

# 4-Mbit (512K x 8) Static RAM

## Features

- **Temperature Ranges**
  - Commercial: 0°C to 70°C
  - Industrial: -40°C to 85°C
  - Automotive: -40°C to 125°C
- **High speed**
  - $t_{AA} = 10$  ns
- **Low active power**
  - 324 mW (max.)
- **2.0V data retention**
- **Automatic power-down when deselected**
- **TTL-compatible inputs and outputs**
- **Easy memory expansion with  $\overline{CE}$  and  $\overline{OE}$  features**

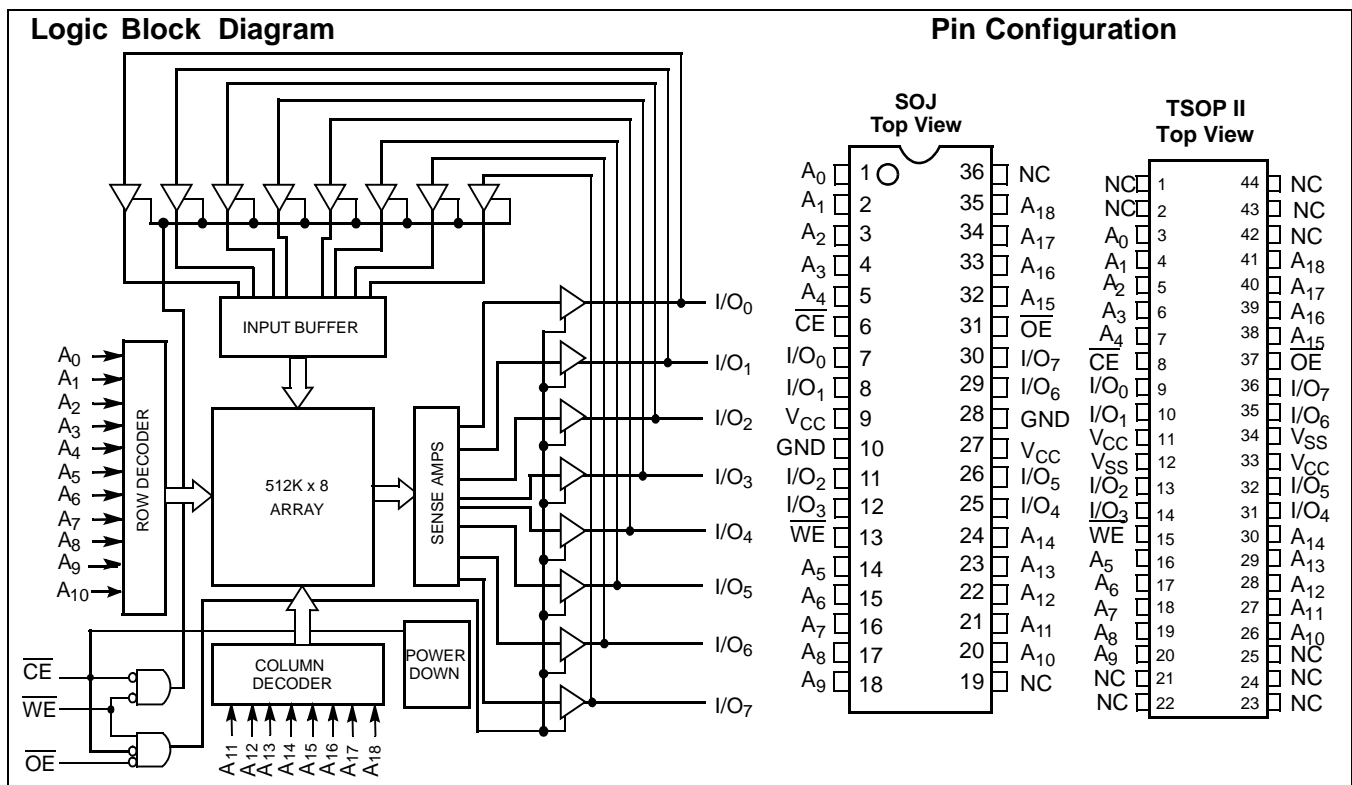
## Functional Description<sup>[1]</sup>

The CY7C1049CV33 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 ( $\overline{CE}$ ), 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 eight I/O pins ( $I/O_0$  through  $I/O_7$ ) is then written into the location specified on the address pins ( $A_0$  through  $A_{18}$ ).

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 eight input/output pins ( $I/O_0$  through  $I/O_7$ ) 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 CY7C1049CV33 is available in standard 400-mil-wide 36-pin SOJ package and 44-pin TSOP II package with center power and ground (revolutionary) pinout.



### 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).

**Selection Guide**

		-8	-10	-12	-15	-20	Unit
Maximum Access Time		8	10	12	15	20	ns
Maximum Operating Current	Commercial	100	90	85	80	80	mA
	Industrial	110	100	95	90	90	mA
	Automotive	-	-	-	95	-	mA
Maximum CMOS Standby Current	Commercial / Industrial	10	10	10	10	10	mA
	Automotive	-	-	-	15	-	mA

Shaded areas contain advance information.

**Pin Definitions**

Pin Name	36-SOJ Pin Number	44 TSOP-II Pin Number	I/O Type	Description
A <sub>0</sub> -A <sub>18</sub>	1-5,14-18, 20-24,32-35	3-7,16-20, 26-30,38-41	Input	<b>Address Inputs used to select one of the address locations.</b>
I/O <sub>0</sub> -I/O <sub>7</sub>	7,8,11,12,25, 26,29,30	9,10,13,14, 31,32,35,36	Input/Output	<b>Bidirectional Data I/O lines.</b> Used as input or output lines depending on operation
NC <sup>[2]</sup>	19,36	1,2,21,22,23, 24,25,42,43, 44	No Connect	<b>No Connects.</b> This pin is not connected to the die
$\overline{\text{WE}}$	13	15	Input/Control	<b>Write Enable Input, active LOW.</b> When selected LOW, a WRITE is conducted. When selected HIGH, a READ is conducted.
$\overline{\text{CE}}$	6	8	Input/Control	<b>Chip Enable Input, active LOW.</b> When LOW, selects the chip. When HIGH, deselects the chip.
$\overline{\text{OE}}$	31	37	Input/Control	<b>Output Enable, active LOW.</b> Controls the direction of the I/O pins. When LOW, the I/O pins are allowed to behave as outputs. When deasserted HIGH, I/O pins are three-stated, and act as input data pins.
V <sub>SS</sub> , GND	10,28	12,34	Ground	<b>Ground for the device.</b> Should be connected to ground of the system.
V <sub>CC</sub>	9,27	11,33	Power Supply	<b>Power Supply inputs to the device.</b>

**Notes:**

- NC pins are not connected on the die.

**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>[3]</sup> -0.5V to +4.6VDC  
 Voltage Applied to Outputs in High-Z State<sup>[3]</sup> ..... -0.5V to  $V_{CC} + 0.5V$

Input Voltage<sup>[3]</sup> ..... -0.5V to  $V_{CC} + 0.5V$

Current into Outputs (LOW)..... 20 mA

**Operating Range**

Range	Ambient Temperature	$V_{CC}$
Commercial	0°C to +70°C	3.3V ± 0.3V
Industrial	-40°C to +85°C	
Automotive	-40°C to +125°C	

**Electrical Characteristics Over the Operating Range**

Parameter	Description	Test Conditions	-8		-10		-12		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		2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	V	
$V_{IL}$	Input LOW Voltage <sup>[3]</sup>		-0.3	0.8	-0.3	0.8	-0.3	0.8	V	
$I_{IX}$	Input Load Current	$GND \leq V_I \leq V_{CC}$	Com'l/Ind'l	-1	+1	-1	+1	-1	+1	µA
$I_{OZ}$	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC}$ , Output Disabled	Com'l/Ind'l	-1	+1	-1	+1	-1	+1	µA
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.},$ $f = f_{MAX} = 1/t_{RC}$	Com'l		100		90		85	mA
			Ind'l		110		100		95	mA
$I_{SB1}$	Automatic CE Power-down Current —TTL Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{IH}$ ; $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$	Com'l/Ind'l		40		40		40	mA
$I_{SB2}$	Automatic CE Power-down Current —CMOS Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{CC} - 0.3V$ , $V_{IN} \geq V_{CC} - 0.3V$ , or $V_{IN} \leq 0.3V$ , $f = 0$	Com'l/Ind'l		10		10		10	mA

**Electrical Characteristics Over the Operating Range**

Parameter	Description	Test Conditions	-15		-20		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		2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	V	
$V_{IL}$	Input LOW Voltage <sup>[3]</sup>		-0.3	0.8	-0.3	0.8	V	
$I_{IX}$	Input Load Current	$GND \leq V_I \leq V_{CC}$	Com'l / Ind'l	-1	+1	-1	+1	µA
			Automotive	-20	+20	-	-	µA
$I_{OZ}$	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC}$ , Output Disabled	Com'l / Ind'l	-1	+1	-1	+1	µA
			Automotive	-20	+20	-	-	µA
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.},$ $f = f_{MAX} = 1/t_{RC}$	Com'l		80		80	mA
			Ind'l		90		90	mA
			Automotive		95		-	mA

**Note:**

3.  $V_{IL}(\text{min.}) = -2.0V$  and  $V_{IH}(\text{max.}) = V_{CC} + 0.5V$  for pulse durations of less than 20 ns.

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

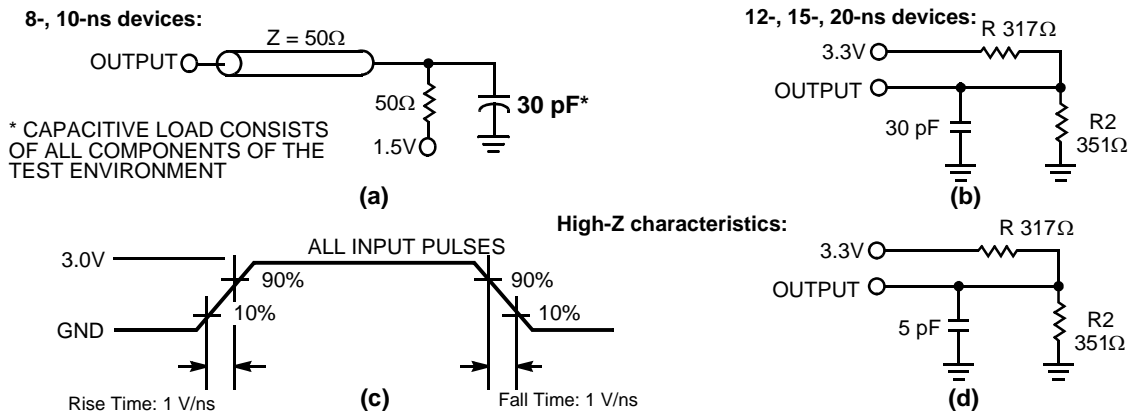
Parameter	Description	Test Conditions	-15		-20		Unit	
			Min.	Max.	Min.	Max.		
$I_{SB1}$	Automatic CE Power-down Current —TTL Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{IH}$ ; $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$	Com'l / Ind'l		40		40	mA
			Automotive		45		-	mA
$I_{SB2}$	Automatic CE Power-down Current —CMOS Inputs	Max. $V_{CC}$ , $CE \geq V_{CC} - 0.3V$ , $V_{IN} \geq V_{CC} - 0.3V$ , or $V_{IN} \leq 0.3V$ , $f = 0$	Com'l/Ind'l		10		10	mA
			Automotive		15		-	mA

**Thermal Resistance<sup>[4]</sup>**

Parameter	Description	Test Conditions	36-pin SOJ (Non Pb-Free)	36-pin SOJ (Pb-Free)	44-TSOP-II (Non Pb-Free)	44-TSOP-II (Pb-Free)	Unit
$\Theta_{JA}$	Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA / JESD51.	46.51	46.51	41.66	41.66	$^{\circ}C/W$
$\Theta_{JC}$	Thermal Resistance (Junction to Case)		18.8	18.8	10.56	10.56	$^{\circ}C/W$

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

Parameter	Description	Test Conditions	Max.	Unit
$C_{IN}$	Input Capacitance	$T_A = 25^{\circ}C$ , $f = 1$ MHz, $V_{CC} = 3.3V$	8	pF
$C_{OUT}$	I/O Capacitance		8	pF

**AC Test Loads and Waveforms<sup>[5]</sup>**

**Notes:**

- Tested initially and after any design or process changes that may affect these parameters.
- 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** Over the Operating Range <sup>[6]</sup>

Parameter	Description	-8		-10		-12		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
<b>Read Cycle</b>								
$t_{power}^{[7]}$	$V_{CC}$ (typical) to the first access	1		1		1		$\mu s$
$t_{RC}$	Read Cycle Time	8		10		12		ns
$t_{AA}$	Address to Data Valid		8		10		12	ns
$t_{OHA}$	Data Hold from Address Change	3		3		3		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		8		10		12	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		4		5		6	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z	0		0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[8, 9]</sup>		4		5		6	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low-Z <sup>[9]</sup>	3		3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High-Z <sup>[8, 9]</sup>		4		5		6	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-up	0		0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-down		8		10		12	ns
<b>Write Cycle</b> <sup>[10, 11]</sup>								
$t_{WC}$	Write Cycle Time	8		10		12		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	6		7		8		ns
$t_{AW}$	Address Set-up to Write End	6		7		8		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	6		7		8		ns
$t_{SD}$	Data Set-up to Write End	4		5		6		ns
$t_{HD}$	Data Hold from Write End	0		0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[9]</sup>	3		3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[8, 9]</sup>		4		5		6	ns

Shaded areas contain advance information.

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

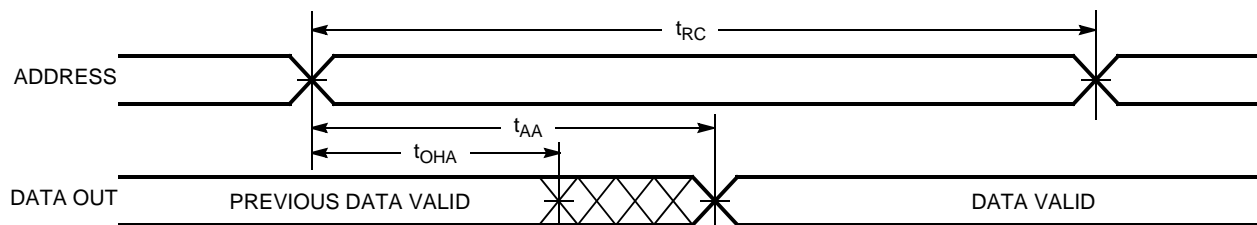
Parameter	Description	-15		-20		Unit
		Min.	Max.	Min.	Max.	
<b>Read Cycle</b>						
$t_{power}^{[7]}$	$V_{CC}$ (typical) to the first access	1		1		$\mu s$
$t_{RC}$	Read Cycle Time	15		20		ns
$t_{AA}$	Address to Data Valid		15		20	ns
$t_{OHA}$	Data Hold from Address Change		3		3	ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		15		20	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		7		8	ns

**Notes:**

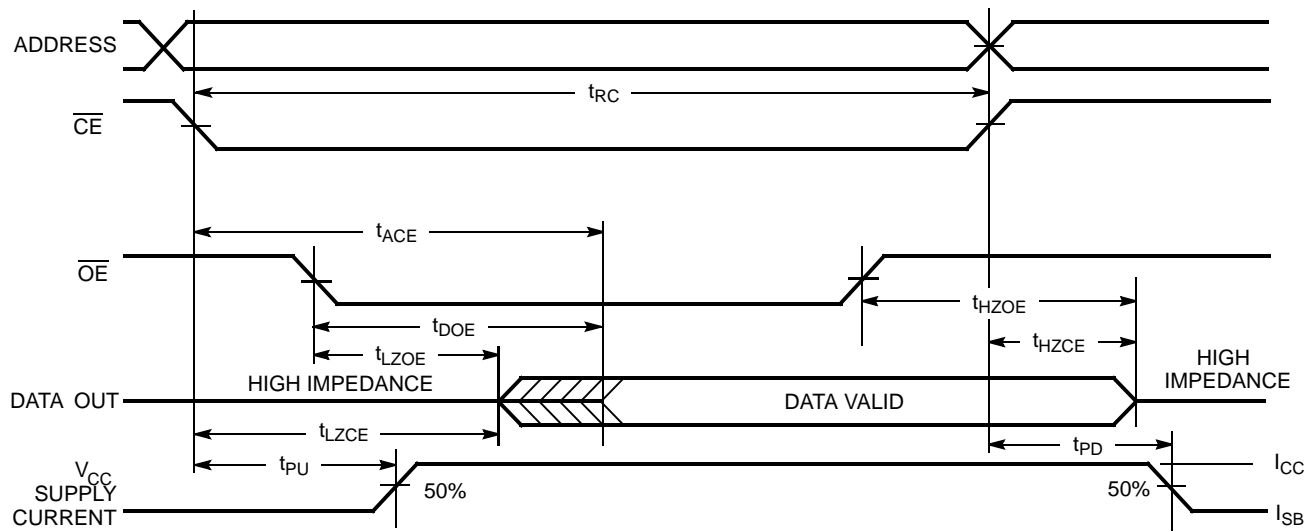
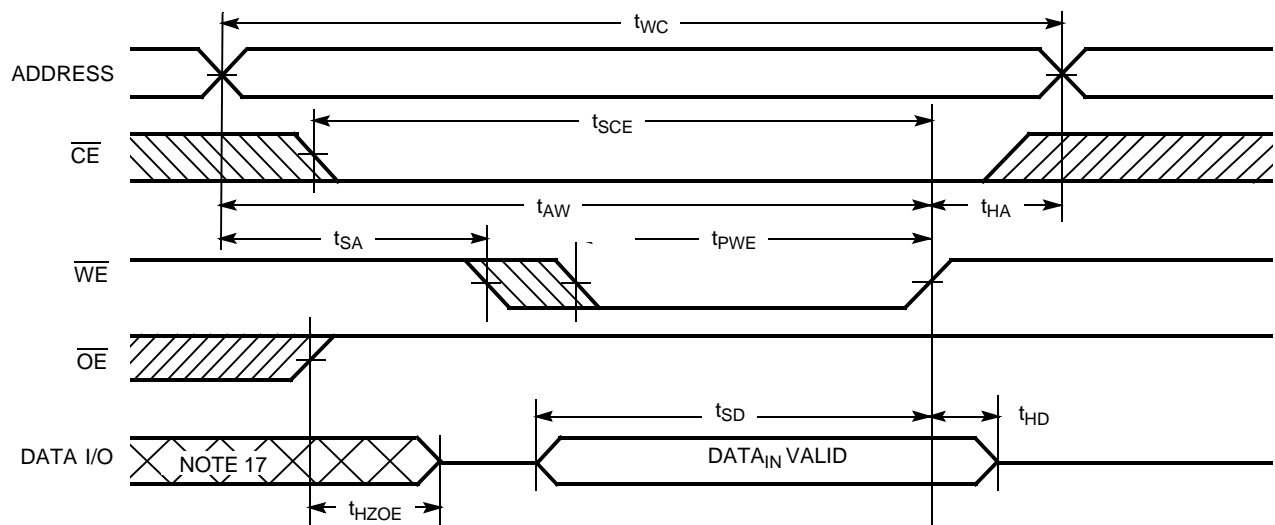
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V.
- $t_{POWER}$  gives the minimum amount of time that the power supply should be at stable, typical  $V_{CC}$  values until the first memory access can be performed.
- $t_{HZOE}$ ,  $t_{HZCE}$ , 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.
- 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  $t_{SD}$ .

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

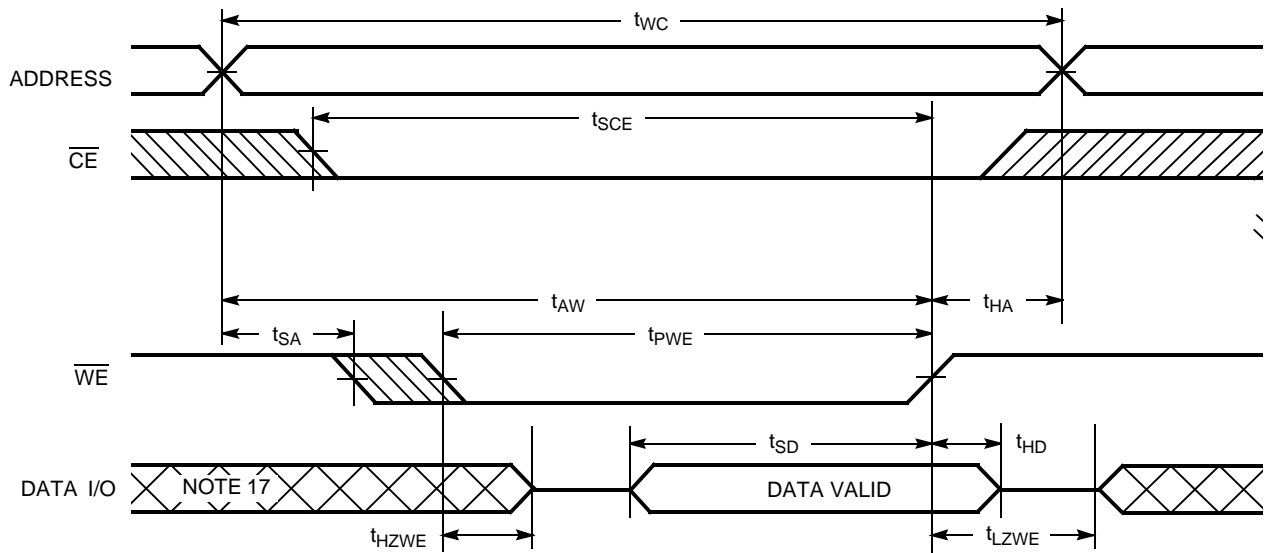
Parameter	Description	-15		-20		Unit
		Min.	Max.	Min.	Max.	
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z	0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[8, 9]</sup>		7		8	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low-Z <sup>[9]</sup>	3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High-Z <sup>[8, 9]</sup>		7		8	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>[10, 11]</sup></b>						
$t_{WC}$	Write Cycle Time	15		20		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	10		10		ns
$t_{AW}$	Address Set-up to Write End	10		10		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		10		ns
$t_{SD}$	Data Set-up to Write End	7		8		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[9]</sup>	3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[8, 9]</sup>		7		8	ns

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

**Notes:**

12. Device is continuously selected.  $\overline{OE}, \overline{CE} = V_{IL}$ .  
 13.  $\overline{WE}$  is HIGH for Read cycle.

**Switching Waveforms (continued)**
**Read Cycle No. 2 ( $\overline{OE}$  Controlled)<sup>[13, 14]</sup>**

**Write Cycle No. 1 ( $\overline{WE}$  Controlled,  $\overline{OE}$  HIGH During Write)<sup>[15, 16]</sup>**

**Notes:**

14. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.
15. Data I/O is high-impedance if  $OE = V_{IH}$ .
16. If CE goes HIGH simultaneously with  $\overline{WE}$  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. 2 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)<sup>[16]</sup>**




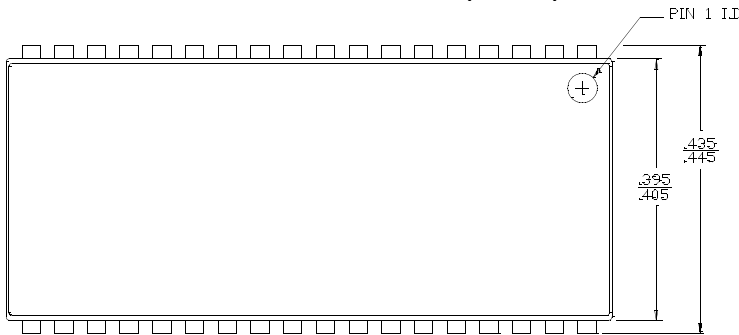
**Truth Table**

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

**Ordering Information**

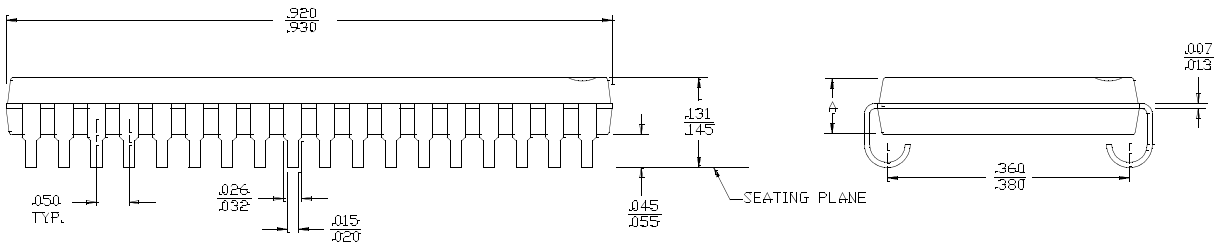
Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
10	CY7C1049CV33-10VC	V36	36-lead (400-Mil) Molded SOJ	Commercial
	CY7C1049CV33-10ZC	Z44	44-pin TSOP II	
	CY7C1049CV33-10VI	V36	36-lead (400-Mil) Molded SOJ	Industrial
	CY7C1049CV33-10ZI	Z44	44-pin TSOP II	
12	CY7C1049CV33-12VC	V36	36-lead (400-Mil) Molded SOJ	Commercial
	CY7C1049CV33-12ZC	Z44	44-pin TSOP II	
	CY7C1049CV33-12VI	V36	36-lead (400-Mil) Molded SOJ	Industrial
	CY7C1049CV33-12ZI	Z44	44-pin TSOP II	
15	CY7C1049CV33-15VC	V36	36-lead (400-Mil) Molded SOJ	Commercial
	CY7C1049CV33-15ZC	Z44	44-pin TSOP II	
	CY7C1049CV33-15VI	V36	36-lead (400-Mil) Molded SOJ	Industrial
	CY7C1049CV33-15ZI	Z44	44-pin TSOP II	
	CY7C1049CV33-15VE	V36	36-lead (400-Mil) Molded SOJ	Automotive
	CY7C1049CV33-15ZSE	Z44	44-pin TSOP II	
20	CY7C1049CV33-20VC	V36	36-lead (400-Mil) Molded SOJ	Commercial
	CY7C1049CV33-20VI	V36	36-lead (400-Mil) Molded SOJ	Industrial
10	CY7C1049CV33-10VXC	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Commercial
	CY7C1049CV33-10ZXC	Z44	44-pin TSOP II (Pb-Free)	
	CY7C1049CV33-10VXI	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Industrial
	CY7C1049CV33-10ZXI	Z44	44-pin TSOP II (Pb-Free)	Industrial
12	CY7C1049CV33-12VXC	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Commercial
	CY7C1049CV33-12ZXC	Z44	44-pin TSOP II (Pb-Free)	
	CY7C1049CV33-12VXI	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Industrial
	CY7C1049CV33-12ZXI	Z44	44-pin TSOP II (Pb-Free)	
15	CY7C1049CV33-15VXC	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Commercial
	CY7C1049CV33-15ZXC	Z44	44-pin TSOP II (Pb-Free)	
	CY7C1049CV33-15VXI	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Industrial
	CY7C1049CV33-15ZXI	Z44	44-pin TSOP II (Pb-Free)	
	CY7C1049CV33-15VXE	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Automotive
	CY7C1049CV33-15ZSXE	Z44	44-pin TSOP II	Automotive
20	CY7C1049CV33-20VXC	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Commercial
	CY7C1049CV33-20VXI	V36	36-lead (400-Mil) Molded SOJ (Pb-Free)	Industrial

Shaded areas contain advance information. Please contact your local Cypress Sales representative for availability of these parts.

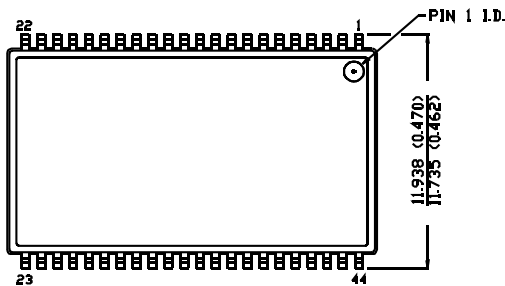
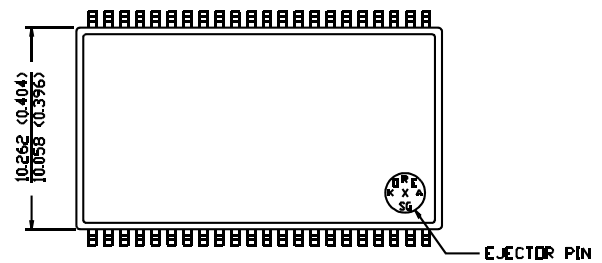
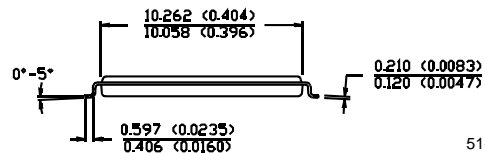
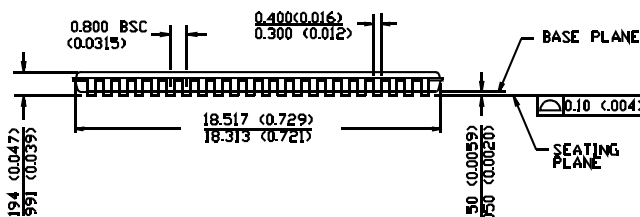
**Package Diagrams**
**36-Lead (400-Mil) Molded SOJ V36**


DIMENSIONS IN INCHES MIN. MAX.

DIM. A	
ANAM	CSP1
.086	.095
.090	.115



51-85090-\*B

**MAX  
MIN**
**44-pin TSOP II Z44**

**TOP VIEW**

**BOTTOM VIEW**


51-85087-\*A

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**Document History Page**

Document Title: CY7C1049CV33 4-Mbit (512K x 8) Static RAM				
Document Number: 38-05006				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	112569	03/06/02	HGK	New data sheet
*A	114091	04/25/02	DFP	Changed Tpower unit from ns to $\mu$ s
*B	116479	09/16/02	CEA	Add applications foot note to data sheet, page 1.
*C	262949	See ECN	RKF	Added Automotive Specs Added $\Theta_{JA}$ and $\Theta_{JC}$ values on Page #3.
*D	300091	See ECN	RKF	Added -20-ns Speed bin
*E	344595	See ECN	SYT	Added Pb-Free package on page #8 Removed shading for CY7C1049CV33-15ZSXE in the ordering Information on page 9