

## 512K x 8 Static RAM

### Features

- **High speed**
  - $t_{AA} = 12 \text{ ns}$
- **Low active power**
  - 1320 mW (max.)
- **Low CMOS standby power (Commercial L version)**
  - 2.75 mW (max.)
- **2.0V Data Retention (400  $\mu\text{W}$  at 2.0V retention)**
- **Automatic power-down when deselected**
- **TTL-compatible inputs and outputs**
- **Easy memory expansion with  $\overline{\text{CE}}$  and  $\overline{\text{OE}}$  features**

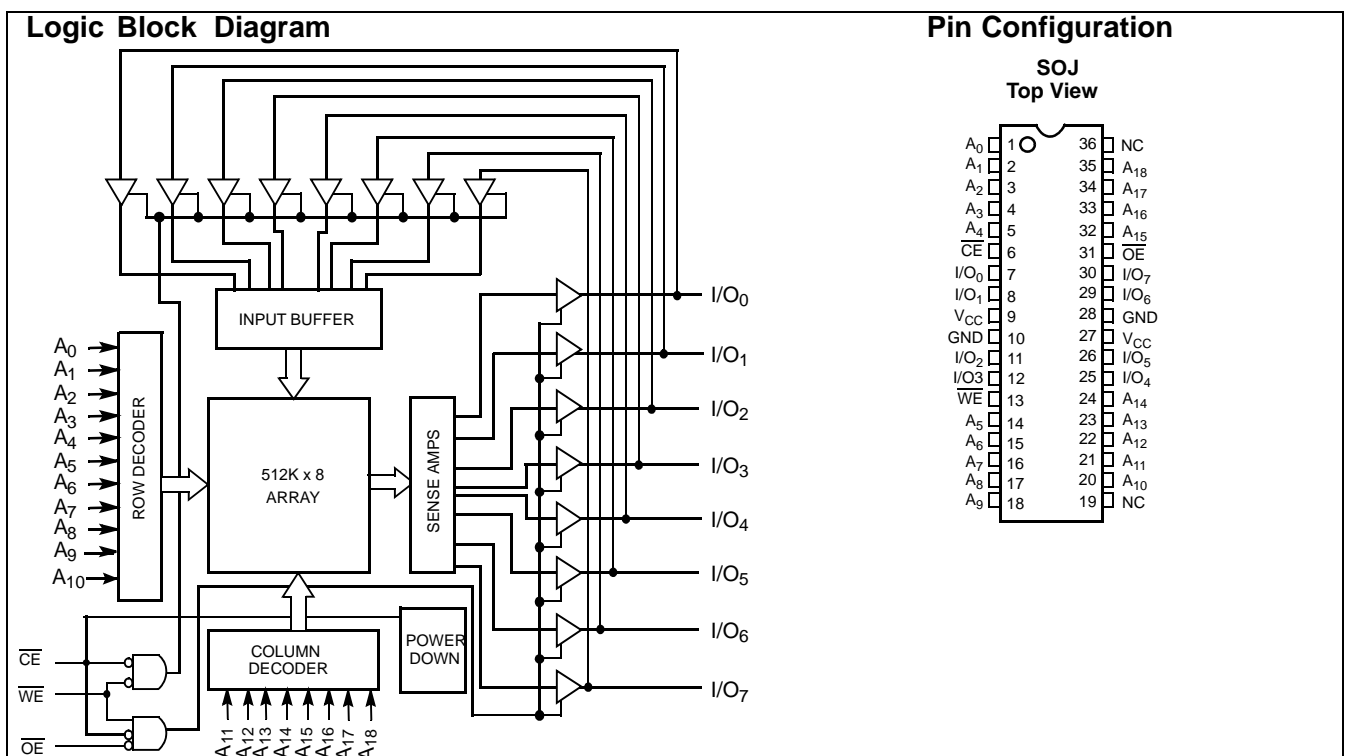
### Functional Description<sup>[1]</sup>

The CY7C1049BN is a high-performance CMOS static RAM organized as 524,288 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ( $\overline{\text{CE}}$ ), an active LOW Output Enable ( $\overline{\text{OE}}$ ), and three-state drivers. Writing to the device is accomplished by taking Chip Enable ( $\overline{\text{CE}}$ ) and Write Enable ( $\overline{\text{WE}}$ ) inputs LOW. Data on the eight I/O pins ( $\text{I/O}_0$  through  $\text{I/O}_7$ ) is then written into the location specified on the address pins ( $\text{A}_0$  through  $\text{A}_{18}$ ).

Reading from the device is accomplished by taking Chip Enable ( $\overline{\text{CE}}$ ) and Output Enable ( $\overline{\text{OE}}$ ) LOW while forcing Write Enable ( $\overline{\text{WE}}$ ) 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 ( $\text{I/O}_0$  through  $\text{I/O}_7$ ) are placed in a high-impedance state when the device is deselected ( $\overline{\text{CE}}$  HIGH), the outputs are disabled ( $\overline{\text{OE}}$  HIGH), or during a write operation ( $\overline{\text{CE}}$  LOW, and  $\overline{\text{WE}}$  LOW).

The CY7C1049BN is available in a standard 400-mil-wide 36-pin SOJ package with center power and ground (revolutionary) pinout.



**Selection Guide**

		7C1049BN-12	7C1049BN-15	7C1049BN-17	7C1049BN-20	7C1049BN-25
Maximum Access Time (ns)		12	15	17	20	25
Maximum Operating Current (mA)		240	220	195	185	180
Maximum CMOS Standby Current (mA)	Com'l	8	8	8	8	8
	Com'l/Ind'l   L	-	-	0.5	0.5	0.5
	Ind'l	-	-	-	9	9

**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](http://www.cypress.com).

**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<sub>CC</sub> to Relative GND<sup>[2]</sup> .... -0.5V to +7.0V
- DC Voltage Applied to Outputs in High Z State<sup>[2]</sup> ..... -0.5V to V<sub>CC</sub> + 0.5V
- DC Input Voltage<sup>[2]</sup> ..... -0.5V to V<sub>CC</sub> + 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 <sub>CC</sub>
Commercial	0°C to +70°C	4.5V–5.5V
Industrial	-40°C to +85°C	

**Electrical Characteristics** Over the Operating Range

Parameter	Description	Test Conditions	7C1049B-12		7C1049B-15		7C1049B-17		Unit		
			Min.	Max.	Min.	Max.	Min.	Max.			
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = Min., I <sub>OH</sub> = -4.0 mA	2.4		2.4		2.4		V		
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = Min., I <sub>OL</sub> = 8.0 mA		0.4		0.4		0.4	V		
V <sub>IH</sub>	Input HIGH Voltage		2.2	V <sub>CC</sub> +0.3	2.2	V <sub>CC</sub> +0.3	2.2	V <sub>CC</sub> +0.3	V		
V <sub>IL</sub>	Input LOW Voltage <sup>[2]</sup>		-0.3	0.8	-0.3	0.8	-0.3	0.3	V		
I <sub>IX</sub>	Input Load Current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-1	+1	-1	+1	-1	+1	μA		
I <sub>OZ</sub>	Output Leakage Current	GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> , Output Disabled	-1	+1	-1	+1	-1	+1	μA		
I <sub>CC</sub>	V <sub>CC</sub> Operating Supply Current	V <sub>CC</sub> = Max. f = f <sub>MAX</sub> = 1/t <sub>RC</sub>		240		220		195	mA		
I <sub>SB1</sub>	Automatic CE Power-Down Current —TTL Inputs	Max. V <sub>CC</sub> , $\overline{CE} \geq V_{IH}$ V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>IL</sub> , f = f <sub>MAX</sub>		40		40		40	mA		
I <sub>SB2</sub>	Automatic CE Power-Down Current —CMOS Inputs	Max. V <sub>CC</sub> , CE ≥ V <sub>CC</sub> - 0.3V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.3V, or V <sub>IN</sub> ≤ 0.3V, f = 0	Com'l			8		8		mA	
			Com'l	L		-		-		0.5	mA
			Ind'l			-		-		8	mA
			Ind'l	L		-		-		0.5	mA

**Note:**

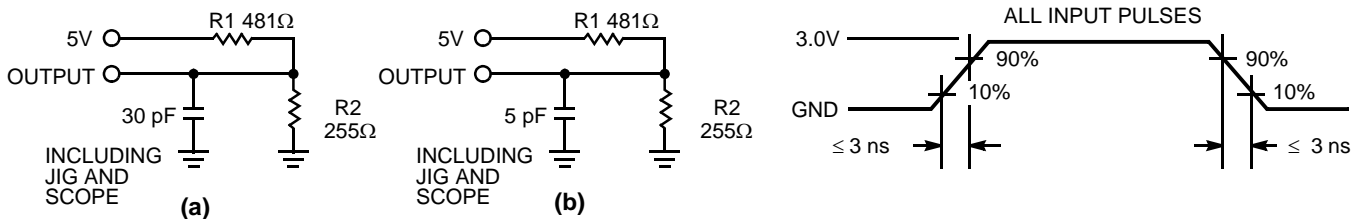
2. Minimum voltage is -2.0V for pulse durations of less than 20 ns.

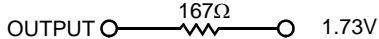
**Electrical Characteristics** Over the Operating Range (continued)

Parameter	Description	Test Conditions	7C1049B-20		7C1049B-25		Unit		
			Min.	Max.	Min.	Max.			
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$	2.4		2.4		V		
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$		0.4		0.4	V		
$V_{IH}$	Input HIGH Voltage		2.2	$V_{CC} + 0.3$	2.2	$V_{CC} + 0.3$	V		
$V_{IL}$	Input LOW Voltage <sup>[2]</sup>		-0.3	0.8	-0.3	0.8	V		
$I_{IX}$	Input Load Current	$GND \leq V_I \leq V_{CC}$	-1	+1	-1	+1	$\mu\text{A}$		
$I_{OZ}$	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC}$ , Output Disabled	-1	+1	-1	+1	$\mu\text{A}$		
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.}$ , $f = f_{MAX} = 1/t_{RC}$		185		180	mA		
$I_{SB1}$	Automatic CE Power-Down Current —TTL Inputs	Max. $V_{CC}$ , $CE \geq V_{IH}$ $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$		40		40	mA		
$I_{SB2}$	Automatic CE Power-Down Current —CMOS Inputs	Max. $V_{CC}$ , $CE \geq V_{CC} - 0.3\text{V}$ , $V_{IN} \geq V_{CC} - 0.3\text{V}$ , or $V_{IN} \leq 0.3\text{V}$ , $f = 0$	Com'l			8		8	mA
			Com'l	L		0.5		0.5	mA
			Ind'l			8		8	mA
			Ind'l	L		0.5		0.5	mA

**Capacitance<sup>[3]</sup>**

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

**AC Test Loads and Waveforms**


Equivalent to: THÉVENIN EQUIVALENT  

 167Ω  
 OUTPUT — 1.73V

**Note:**

3. Tested initially and after any design or process changes that may affect these parameters.

**Switching Characteristics<sup>[4]</sup>** Over the Operating Range

Parameter	Description	7C1049B-12		7C1049B-15		7C1049B-17		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
<b>Read Cycle</b>								
$t_{power}$	$V_{CC}$ (typical) to the First Access <sup>[5]</sup>	1		1		1		ms
$t_{RC}$	Read Cycle Time	12		15		17		ns
$t_{AA}$	Address to Data Valid		12		15		17	ns
$t_{OHA}$	Data Hold from Address Change	3		3		3		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		12		15		17	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		6		7		8	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low Z <sup>[7]</sup>	0		0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[6, 7]</sup>		6		7		7	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low Z <sup>[7]</sup>	3		3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High Z <sup>[6, 7]</sup>		6		7		7	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-Up	0		0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-Down		12		15		17	ns
<b>Write Cycle<sup>[8, 9]</sup></b>								
$t_{WC}$	Write Cycle Time	12		15		17		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	10		12		12		ns
$t_{AW}$	Address Set-Up to Write End	10		12		12		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		8		ns
$t_{HD}$	Data Hold from Write End	0		0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[7]</sup>	3		3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[6, 7]</sup>		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.
- This part has a voltage regulator which steps down the voltage from 5V to 3.3V internally.  $t_{power}$  time has to be provided initially before a read/write operation is started.
- $t_{HZOE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (b) of AC Test Loads. Transition is measured  $\pm 500$  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  $\overline{CE}$  LOW, and  $\overline{WE}$  LOW.  $\overline{CE}$  and  $\overline{WE}$  must be LOW to initiate a write, and the transition of either 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  $t_{SD}$ .

**Switching Characteristics<sup>[4]</sup>** Over the Operating Range (continued)

Parameter	Description	7C1049B-20		7C1049B-25		Unit
		Min.	Max.	Min.	Max.	
<b>Read Cycle</b>						
$t_{power}$	$V_{CC}$ (typical) to the First Access <sup>[5]</sup>	1		1		1
$t_{RC}$	Read Cycle Time	20		25		ns
$t_{AA}$	Address to Data Valid		20		25	ns
$t_{OHA}$	Data Hold from Address Change	3		5		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		20		25	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		8		10	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low Z <sup>[7]</sup>	0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[6, 7]</sup>		8		10	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low Z <sup>[7]</sup>	3		5		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High Z <sup>[6, 7]</sup>		8		10	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-Up	0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-Down		20		25	ns
<b>Write Cycle<sup>[8]</sup></b>						
$t_{WC}$	Write Cycle Time	20		25		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	13		15		ns
$t_{AW}$	Address Set-Up to Write End	13		15		ns
$t_{HA}$	Address Hold from Write End	0		0		ns
$t_{SA}$	Address Set-Up to Write Start	0		0		ns
$t_{PWE}$	$\overline{WE}$ Pulse Width	13		15		ns
$t_{SD}$	Data Set-Up to Write End	9		10		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[7]</sup>	3		5		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[6, 7]</sup>		8		10	ns

**Data Retention Characteristics** Over the Operating Range

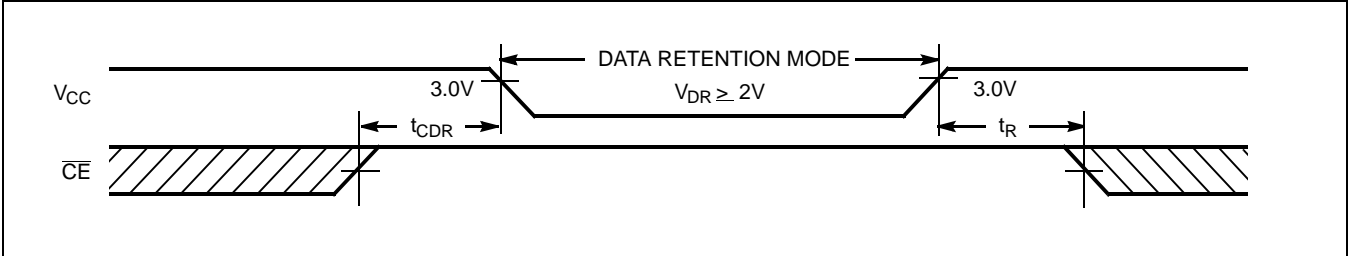
Parameter	Description		Conditions <sup>[11]</sup>		Min.	Max	Unit
$V_{DR}$	$V_{CC}$ for Data Retention				2.0		V
$I_{CCDR}$	Data Retention Current	Com'l	L	$V_{CC} = V_{DR} = 3.0V$ , $CE \geq V_{CC} - 0.3V$ $V_{IN} \geq V_{CC} - 0.3V$ or $V_{IN} \leq 0.3V$		200	$\mu A$
		Ind'l				1	mA
$t_{CDR}^{[3]}$	Chip Deselect to Data Retention Time				0		ns
$t_R^{[10]}$	Operation Recovery Time				$t_{RC}$		ns

**Notes:**

 10.  $t_r \leq 3$  ns for the -12 and -15 speeds.  $t_r \leq 5$  ns for the -20 and slower speeds.

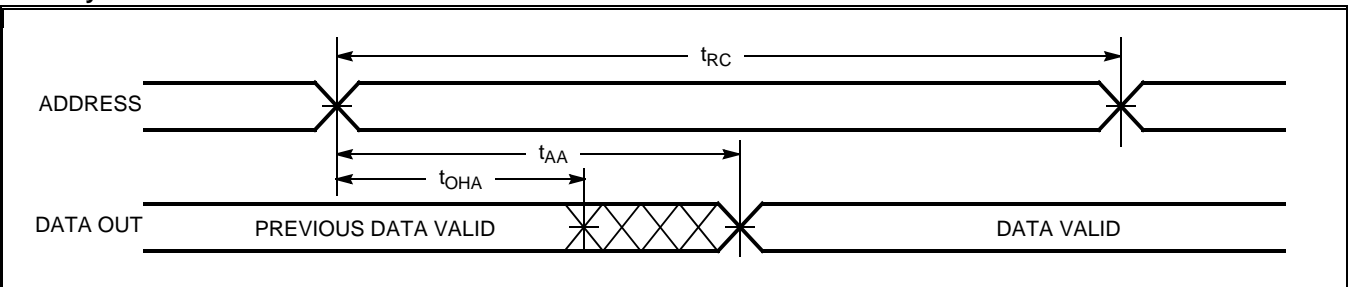
 11. No input may exceed  $V_{CC} + 0.5V$ .

Data Retention Waveform

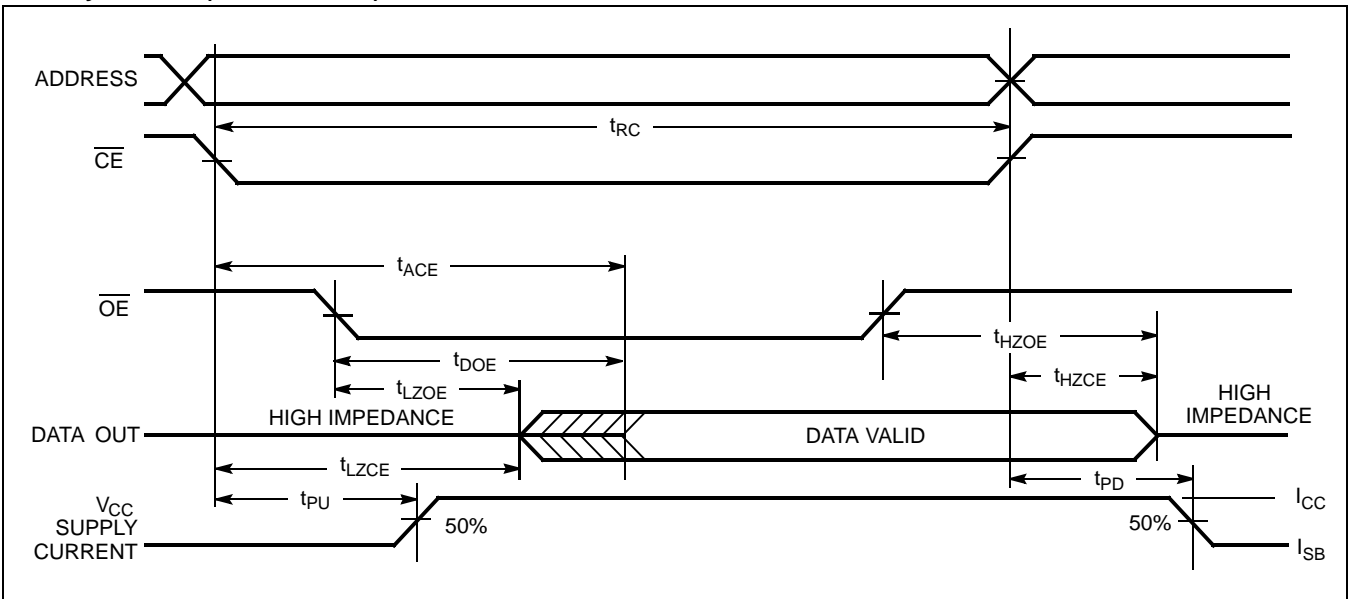


Switching Waveforms

Read Cycle No. 1<sup>[12, 13]</sup>



Read Cycle No. 2 (OE Controlled)<sup>[13, 14]</sup>

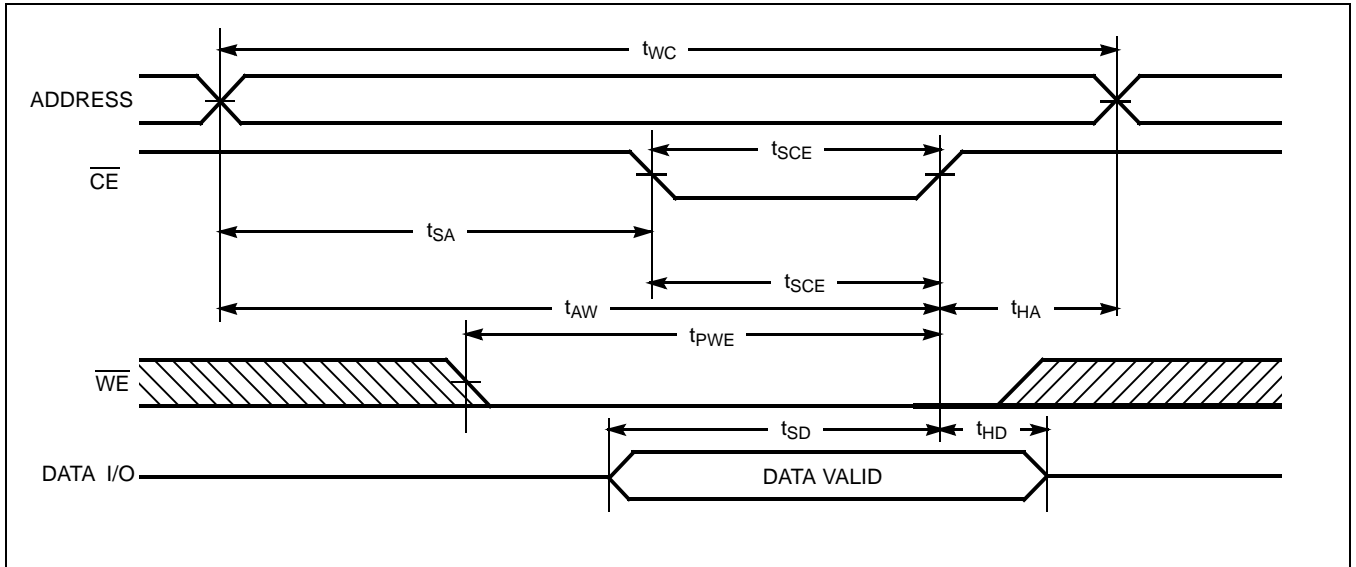


Notes:

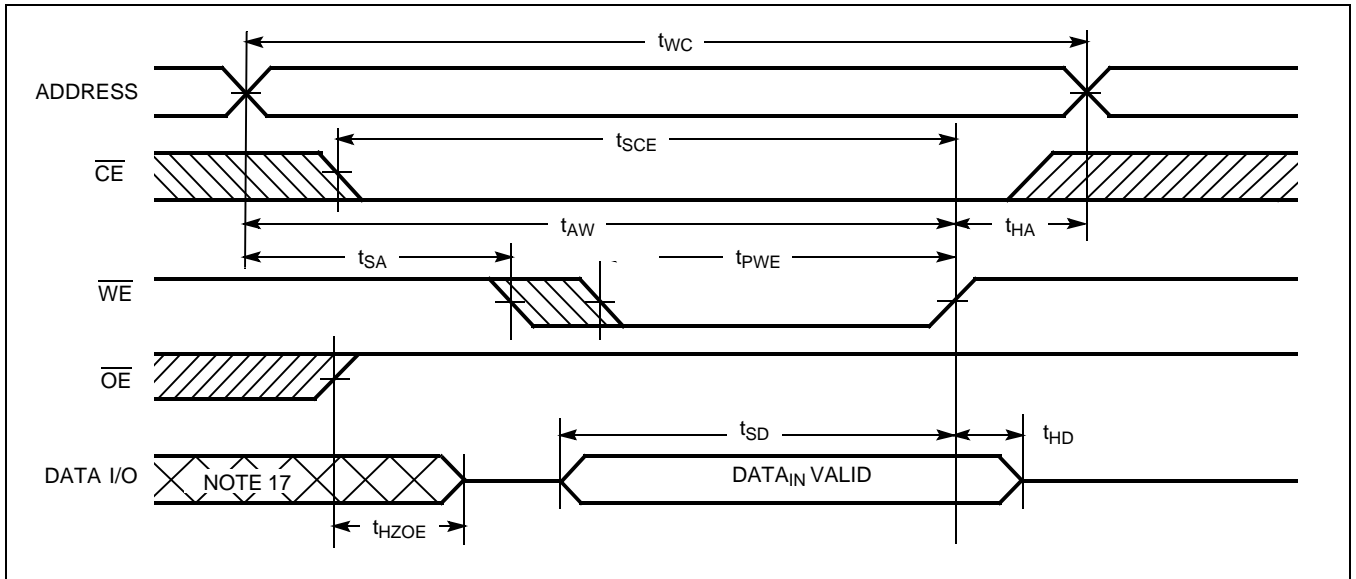
- 12. Device is continuously selected.  $\overline{OE}, \overline{CE} = V_{IL}$ .
- 13.  $\overline{WE}$  is HIGH for read cycle.
- 14. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.

Switching Waveforms (continued)

Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled)<sup>[15, 16]</sup>



Write Cycle No. 2 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  HIGH During Write)<sup>[15, 16]</sup>

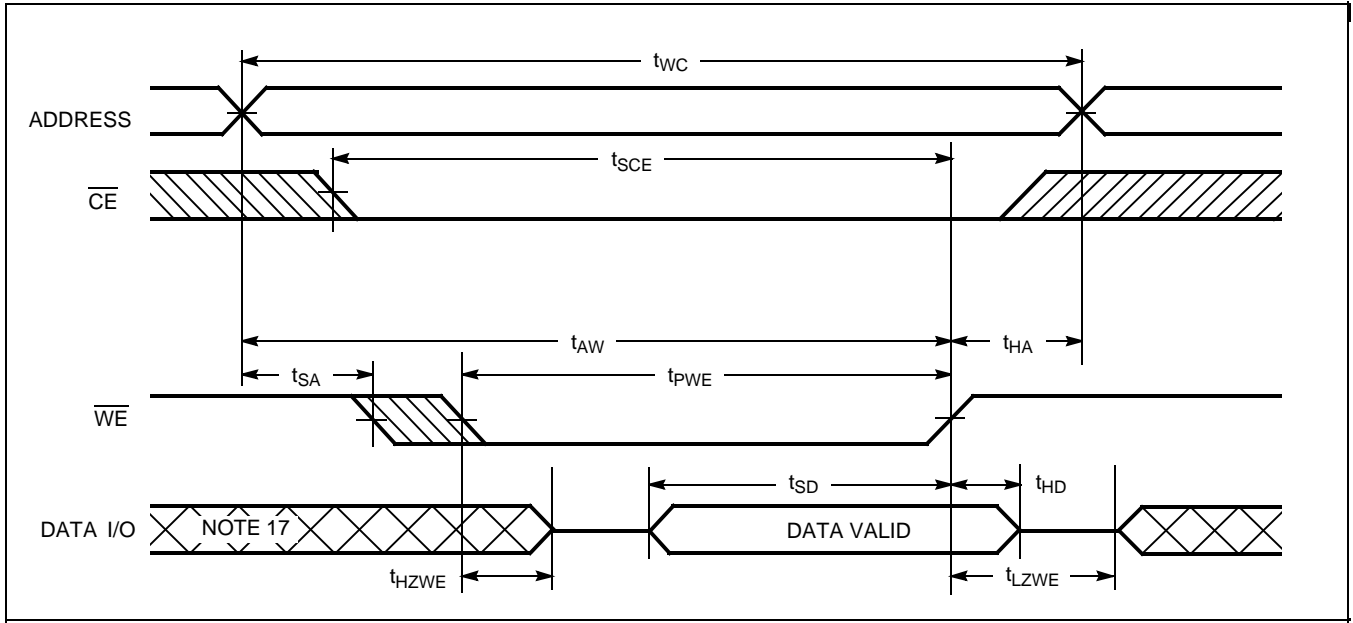


Notes:

- 15. Data I/O is high impedance if  $\overline{\text{OE}} = V_{\text{IH}}$ .
- 16. If CE goes HIGH simultaneously with WE going HIGH, the output remains in a high-impedance state.
- 17. 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 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)<sup>[16]</sup>**



**Truth Table**

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	Inputs/Outputs	Mode	Power
H	X	X	High Z	Power-down	Standby ( $I_{SB}$ )
L	H	L	Data Out	Read	Active ( $I_{CC}$ )
L	L	X	Data In	Write	Active ( $I_{CC}$ )
L	H	H	High Z	Selected, Output disabled	Active ( $I_{CC}$ )

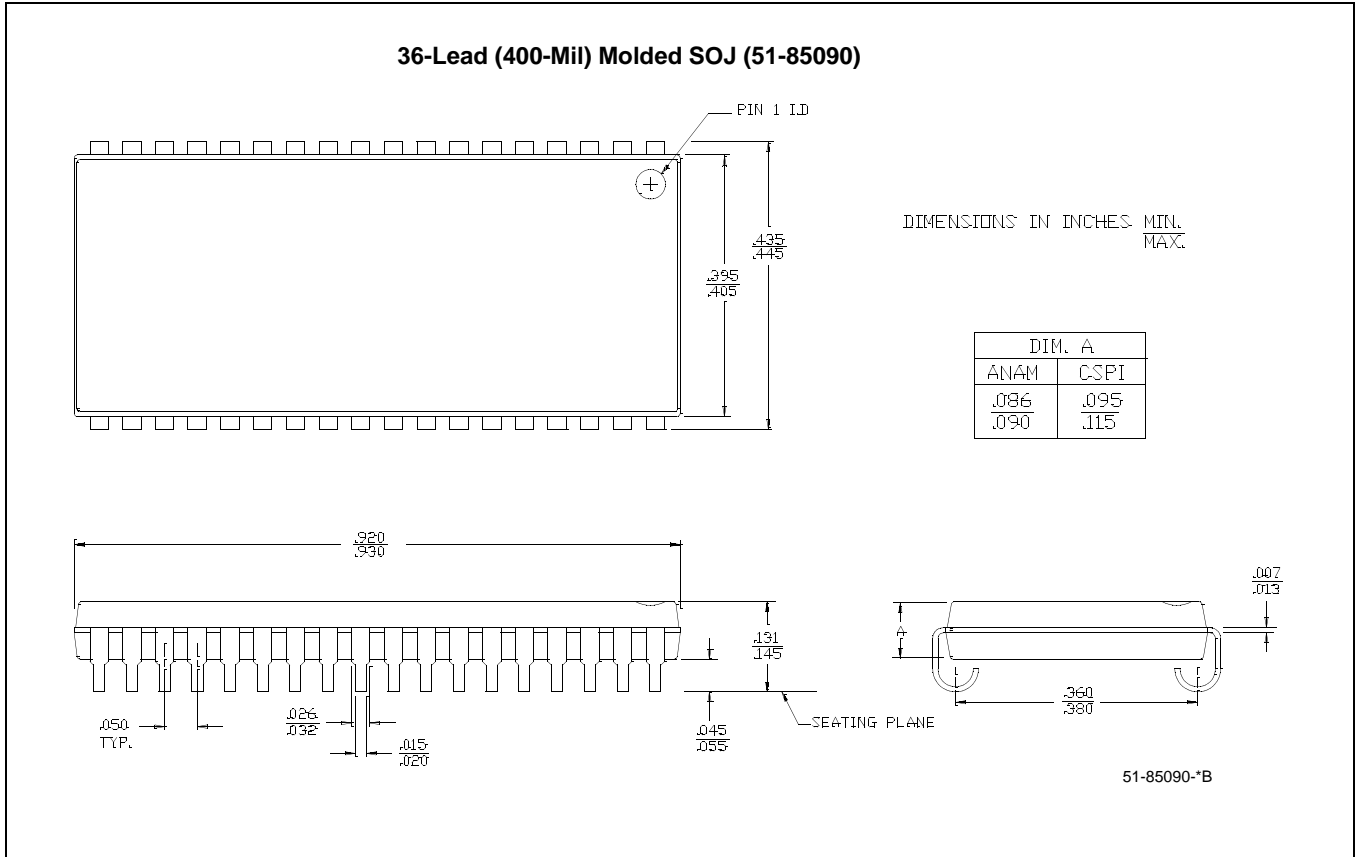
**Ordering Information**

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
12	CY7C1049BN-12VC	51-85090	36-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1049BN-12VXC	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	
15	CY7C1049BN-15VC	51-85090	36-Lead (400-Mil) Molded SOJ	Industrial
	CY7C1049BN-15VXC	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	
	CY7C1049BN-15VI	51-85090	36-Lead (400-Mil) Molded SOJ	
17	CY7C1049BN-15VXI	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	Commercial
	CY7C1049BN-17VC	51-85090	36-Lead (400-Mil) Molded SOJ	
	CY7C1049BNL-17VC	51-85090	36-Lead (400-Mil) Molded SOJ	
20	CY7C1049BN-17VXC	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	Industrial
	CY7C1049BN-20VC	51-85090	36-Lead (400-Mil) Molded SOJ	
	CY7C1049BNL-20VC	51-85090	36-Lead (400-Mil) Molded SOJ	
	CY7C1049BN-20VXC	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	
25	CY7C1049BN-20VI	51-85090	36-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1049BN-20VXI	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	
	CY7C1049BNL-25VC	51-85090	36-Lead (400-Mil) Molded SOJ	
25	CY7C1049BN-25VI	51-85090	36-Lead (400-Mil) Molded SOJ	Industrial
	CY7C1049BN-25VXI	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	
	CY7C1049BNL-25VC	51-85090	36-Lead (400-Mil) Molded SOJ	

Please contact local sales representative regarding availability of these parts.



**Package Diagram**



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**Document History Page**

<b>Document Title: CY7C1049BN 512K x 8 Static RAM</b> <b>Document Number: 001-06501</b>				
<b>REV.</b>	<b>ECN NO.</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
**	424111	See ECN	NXR	New Data Sheet