

# 32K x 8 3.3V Static RAM

## Features

- Single 3.3V power supply
- Ideal for low-voltage cache memory applications
- High speed
  - 10/12/15 ns
- Low active power
  - 216 mW (max.)
- Low-power alpha immune 6T cell
- Plastic SOJ and TSOP packaging

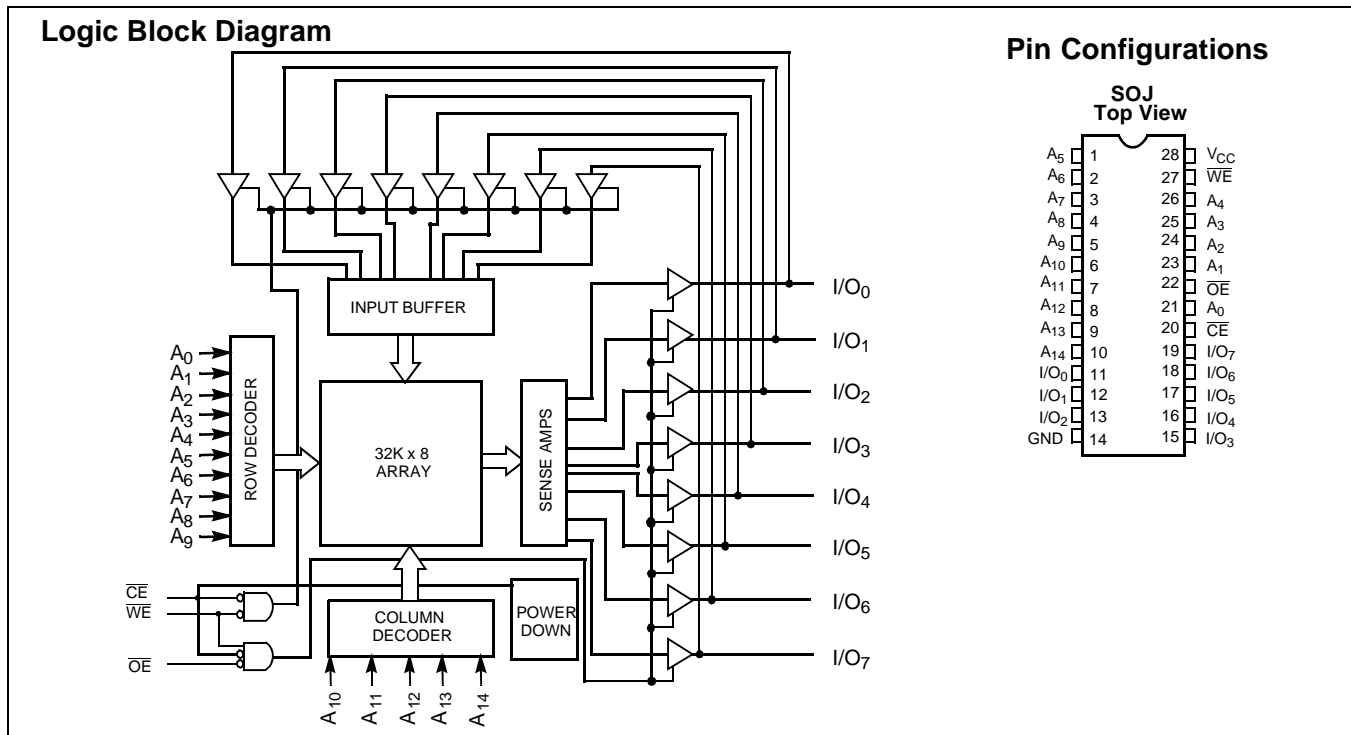
## Functional Description<sup>[1]</sup>

The CY7C1399B is a high-performance 3.3V CMOS Static RAM organized as 32,768 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ( $\overline{CE}$ ) and

active LOW Output Enable ( $\overline{OE}$ ) and three-state drivers. The device has an automatic power-down feature, reducing the power consumption by more than 95% when deselected.

An active LOW Write Enable signal ( $\overline{WE}$ ) controls the writing/reading operation of the memory. When  $\overline{CE}$  and  $\overline{WE}$  inputs are both LOW, data on the eight data input/output pins ( $I/O_0$  through  $I/O_7$ ) is written into the memory location addressed by the address present on the address pins ( $A_0$  through  $A_{14}$ ). Reading the device is accomplished by selecting the device and enabling the outputs,  $\overline{CE}$  and  $\overline{OE}$  active LOW, while  $\overline{WE}$  remains inactive or HIGH. Under these conditions, the contents of the location addressed by the information on address pins is present on the eight data input/output pins.

The input/output pins remain in a high-impedance state unless the chip is selected, outputs are enabled, and Write Enable ( $\overline{WE}$ ) is HIGH. The CY7C1399B is available in 28-pin standard 300-mil-wide SOJ and TSOP Type I packages.



## Selection Guide

	1399B-10	1399B-12	1399B-15	1399B-20
Maximum Access Time (ns)	10	12	15	20
Maximum Operating Current (mA)	60	55	50	45
Maximum CMOS Standby Current ( $\mu$ A)		500	500	500
	L	50	50	50

### 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).

**Pin Configuration**
**TSOP  
Top View**

**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<sup>[2]</sup> .... -0.5V to +4.6V

DC Voltage Applied to Outputs in High Z State<sup>[2]</sup> ..... -0.5V to  $V_{CC} + 0.5V$

DC Input Voltage<sup>[2]</sup>..... -0.5V to  $V_{CC} + 0.5V$

Output 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	3.3V ±300 mV
Industrial	-40°C to +85°C	3.3V ±300 mV

**Electrical Characteristics** Over the Operating Range<sup>[1]</sup>

Parameter	Description	Test Conditions	7C1399B-10		7C1399B-12		Unit
			Min.	Max.	Min.	Max.	
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -2.0 \text{ mA}$	2.4		2.4		V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 4.0 \text{ mA}$		0.4		0.4	V
$V_{IH}$	Input HIGH Voltage		2.2	$V_{CC} + 0.3V$	2.2	$V_{CC} + 0.3V$	V
$V_{IL}$	Input LOW Voltage <sup>[2]</sup>		-0.3	0.8	-0.3	0.8	V
$I_{IX}$	Input Load Current		-1	+1	-1	+1	μA
$I_{OZ}$	Output Leakage Current	$GND \leq V_I \leq V_{CC}$ , Output Disabled	-5	+5	-5	+5	μA
$I_{OS}$	Output Short Circuit Current <sup>[3]</sup>	$V_{CC} = \text{Max.}, V_{OUT} = GND$		-300		-300	mA
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.}, I_{OUT} = 0 \text{ mA}$ , $f = f_{MAX} = 1/t_{RC}$		60		55	mA
$I_{SB1}$	Automatic CE Power-Down Current — TTL Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{IH}$ , $V_{IN} \geq V_{IH}$ , or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$		5		5	mA
			L	4		4	mA
$I_{SB2}$	Automatic CE Power-Down Current — CMOS Inputs <sup>[4]</sup>	Max. $V_{CC}$ , $\overline{CE} \geq V_{CC} - 0.3V$ , $V_{IN} \geq V_{CC} - 0.3V$ , or $V_{IN} \leq 0.3V$ , $WE \geq V_{CC} - 0.3V$ or $WE \leq 0.3V$ , $f = f_{MAX}$		500		500	μA
			L	50		50	μA

**Notes:**

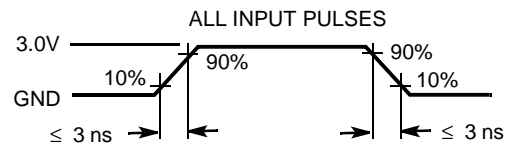
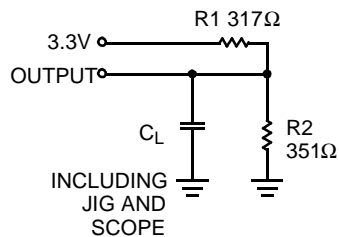
- Minimum voltage is equal to -2.0V for pulse durations of less than 20 ns.
- Not more than one output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
- Device draws low standby current regardless of switching on the addresses.

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

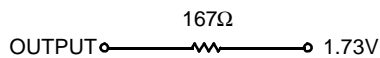
Parameter	Description	Test Conditions	1399B-15		1399B-20		Unit
			Min.	Max.	Min.	Max.	
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -2.0 \text{ mA}$	2.4		2.4		V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 4.0 \text{ mA}$		0.4		0.4	V
$V_{IH}$	Input HIGH Voltage		2.2	$V_{CC} + 0.3V$	2.2	$V_{CC} + 0.3V$	V
$V_{IL}$	Input LOW Voltage		-0.3	0.8	-0.3	0.8	V
$I_{IX}$	Input Load Current		-1	+1	-1	+1	$\mu\text{A}$
$I_{OZ}$	Output Leakage Current	$GND \leq V_I \leq V_{CC}$ , Output Disabled	-5	+5	-5	+5	$\mu\text{A}$
$I_{OS}$	Output Short Circuit Current <sup>[3]</sup>	$V_{CC} = \text{Max.}, V_{OUT} = GND$		-300		-300	mA
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.}, I_{OUT} = 0 \text{ mA}$ , $f = f_{MAX} = 1/t_{RC}$		50		45	mA
$I_{SB1}$	Automatic CE Power-Down Current — TTL Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{IH}$ , $V_{IN} \geq V_{IH}$ , or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$		5		5	mA
			L	4		4	mA
$I_{SB2}$	Automatic CE Power-Down Current — CMOS Inputs <sup>[4]</sup>	Max. $V_{CC}$ , $\overline{CE} \geq V_{CC} - 0.3V$ , $V_{IN} \geq V_{CC} - 0.3V$ , or $V_{IN} \leq 0.3V$ , $WE \geq V_{CC} - 0.3V$ or $WE \leq 0.3V$ , $f = f_{MAX}$		500		500	$\mu\text{A}$
			L	50		50	$\mu\text{A}$

**Capacitance<sup>[5]</sup>**

Parameter	Description	Test Conditions	Max.	Unit
$C_{IN}$ : Addresses	Input Capacitance	$T_A = 25^\circ\text{C}, f = 1 \text{ MHz}, V_{CC} = 3.3V$	5	pF
$C_{IN}$ : Controls			6	pF
$C_{OUT}$	Output Capacitance		6	pF

**AC Test Loads and Waveforms**


Equivalent to: THÉVENIN EQUIVALENT


**Note:**

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

**Switching Characteristics** Over the Operating Range<sup>[6]</sup>

Parameter	Description	1399B-10		1399B-12		Unit
		Min.	Max.	Min.	Max.	
<b>Read Cycle</b>						
$t_{RC}$	Read Cycle Time	10		12		ns
$t_{AA}$	Address to Data Valid		10		12	ns
$t_{OHA}$	Data Hold from Address Change	3		3		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		10		12	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		5		5	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low Z <sup>[7]</sup>	0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[7, 8]</sup>		5		5	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low Z <sup>[7]</sup>	3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High Z <sup>[7, 8]</sup>		5		6	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-Up	0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-Down		10		12	ns
<b>Write Cycle<sup>[9, 10]</sup></b>						
$t_{WC}$	Write Cycle Time	10		12		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	8		8		ns
$t_{AW}$	Address Set-Up to Write End	7		8		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	7		8		ns
$t_{SD}$	Data Set-Up to Write End	5		7		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[9]</sup>		7		7	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[7]</sup>	3		3		ns

**Notes:**

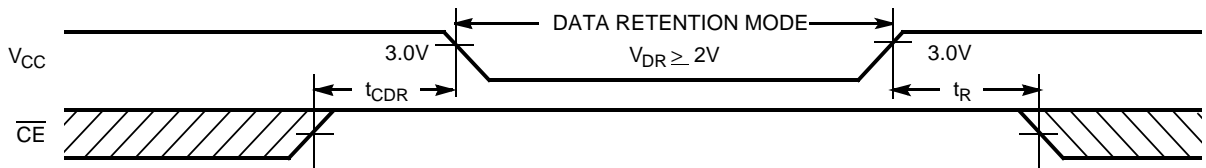
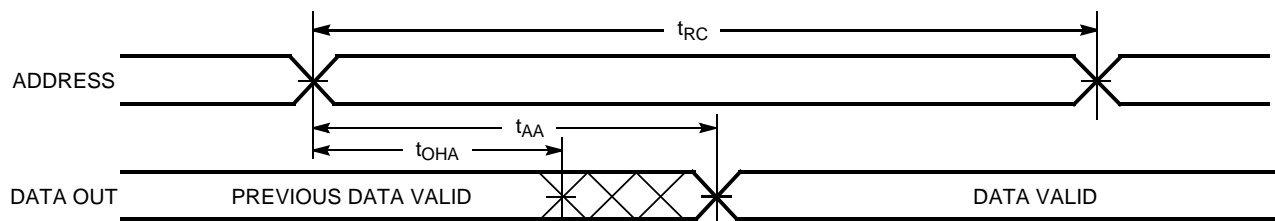
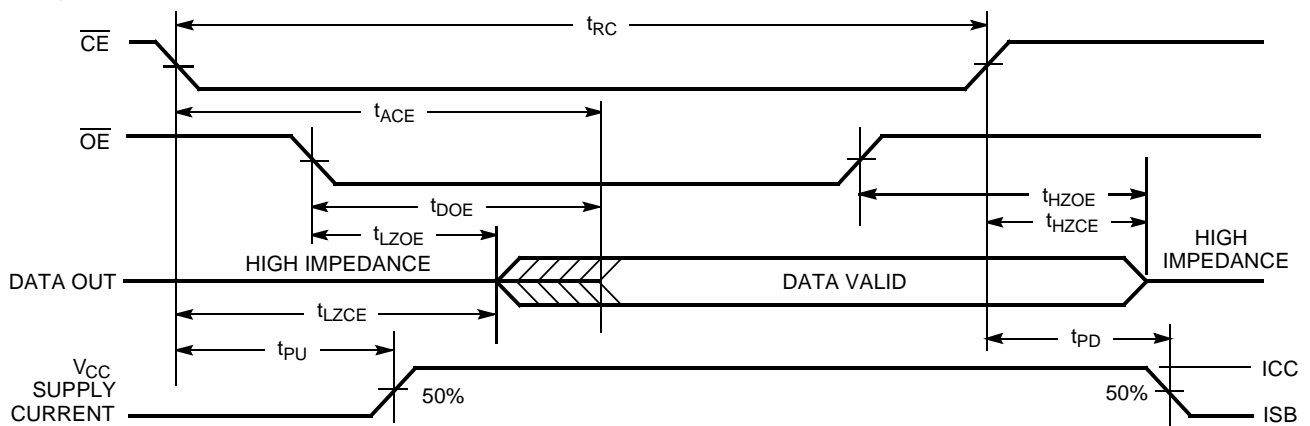
6. Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified  $I_{OL}/I_{OH}$  and capacitance  $C_L = 30$  pF.
7. At any given temperature and voltage condition,  $t_{HZCE}$  is less than  $t_{LZCE}$ ,  $t_{HZOE}$  is less than  $t_{LZOE}$ , and  $t_{HZWE}$  is less than  $t_{LZWE}$  for any given device.
8.  $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZWE}$  are specified with  $C_L = 5$  pF as in AC Test Loads. Transition is measured  $\pm 500$  mV from steady state voltage.
9. The internal write time of the memory is defined by the overlap of  $\overline{CE}$  LOW and  $\overline{WE}$  LOW. Both signals must be LOW to initiate a write and either signal can terminate a write by going HIGH. The data input set-up and hold timing should be referenced to the rising edge of the signal that terminates the write.
10. The minimum write cycle time for write cycle #3 ( $\overline{WE}$  controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

**Switching Characteristics** Over the Operating Range<sup>[6]</sup> (Continued)

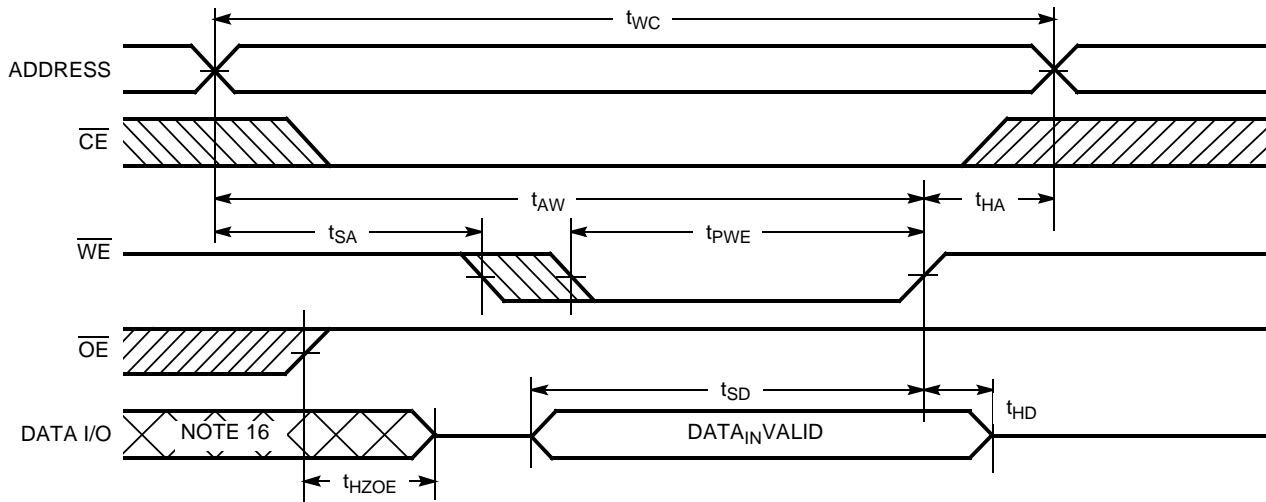
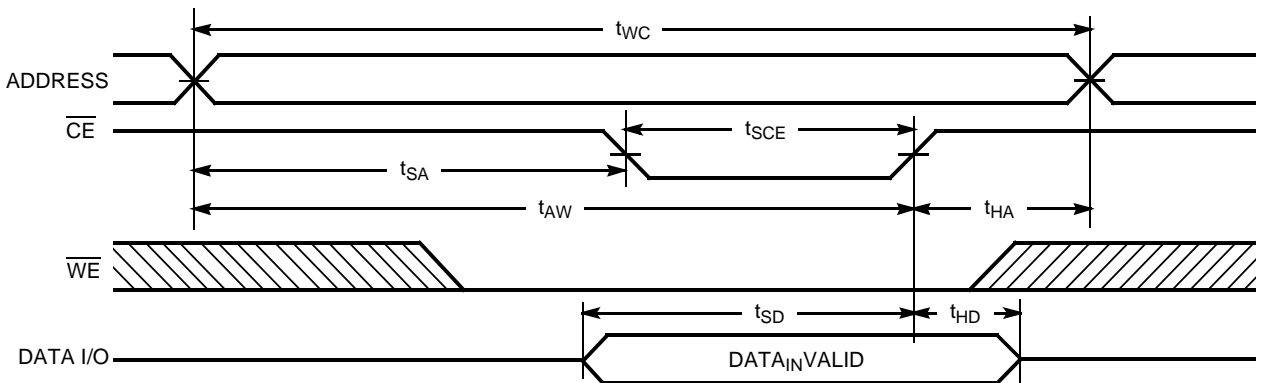
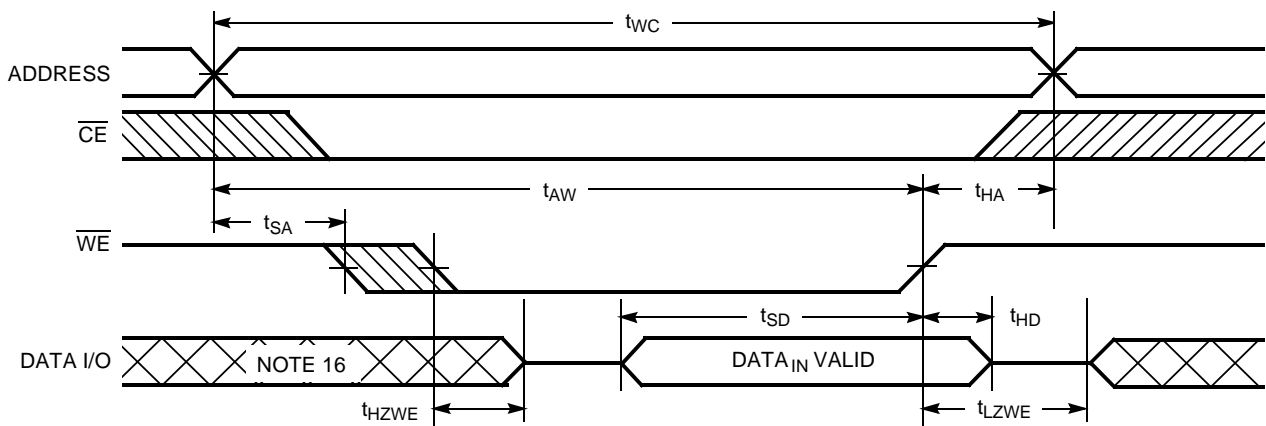
Parameter	Description	1399B-15		1399B-20		Unit
		Min.	Max.	Min.	Max.	
<b>Read Cycle</b>						
$t_{RC}$	Read Cycle Time	15		20		ns
$t_{AA}$	Address to Data Valid		15		20	ns
$t_{OHA}$	Data Hold from Address Change	3		3		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		15		20	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		6		7	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low Z <sup>[7]</sup>	0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[7, 8]</sup>		6		6	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low Z <sup>[7]</sup>	3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High Z <sup>[7, 8]</sup>		7		7	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-Up	0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-Down		15		20	ns
<b>Write Cycle<sup>[9, 10]</sup></b>						
$t_{WC}$	Write Cycle Time	15		20		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	10		12		ns
$t_{AW}$	Address Set-Up to Write End	10		12		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	10		12		ns
$t_{SD}$	Data Set-Up to Write End	8		10		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[9]</sup>		7		7	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[7]</sup>	3		3		ns

**Data Retention Characteristics** (Over the Operating Range - L version only)

Parameter	Description	Conditions	Min.	Max.	Unit
$V_{DR}$	$V_{CC}$ for Data Retention		2.0		V
$I_{CCDR}$	Data Retention Current	$V_{CC} = V_{DR} = 2.0V,$ $CE \geq V_{CC} - 0.3V,$ $V_{IN} \geq V_{CC} - 0.3V$ or $V_{IN} \leq 0.3V$	0	20	$\mu A$
$t_{CDR}$	Chip Deselect to Data Retention Time		0		ns
$t_R$	Operation Recovery Time		$t_{RC}$		ns

**Data Retention Waveform**

**Switching Waveforms**
**Read Cycle No. 1<sup>[11, 12]</sup>**

**Read Cycle No. 2<sup>[12, 13]</sup>**

**Notes:**

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

**Switching Waveforms (continued)**
**Write Cycle No. 1 ( $\overline{WE}$  Controlled)<sup>[9, 14, 15]</sup>**

**Write Cycle No. 2 ( $\overline{CE}$  Controlled)<sup>[9, 14, 15]</sup>**

**Write Cycle No. 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)<sup>[10, 15]</sup>**

**Notes:**

14. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
15. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE}$  HIGH, the output remains in a high-impedance state.
16. During this period, the I/Os are in the output state and input signals should not be applied.

**Truth Table**

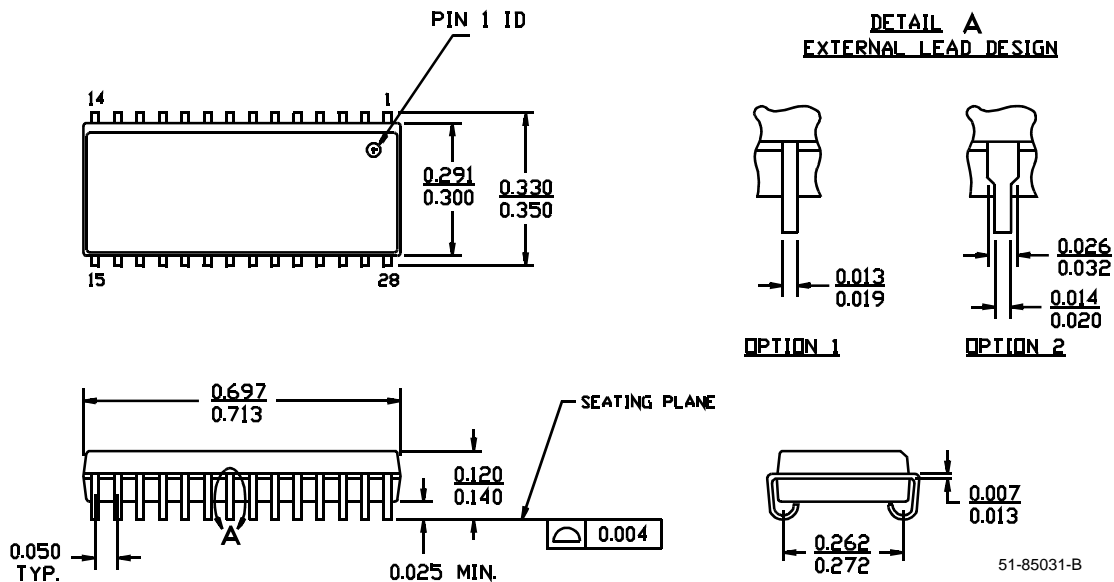
<b>CE</b>	<b>WE</b>	<b>OE</b>	<b>Input/Output</b>	<b>Mode</b>	<b>Power</b>
H	X	X	High Z	Deselect/Power-Down	Standby ( $I_{SB}$ )
L	H	L	Data Out	Read	Active ( $I_{CC}$ )
L	L	X	Data In	Write	Active ( $I_{CC}$ )
L	H	H	High Z	Deselect, Output Disabled	Active ( $I_{CC}$ )

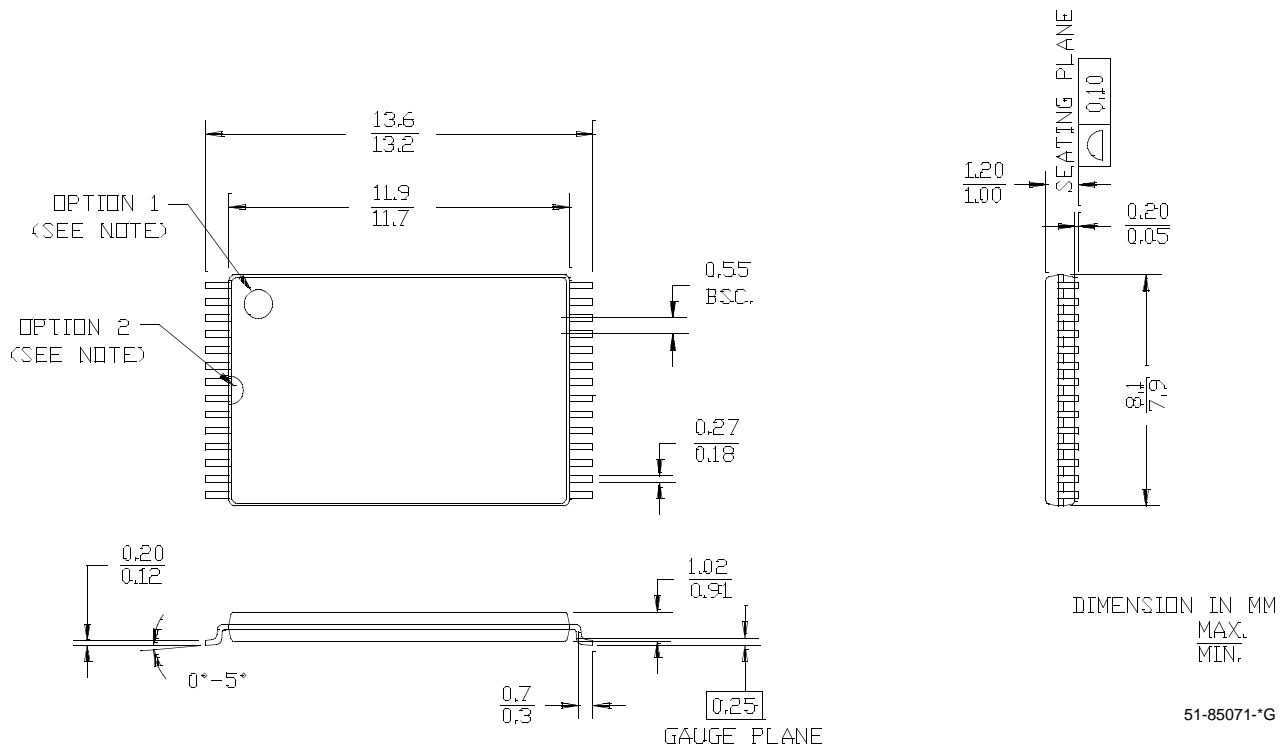
**Ordering Information**

<b>Speed (ns)</b>	<b>Ordering Code</b>	<b>Package Name</b>	<b>Package Type</b>	<b>Operating Range</b>	
10	CY7C1399B-10VC	V21	28-Lead Molded SOJ	Commercial	
	CY7C1399B-10ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399BL-10VC	V21	28-Lead Molded SOJ		
	CY7C1399BL-10ZC	Z28	28-Lead Thin Small Outline Package		
12	CY7C1399B-12VC	V21	28-Lead Molded SOJ	Commercial	
	CY7C1399B-12ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399BL-12VC	V21	28-Lead Molded SOJ		
	CY7C1399BL-12ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399B-12VI	V21	28-Lead Molded SOJ		Industrial
	CY7C1399B-12ZI	Z28	28-Lead Thin Small Outline Package		
15	CY7C1399B-15VC	V21	28-Lead Molded SOJ	Commercial	
	CY7C1399B-15ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399BL-15VC	V21	28-Lead Molded SOJ		
	CY7C1399BL-15ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399B-15VI	V21	28-Lead Molded SOJ		Industrial
	CY7C1399B-15ZI	Z28	28-Lead Thin Small Outline Package		
20	CY7C1399B-20VC	V21	28-Lead Molded SOJ	Commercial	
	CY7C1399B-20ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399BL-20VC	V21	28-Lead Molded SOJ		
	CY7C1399BL-20ZC	Z28	28-Lead Thin Small Outline Package		
	CY7C1399B-20VI	V21	28-Lead Molded SOJ		Industrial
	CY7C1399B-20ZI	Z28	28-Lead Thin Small Outline Package		



**Package Diagrams**
**28-Lead (300-Mil) Molded SOJ V21**

 DIMENSIONS IN INCHES **MIN.**  
**MAX.**

**28-Lead Thin Small Outline Package Type 1 (8x13.4 mm) Z28**

 NOTE: ORIENTATION I.D. MAY BE LOCATED EITHER  
 AS SHOWN IN OPTION 1 OR OPTION 2


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**Document History Page**

<b>Document Title: CY7C1399B 32K x 8 3.3V Static RAM</b> <b>Document Number: 38-05071</b>				
<b>REV.</b>	<b>ECN NO.</b>	<b>ISSUE DATE</b>	<b>ORIG. OF CHANGE</b>	<b>DESCRIPTION OF CHANGE</b>
**	107264	05/25/01	SZV	Change from Spec #: 38-01102 to 38-05071
*A	107533	06/28/01	MAX	Add Low Power
*B	116472	09/17/02	CEA	Add applications foot note to data sheet, page 1.