		μs

Data Retention Waveform

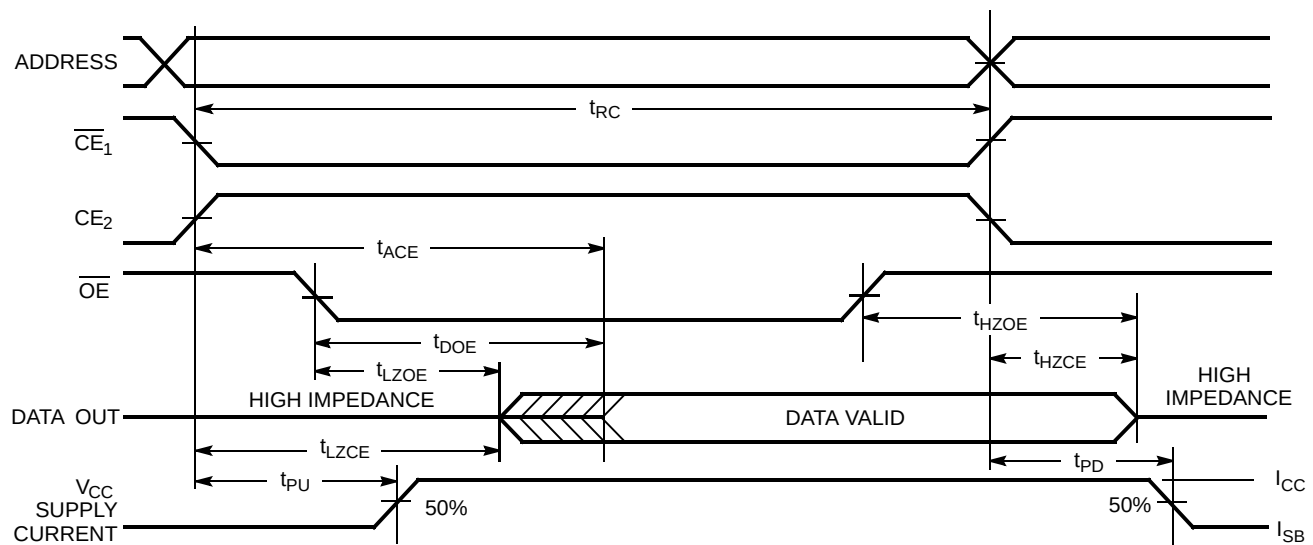


Switching Waveforms

Read Cycle No. 1^[10, 11]



Read Cycle No. 2 (OE Controlled)^[11, 12]

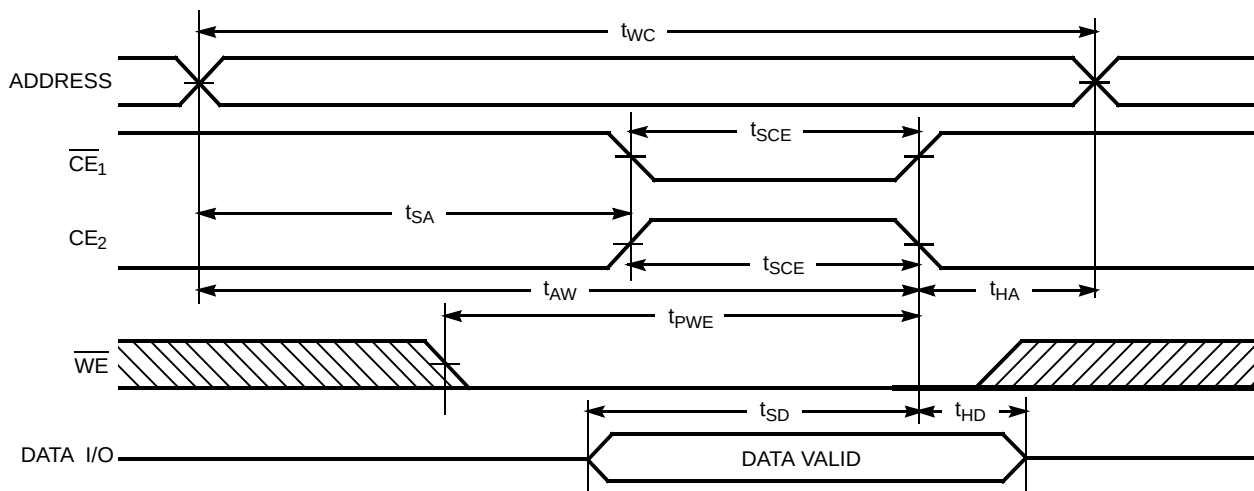


Notes:

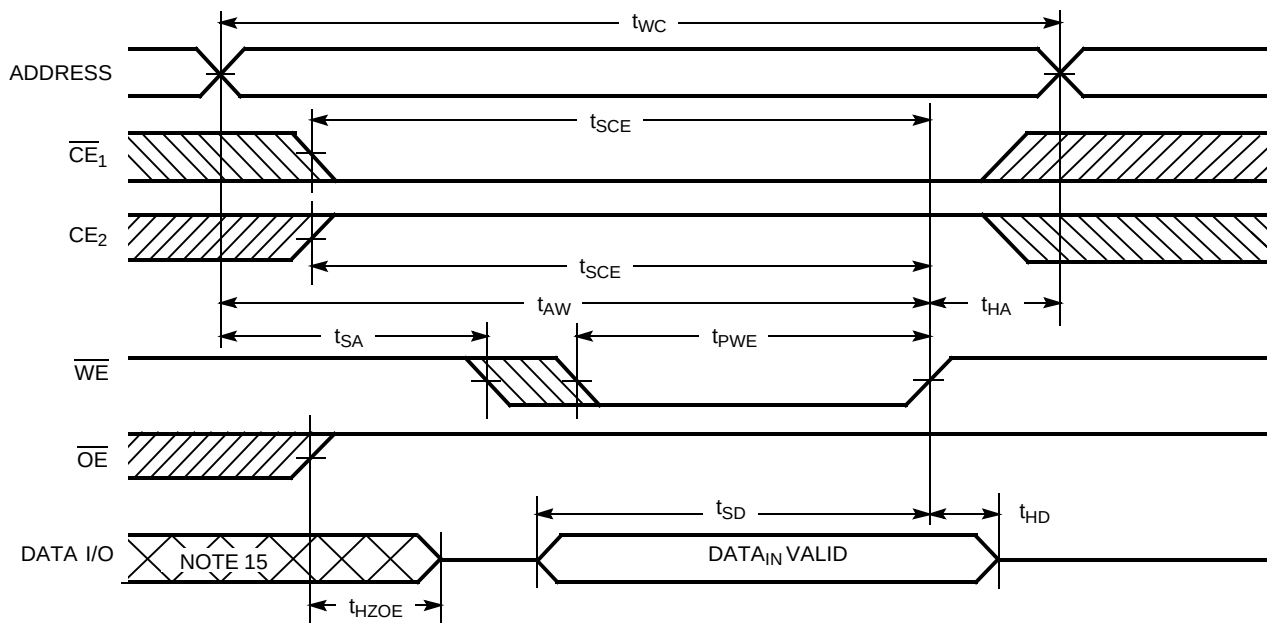
10. Device is continuously selected. $\overline{OE}$, $\overline{CE}_1 = V_{IL}$, $CE_2 = V_{IH}$.
11. $\overline{WE}$ is HIGH for read cycle.
12. Address valid prior to or coincident with $\overline{CE}_1$ transition LOW and CE_2 transition HIGH.

Switching Waveforms (continued)

Write Cycle No. 1 ($\overline{CE}_1$ or CE_2 Controlled)^[13, 14]



Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ HIGH During Write)^[13, 14]



Notes:

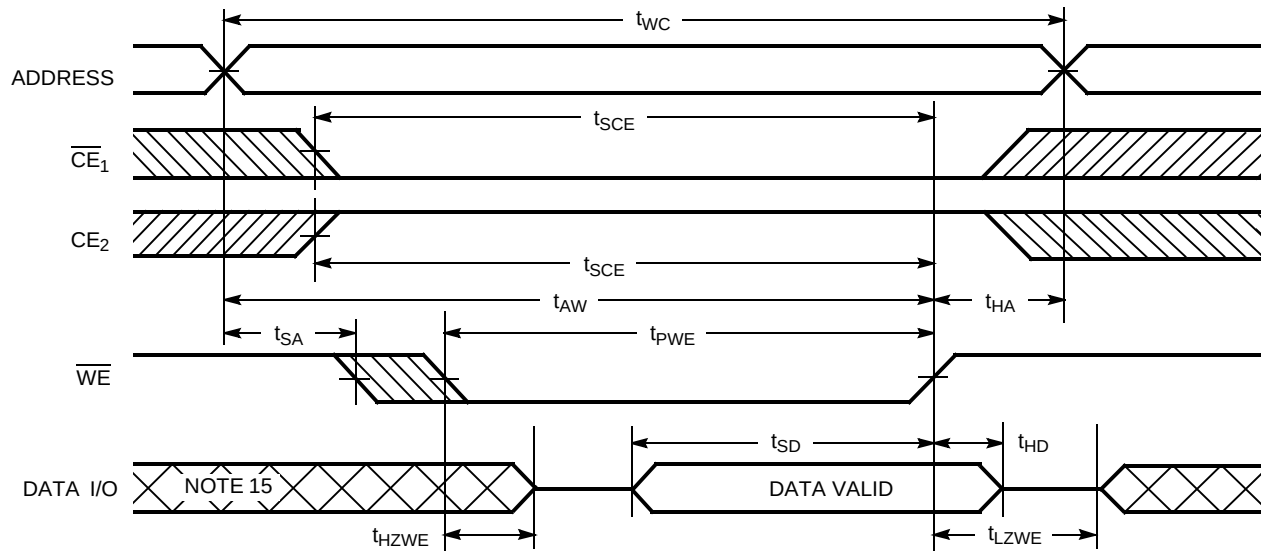
13. Data I/O is high impedance if $\overline{OE} = V_{IH}$.

14. If $\overline{CE}_1$ goes HIGH or CE_2 goes LOW simultaneously with $\overline{WE}$ going HIGH, the output remains in a high-impedance state.

15. During this period the I/Os are in the output state and input signals should not be applied.

Switching Waveforms (continued)

Write Cycle No. 3 ($\overline{\text{WE}}$ Controlled, $\overline{\text{OE}}$ LOW)^[14]



Truth Table

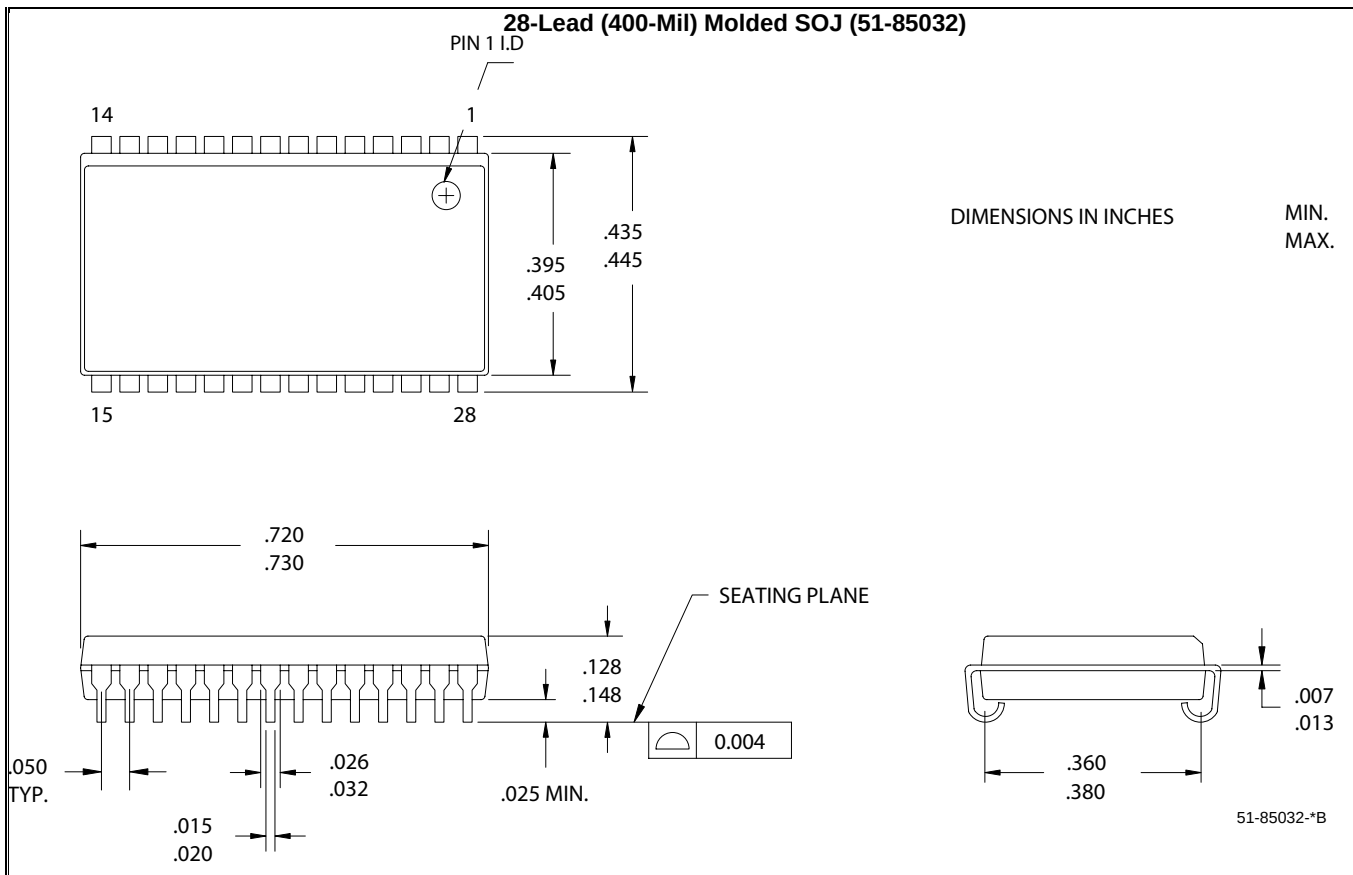
$\overline{\text{CE}}_1$	$\overline{\text{CE}}_2$	$\overline{\text{OE}}$	$\overline{\text{WE}}$	I/O ₀ –I/O ₇	Mode	Power
H	X	X	X	High Z	Power-Down	Standby (I_{SB})
X	L	X	X	High Z	Power-Down	Standby (I_{SB})
L	H	L	H	Data Out	Read	Active (I_{CC})
L	H	X	L	Data In	Write	Active (I_{CC})
L	H	H	H	High Z	Selected, Outputs Disabled	Active (I_{CC})

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
12	CY7C109BN-12VC	51-85032	32-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1009BN-12VC	51-85031	32-Lead (300-Mil) Molded SOJ	
	CY7C109BN-12ZC	51-85056	32-Lead TSOP Type I	
	CY7C109BN-12ZXC	51-85056	32-Lead TSOP Type I (Pb-free)	
15	CY7C109BNL-15VC	51-85032	32-Lead (400-Mil) Molded SOJ	Commercial
	CY7C109BN-15VC	51-85032	32-Lead (400-Mil) Molded SOJ	
	CY7C1009BN-15VC	51-85031	32-Lead (300-Mil) Molded SOJ	
	CY7C109BN-15ZC	51-85056	32-Lead TSOP Type I	
	CY7C109BN-15ZXC	51-85056	32-Lead TSOP Type I (Pb-free)	
	CY7C109BN-15VI	51-85032	32-Lead (400-Mil) Molded SOJ	Industrial
	CY7C1009BN-15VI	51-85031	32-Lead (300-Mil) Molded SOJ	
20	CY7C109BN-20VC	51-85032	32-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1009BN-20VC	51-85031	32-Lead (300-Mil) Molded SOJ	
	CY7C109BN-20VI	51-85032	32-Lead (400-Mil) Molded SOJ	Industrial
	CY7C109BN-20ZC	51-85056	32-Lead TSOP Type I	Commercial
	CY7C109BN-20ZXC	51-85056	32-Lead TSOP Type I (Pb-free)	

Please contact local sales representative regarding availability of these parts

Package Diagrams

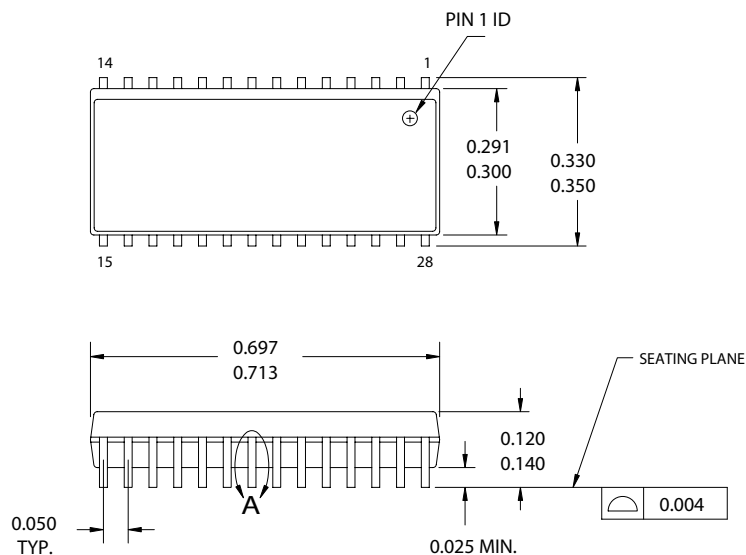


Package Diagrams (continued)

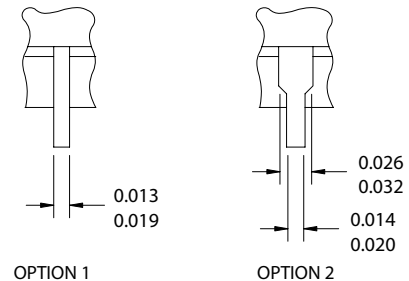
NOTE :

1. JEDEC STD REF MO088
2. BODY LENGTH DIMENSION DOES NOT INCLUDE MOLD PROTRUSION/END FLASH
MOLD PROTRUSION/END FLASH SHALL NOT EXCEED 0.006 in (0.152 mm) PER SIDE
3. DIMENSIONS IN INCHES
MIN.
MAX.

28-Lead (300-Mil) Molded SOJ (51-85031)

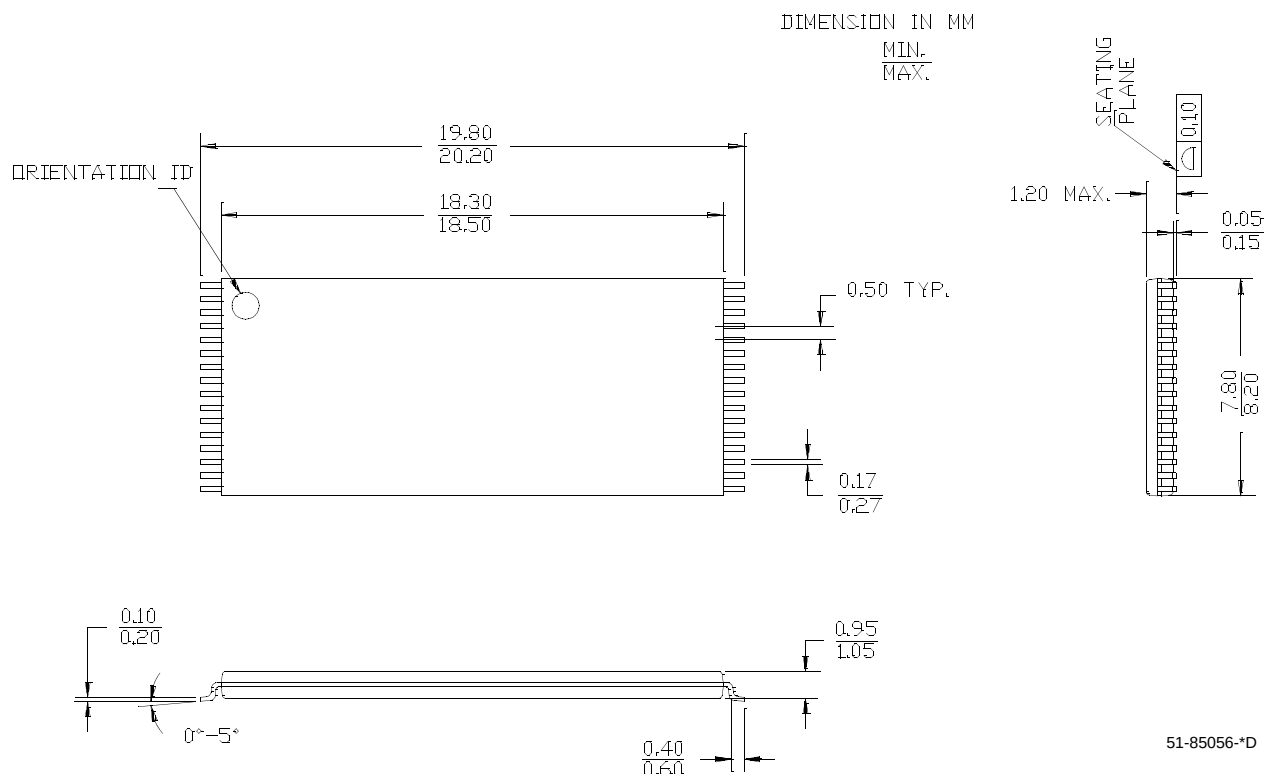


**DETAIL A
EXTERNAL LEAD DESIGN**



51-85031-°C

32-Lead TSOP I (8x20 mm) (51-85056)



51-85056-°D

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Document History Page

Document Title: CY7C109BN/CY7C1009BN 128K x 8 Static RAM Document Number: 001-06430				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	423847	See ECN	NXR	New Data Sheet