

# 1M x 4 Static RAM

## Features

- **High speed**  
—  $t_{AA} = 10\text{ns}$
- **Low active power for 10 ns speed**  
— 324 mW (max.)
- **2.0V data retention**
- **Automatic power-down when deselected**
- **TTL-compatible inputs and outputs**
- **Easy memory expansion with CE and OE features**

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

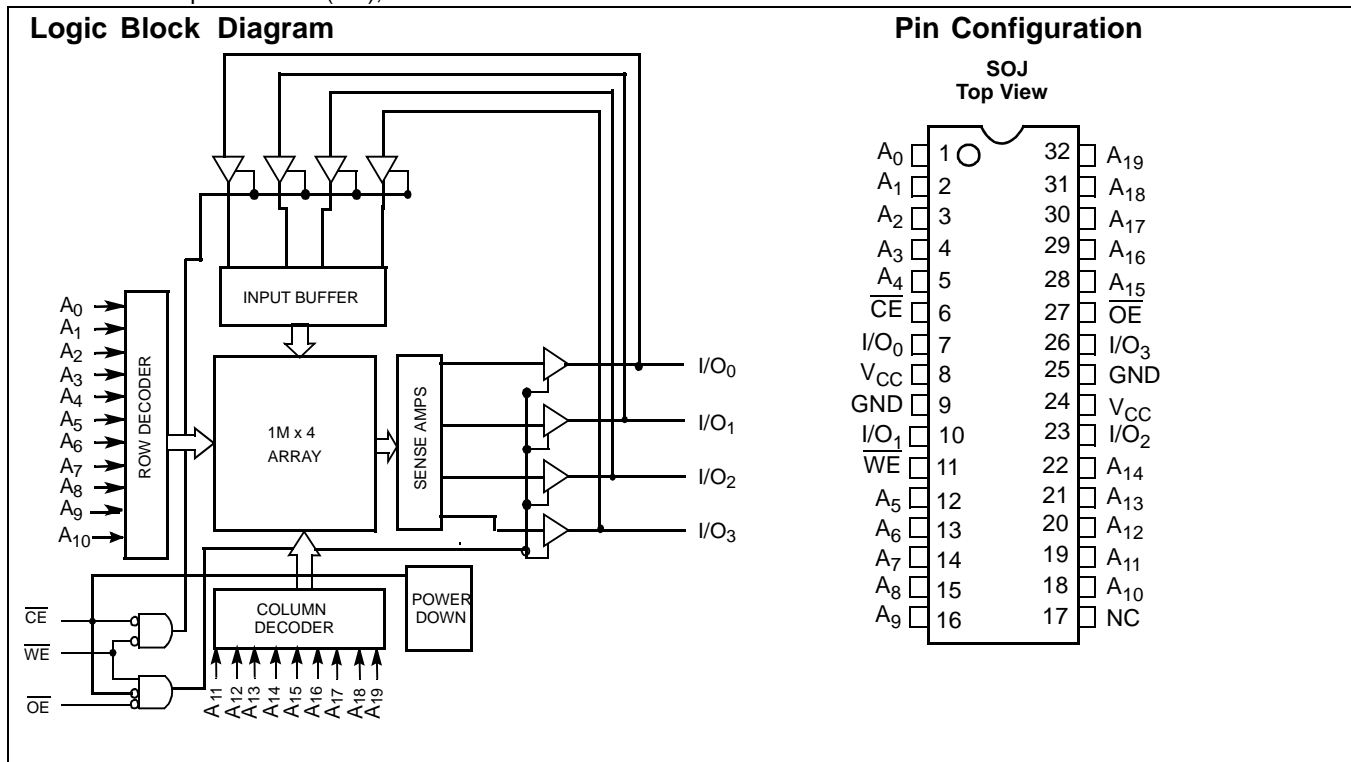
The CY7C1046CV33 is a high-performance CMOS static RAM organized as 1,048,576 words by 4 bits. Easy memory expansion is provided by an active LOW Chip Enable ( $\overline{CE}$ ), an active LOW Output Enable ( $\overline{OE}$ ), and three-state drivers.

Writing to the device is accomplished by taking Chip Enable ( $\overline{CE}$ ) and Write Enable ( $\overline{WE}$ ) inputs LOW. Data on the four I/O pins ( $I/O_0$  through  $I/O_3$ ) is then written into the location specified on the address pins ( $A_0$  through  $A_{19}$ ).

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

The four input/output pins ( $I/O_0$  through  $I/O_3$ ) are placed in a high-impedance state when the device is deselected ( $\overline{CE}$  HIGH), the outputs are disabled ( $\overline{OE}$  HIGH), or during a Write operation ( $\overline{CE}$  LOW, and  $\overline{WE}$  LOW).

The CY7C1046CV33 is available in a standard 400-mil-wide 32-pin SOJ package with center power and ground (revolutionary) pinout.



## Selection Guide

	-8 <sup>[2]</sup>	-10	-12	-15	Unit
Maximum Access Time	8	10	12	15	ns
Maximum Operating Current	100	90	85	80	mA
Maximum CMOS Standby Current	10	10	10	10	mA

### Notes:

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).
2. Shaded areas contain advance information.



**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>[3]</sup> .... -0.5V to +4.6V
- DC Voltage Applied to Outputs in High-Z State<sup>[3]</sup>.....-0.5V to V<sub>CC</sub> + 0.5V
- DC Input Voltage<sup>[3]</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	3.0V – 3.6V
Industrial	-40°C to + 85°C	3.0V – 3.6V

**DC Electrical Characteristics** Over the Operating Range

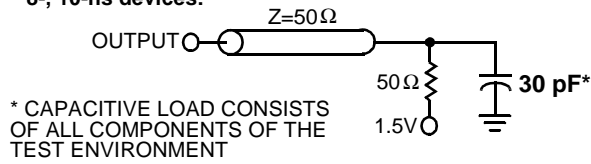
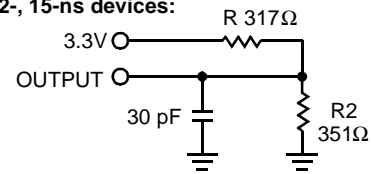
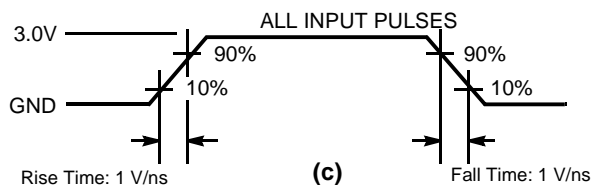
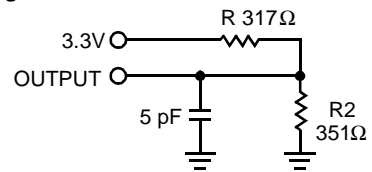
Parameter	Description	Test Conditions	-8 <sup>[2]</sup>		-10		-12		-15		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = Min., I <sub>OH</sub> = -4.0 mA	2.4		2.4		2.4		2.4		V
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = Min., I <sub>OL</sub> = 8.0 mA		0.4		0.4		0.4		0.4	V
V <sub>IH</sub>	Input HIGH Voltage		2.0	V <sub>CC</sub> + 0.3	2.0	V <sub>CC</sub> + 0.3	2.0	V <sub>CC</sub> + 0.3	2.0	V <sub>CC</sub> + 0.3	V
V <sub>IL</sub>	Input LOW Voltage <sup>[3]</sup>		-0.3	0.8	-0.3	0.8	-0.3	0.8	-0.3	0.8	V
I <sub>IX</sub>	Input Load Current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-1	+1	-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	-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>		100		90		85		80	mA
I <sub>SB1</sub>	Automatic CE Power-Down Current —TTL Inputs	Max. V <sub>CC</sub> , CE ≥ V <sub>IH</sub> 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		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		10		10		10		10	mA

**Capacitance<sup>[4]</sup>**

Parameter	Description	Test Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	T <sub>A</sub> = 25°C, f = 1 MHz, V <sub>CC</sub> = 3.3V	6	pF
C <sub>OUT</sub>	I/O Capacitance		6	pF

**Notes:**

3. V<sub>IL</sub> (min.) = -2.0V for pulse durations of less than 20 ns.
4. Tested initially and after any design or process changes that may affect these parameters.

**AC Test Loads and Waveforms<sup>[5]</sup>**
**8-, 10-ns devices:**

**(a)**
**12-, 15-ns devices:**

**(b)**

**(c)**
**High-Z characteristics:**

**(d)**
**Notes:**

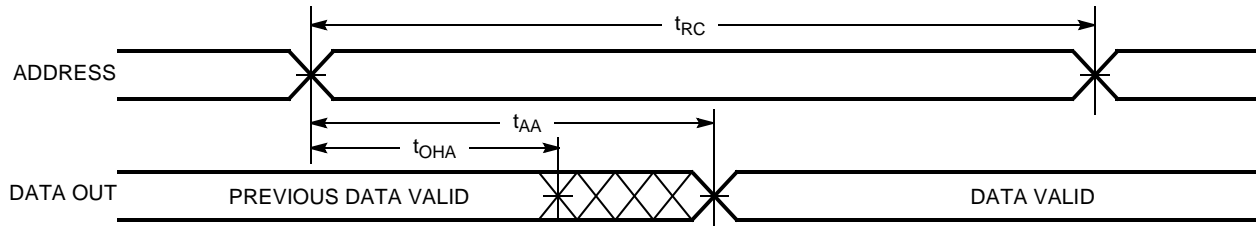
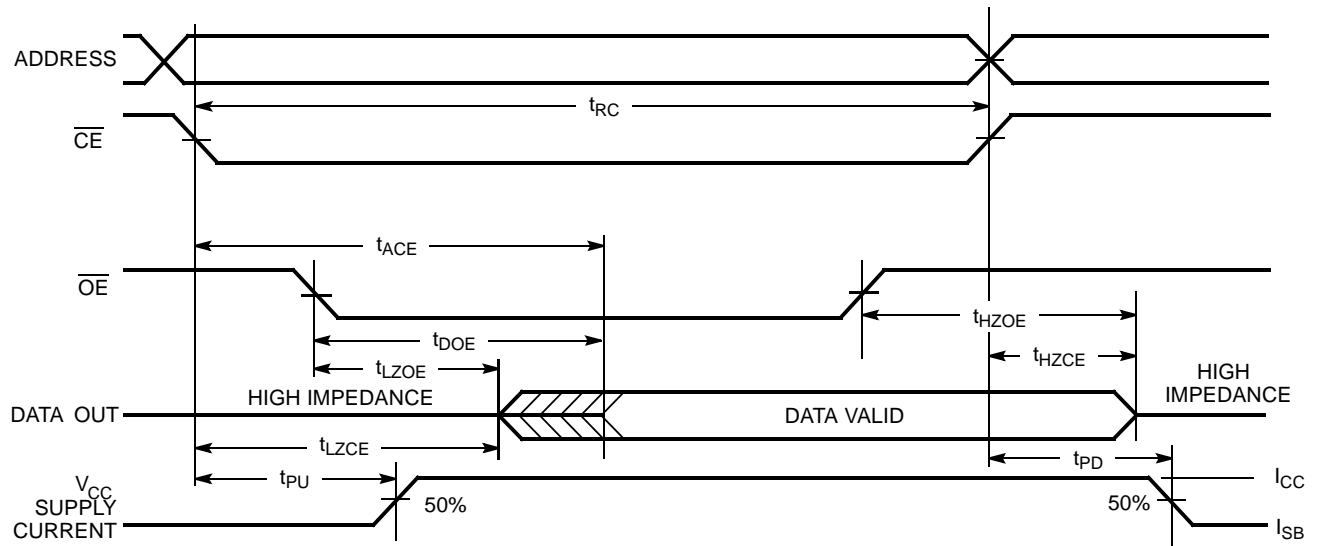
- AC characteristics (except High-Z) for all 8-ns and 10-ns parts are tested using the load conditions shown in Figure (a). All other speeds are tested using the Thevenin load shown in Figure (b). High-Z characteristics are tested for all speeds using the test load shown in Figure (d).

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

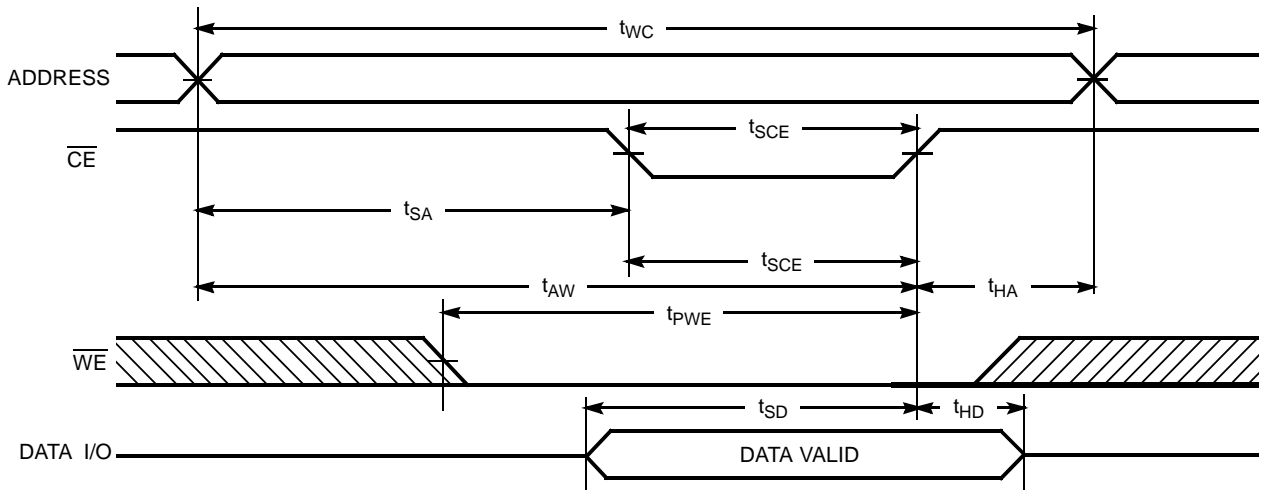
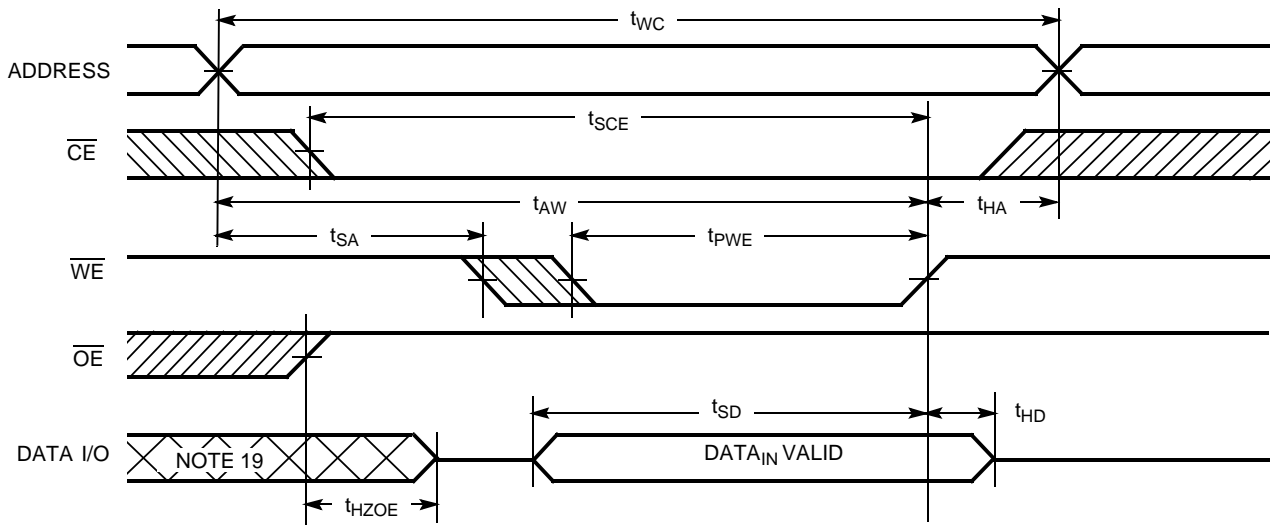
Parameter	Description	-8 <sup>[2]</sup>		-10		-12		-15		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
<b>Read Cycle</b>										
$t_{power}^{[7]}$	$V_{CC}$ (typical) to the first access	1		1		1		1		$\mu s$
$t_{RC}$	Read Cycle Time	8		10		12		15		ns
$t_{AA}$	Address to Data Valid		8		10		12		15	ns
$t_{OHA}$	Data Hold from Address Change	3		3		3		3		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		8		10		12		15	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		4		5		6		7	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z <sup>[9]</sup>	0		0		0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[8, 9]</sup>		4		5		6		7	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low-Z <sup>[9]</sup>	3		3		3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High-Z <sup>[8, 9]</sup>		4		5		6		7	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-up	0		0		0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-Down		8		10		12		15	ns
<b>Write Cycle<sup>[10, 11]</sup></b>										
$t_{WC}$	Write Cycle Time	8		10		12		15		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	6		7		8		10		ns
$t_{AW}$	Address Set-up to Write End	6		7		8		10		ns
$t_{HA}$	Address Hold from Write End	0		0		0		0		ns
$t_{SA}$	Address Set-up to Write Start	0		0		0		0		ns
$t_{PWE}$	$\overline{WE}$ Pulse Width	6		7		8		10		ns
$t_{SD}$	Data Set-up to Write End	4		5		6		7		ns
$t_{HD}$	Data Hold from Write End	0		0		0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[9]</sup>	3		3		3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[8, 9]</sup>		4		5		6		7	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.
7.  $t_{POWER}$  gives the minimum amount of time that the power supply should be at stable, typical  $V_{CC}$  values until the first memory access can be performed.
8.  $t_{HZOE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (d) of AC Test Loads. Transition is measured  $\pm 500$  mV from steady-state voltage.
9. 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.
10. 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.
11. The minimum Write cycle time for Write Cycle no. 3 ( $\overline{WE}$  controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

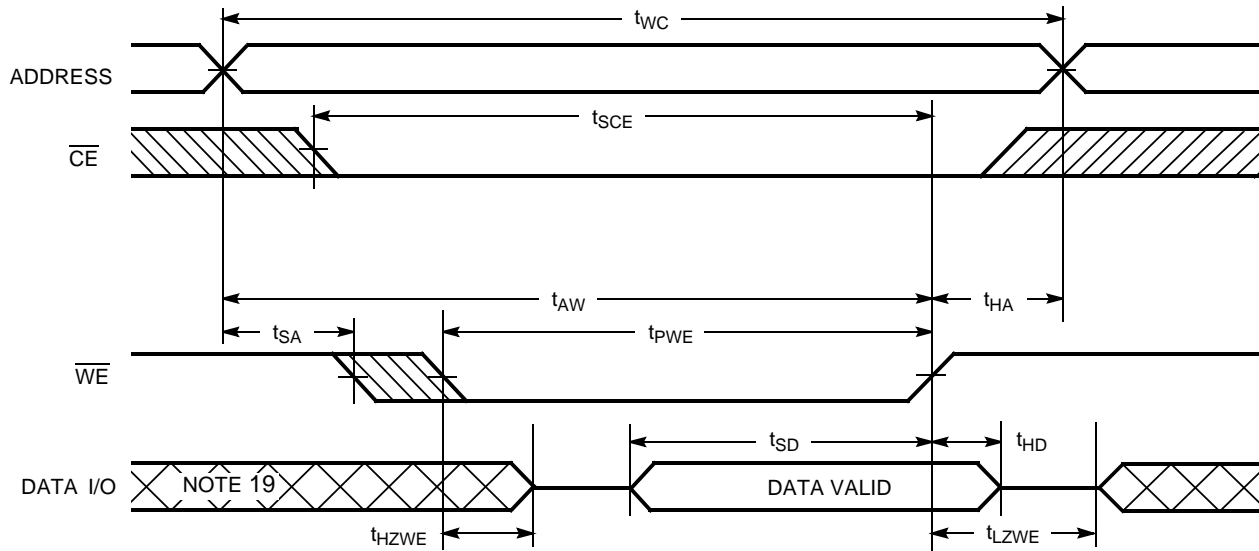
**Switching Waveforms**
**Read Cycle No. 1**<sup>[14, 15]</sup>

**Read Cycle No. 2 ( $\overline{OE}$  Controlled)**<sup>[15, 16]</sup>

**Notes:**

12.  $t_r \leq 3$  ns for the -10, -12, and -15 speeds.
13. No input may exceed  $V_{CC} + 0.5V$ .
14. Device is continuously selected.  $\overline{OE}, \overline{CE} = V_{IL}$ .
15.  $\overline{WE}$  is HIGH for Read cycle.
16. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.

**Switching Waveforms (continued)**
**Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled)<sup>[17, 18]</sup>**

**Write Cycle No. 2 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  HIGH During Write)<sup>[17, 18]</sup>**

**Notes:**

17. Data I/O is high impedance if  $\overline{\text{OE}} = V_{\text{IH}}$ .
18. If  $\overline{\text{CE}}$  goes HIGH simultaneously with  $\overline{\text{WE}}$  going HIGH, the output remains in a high-impedance state.
19. 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>[18]</sup>**

**Truth Table**

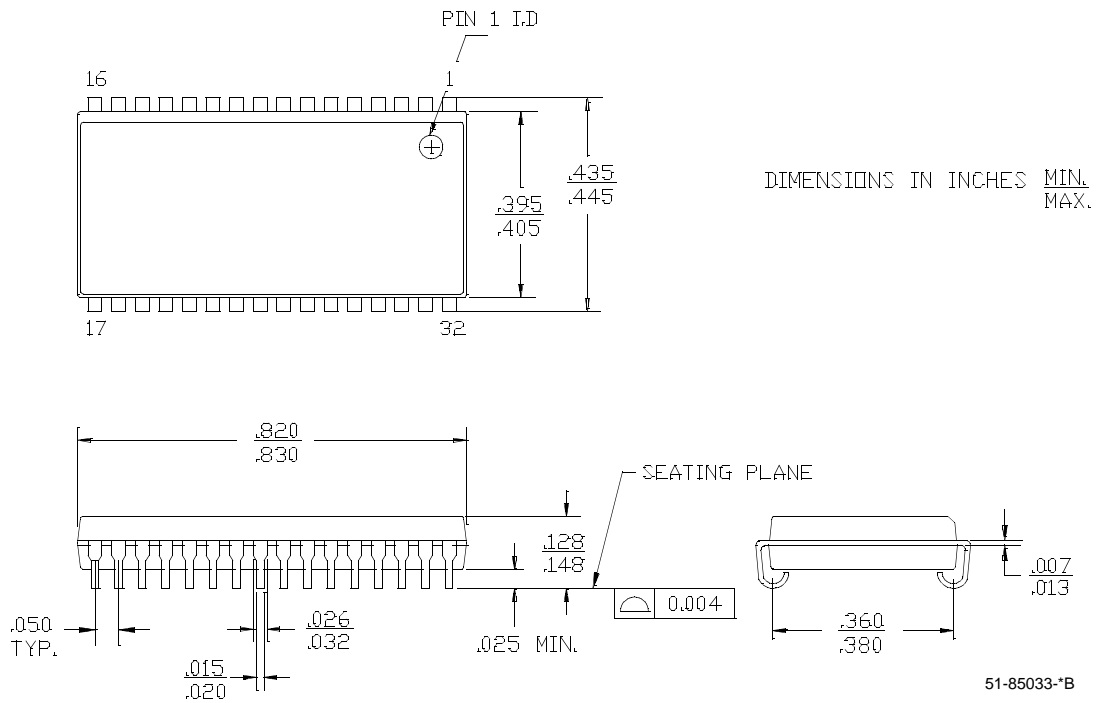
$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O <sub>0</sub> - I/O <sub>7</sub>	Mode	Power
H	X	X	High-Z	Power-down	Standby ( $I_{SB}$ )
L	L	H	Data Out	Read	Active ( $I_{CC}$ )
L	X	L	Data In	Write	Active ( $I_{CC}$ )
L	H	H	High-Z	Selected, Outputs Disabled	Active ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
10	CY7C1046CV33-10VC	V33	32-lead (400-mil) Molded SOJ	Commercial
	CY7C1046CV33-10VI	V33	32-lead (400-mil) Molded SOJ	Industrial
12	CY7C1046CV33-12VC	V33	32-lead (400-mil) Molded SOJ	Commercial
	CY7C1046CV33-12VI	V33	32-lead (400-mil) Molded SOJ	Industrial
15	CY7C1046CV33-15VC	V33	32-lead (400-mil) Molded SOJ	Commercial
	CY7C1046CV33-15VI	V33	32-lead (400-mil) Molded SOJ	Industrial

Package Diagram

32-Lead (400-Mil) Molded SOJ V33



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**Document History Page**

<b>Document Title: CY7C1046CV33 1M x 4 Static RAM</b> <b>Document Number: 38-05003</b>				
<b>REV.</b>	<b>ECN NO.</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
**	112570	03/06/02	HGK	New data sheet for RAM 7
*A	116478	09/16/02	CEA	Add applications foot note to data sheet, page 1.