



# 512K x 8 Static RAM

## Features

- High speed
  - $t_{AA} = 15 \text{ ns}$
- Low active power
  - 504 mW (max.)
- Low CMOS standby power (Commercial L version)
  - 1.8 mW (max.)
- 2.0V Data Retention (660  $\mu\text{W}$  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

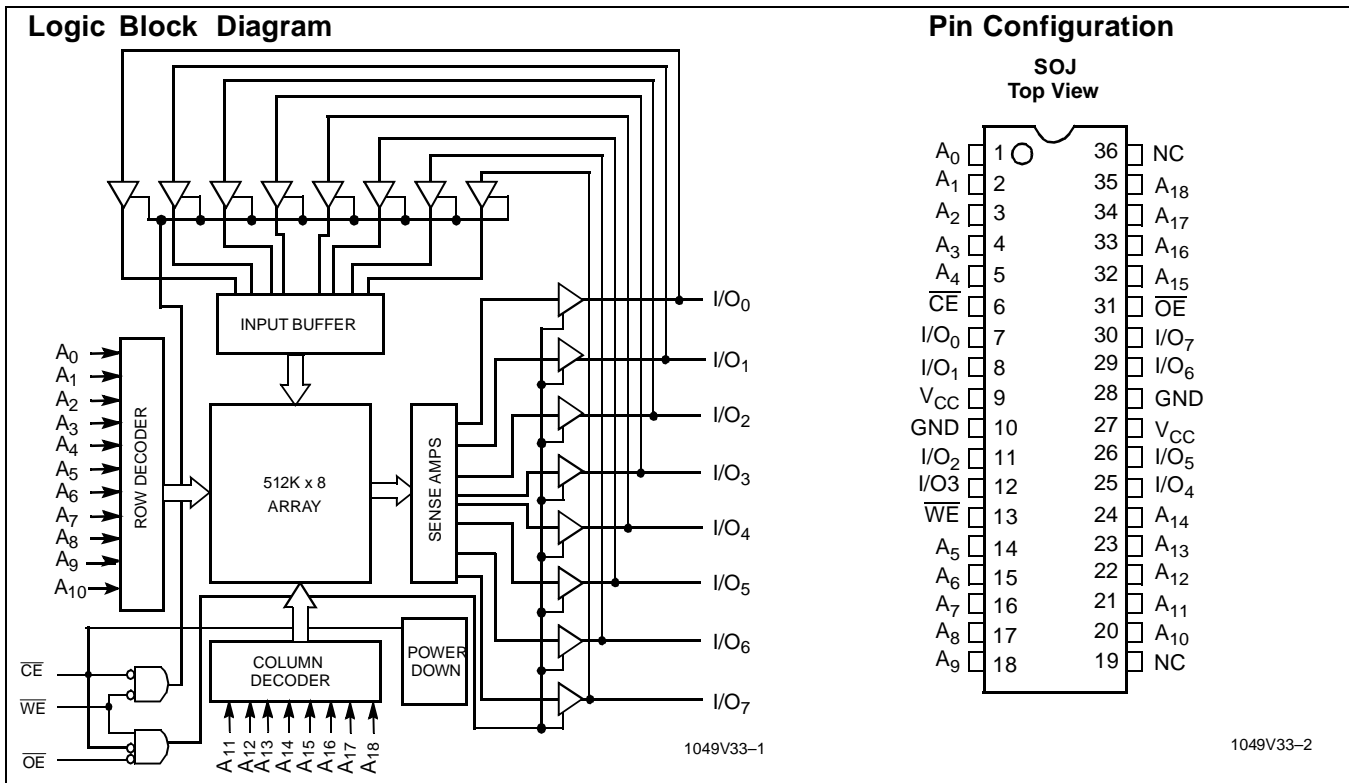
## Functional Description

The CY7C1049V33 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 (I/O<sub>0</sub> through I/O<sub>7</sub>) is then written into the location specified on the address pins (A<sub>0</sub> through A<sub>18</sub>).

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 (I/O<sub>0</sub> through I/O<sub>7</sub>) 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 CY7C1049V33 is available in a standard 400-mil-wide 36-pin SOJ package with center power and ground (revolutionary) pinout.



## Selection Guide

	1049V33-12	1049V33-15	1049V33-17	1049V33-20	1049V33-25
Maximum Access Time (ns)	12	15	17	20	25
Maximum Operating Current (mA)	150	140	130	120	110
Maximum CMOS Standby Current (mA)	Com'l/Ind'l	8	8	8	8
	Com'l L	0.5	0.5	0.5	0.5

Shaded areas contain preliminary 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  $V_{CC}$  to Relative GND<sup>[1]</sup> .... -0.5V to +4.6V

DC Voltage Applied to Outputs in High Z State<sup>[1]</sup> ..... -0.5V to  $V_{CC} + 0.5V$

DC Input Voltage<sup>[1]</sup> ..... -0.5V to  $V_{CC} + 0.5V$

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

### Operating Range

Range	Ambient Temperature <sup>[2]</sup>	$V_{CC}$
Commercial	0°C to +70°C	3.3V ± 0.3V
Industrial	-40°C to +85°C	

### Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	7C1049V33-12		7C1049V33-15		7C1049V33-17		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	$V_{CC} + 0.5$	2.2	$V_{CC} + 0.5$	2.2	$V_{CC} + 0.5$	V
$V_{IL}$	Input LOW Voltage <sup>[1]</sup>		-0.5	0.8	-0.5	0.8	-0.5	0.8	V
$I_{IX}$	Input Load Current	$GND \leq V_I \leq V_{CC}$	-1	+1	-1	+1	-1	+1	μA
$I_{OZ}$	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC},$ Output Disabled	-1	+1	-1	+1	-1	+1	μA
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.}, f = f_{MAX} = 1/t_{RC}$		150		140		130	mA
$I_{SB1}$	Automatic CE Power-Down Current —TTL Inputs	Max. $V_{CC}, \overline{CE} \geq V_{IH}$ $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}, f = f_{MAX}$		30		30		30	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			8		8	mA
			Com'l	L		0.5		0.5	0.5

Shaded areas contain preliminary information.

#### Notes:

- $V_{IL}$  (min.) = -2.0V for pulse durations of less than 20 ns.
- $T_A$  is the "Instant On" case temperature.

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

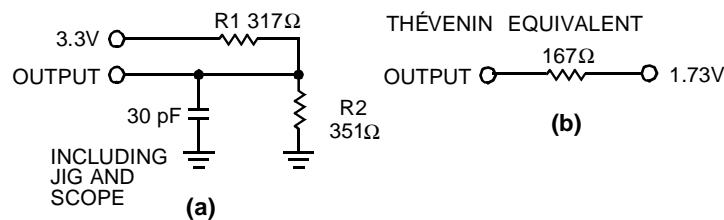
Parameter	Description	Test Conditions	7C1049V33-20		7C1049V33-25		Unit	
			Min.	Max.	Min.	Max.		
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$	2.4		2.4		V	
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$		0.4		0.4	V	
$V_{IH}$	Input HIGH Voltage		2.2	$V_{CC} + 0.5$	2.2	$V_{CC} + 0.5$	V	
$V_{IL}$	Input LOW Voltage <sup>[1]</sup>		-0.5	0.8	-0.5	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	$V_{CC} = \text{Max.},$ $f = f_{MAX} = 1/t_{RC}$		120		110	mA	
$I_{SB1}$	Automatic CE Power-Down Current —TTL Inputs	Max. $V_{CC}, \overline{CE} \geq V_{IH}$ $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}, f = f_{MAX}$		30		30	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'I/Ind'I		8		8	mA
			Com'I   L		0.5		0.5	mA

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

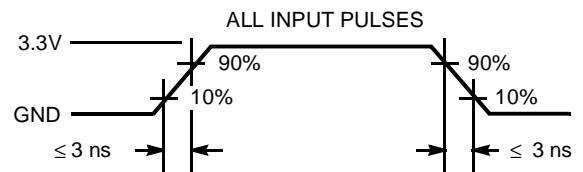
Parameter	Description	Test Conditions	Max.	Unit
$C_{IN}$	Input Capacitance	$T_A = 25^\circ\text{C}, f = 1 \text{ MHz},$ $V_{CC} = 3.3V$	8	pF
$C_{OUT}$	I/O Capacitance		8	pF

**Note:**

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

**AC Test Loads and Waveforms**


1049V33-3



1049V33-4

**Switching Characteristics<sup>[5]</sup> Over the Operating Range**

Parameter	Description	7C1049V33-12		7C1049V33-15		7C1049V33-17		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
<b>READ CYCLE</b>								
$t_{RC}$	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	0		0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[5, 6]</sup>		6		7		8	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low Z <sup>[6]</sup>	3		3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High Z <sup>[5, 6]</sup>		6		7		8	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>[7, 8]</sup></b>								
$t_{WC}$	Write Cycle Time	12		15		17		ns
$t_{SCE}$	$\overline{CE}$ LOW to Write End	10		12		13		ns
$t_{AW}$	Address Set-Up to Write End	10		12		13		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		13		ns
$t_{SD}$	Data Set-Up to Write End	7		8		9		ns
$t_{HD}$	Data Hold from Write End	0		0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[6]</sup>	3		3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[5, 6]</sup>		6		7		8	ns

Shaded areas contain preliminary information.

**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  $\pm 500$  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 (WE controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

**Switching Characteristics<sup>[5]</sup> Over the Operating Range (continued)**

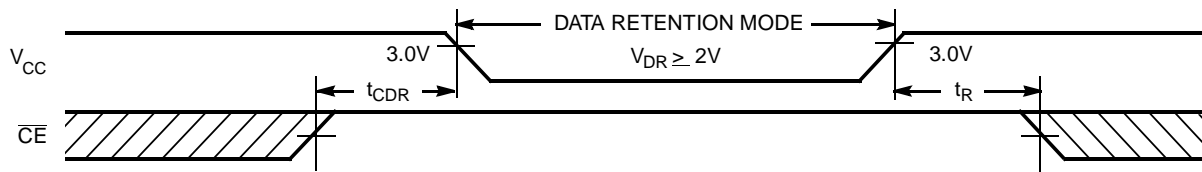
Parameter	Description	7C1049V33-20		7C1049V33-25		Unit
		Min.	Max.	Min.	Max.	
<b>READ CYCLE</b>						
t <sub>RC</sub>	Read Cycle Time	20		25		ns
t <sub>AA</sub>	Address to Data Valid		20		25	ns
t <sub>OHA</sub>	Data Hold from Address Change	3		5		ns
t <sub>ACE</sub>	$\overline{CE}$ LOW to Data Valid		20		25	ns
t <sub>DOE</sub>	$\overline{OE}$ LOW to Data Valid		8		10	ns
t <sub>LZOE</sub>	$\overline{OE}$ LOW to Low Z	0		0		ns
t <sub>HZOE</sub>	$\overline{OE}$ HIGH to High Z <sup>[5, 6]</sup>		8		10	ns
t <sub>LZCE</sub>	$\overline{CE}$ LOW to Low Z <sup>[6]</sup>	3		5		ns
t <sub>HZCE</sub>	$\overline{CE}$ HIGH to High Z <sup>[5, 6]</sup>		8		10	ns
t <sub>PU</sub>	$\overline{CE}$ LOW to Power-Up	0		0		ns
t <sub>PD</sub>	$\overline{CE}$ HIGH to Power-Down		20		25	ns
<b>WRITE CYCLE<sup>[7]</sup></b>						
t <sub>WC</sub>	Write Cycle Time	20		25		ns
t <sub>SCE</sub>	$\overline{CE}$ LOW to Write End	13		15		ns
t <sub>AW</sub>	Address Set-Up to Write End	13		15		ns
t <sub>HA</sub>	Address Hold from Write End	0		0		ns
t <sub>SA</sub>	Address Set-Up to Write Start	0		0		ns
t <sub>PWE</sub>	$\overline{WE}$ Pulse Width	13		15		ns
t <sub>SD</sub>	Data Set-Up to Write End	9		10		ns
t <sub>HD</sub>	Data Hold from Write End	0		0		ns
t <sub>LZWE</sub>	$\overline{WE}$ HIGH to Low Z <sup>[6]</sup>	3		5		ns
t <sub>HZWE</sub>	$\overline{WE}$ LOW to High Z <sup>[5, 6]</sup>		8		10	ns

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

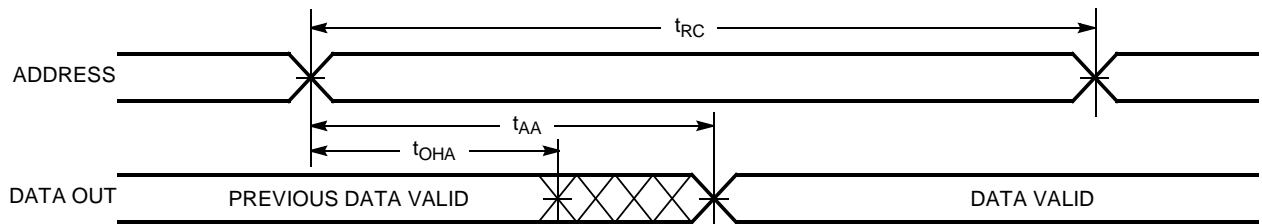
Parameter	Description	Conditions <sup>[10]</sup>	Min.	Max	Unit
V <sub>DR</sub>	V <sub>CC</sub> for Data Retention		2.0		V
I <sub>CCDR</sub>	Data Retention Current	V <sub>CC</sub> = V <sub>DR</sub> = 2.0V, CE ≥ V <sub>CC</sub> - 0.3V V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.3V or V <sub>IN</sub> ≤ 0.3V		330	μA
t <sub>CDR</sub> <sup>[3]</sup>	Chip Deselect to Data Retention Time		0		ns
t <sub>R</sub> <sup>[9]</sup>	Operation Recovery Time		t <sub>RC</sub>		ns

**Notes:**

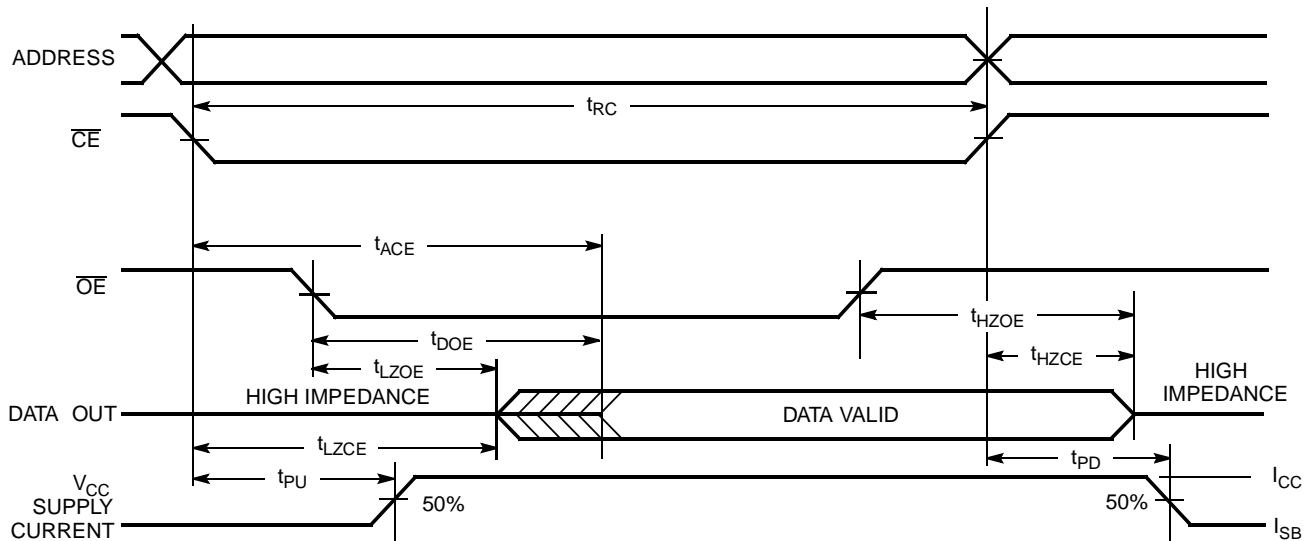
9. t<sub>r</sub> ≤ 3 ns for the -12 and -15 speeds. t<sub>r</sub> ≤ 5 ns for the -20 ns and slower speeds.  
 10. No input may exceed V<sub>CC</sub> + 0.5V.

**Data Retention Waveform**


1049V33-5

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


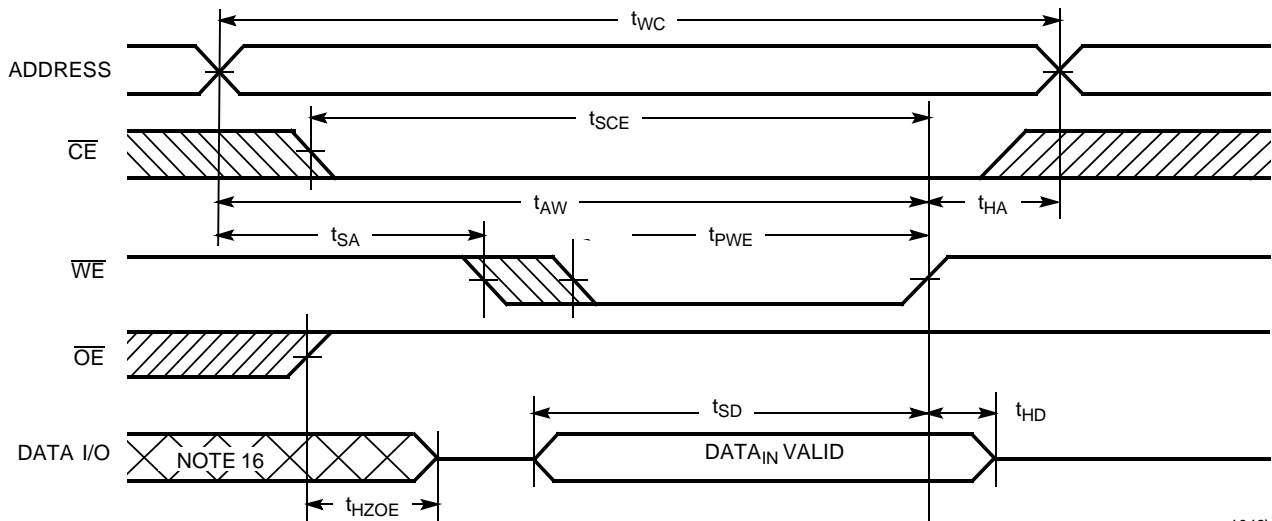
1049V33-6

**Read Cycle No. 2 ( $\overline{OE}$  Controlled)<sup>[12, 13]</sup>**


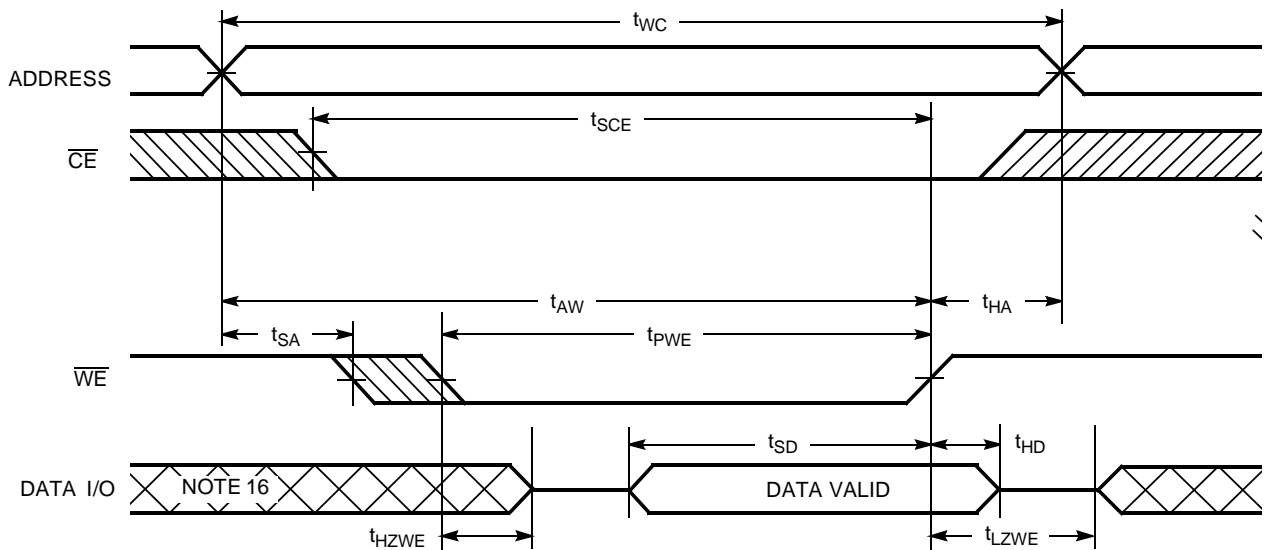
1049V33-7

**Notes:**

11. Device is continuously selected.  $\overline{OE}, \overline{CE} = V_{IL}$ .
12.  $\overline{WE}$  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,  $\overline{OE}$  HIGH During Write)<sup>[14, 15]</sup>**


1049V33-8

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


1049V33-9

**Notes:**

14. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
15. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE}$  going 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.

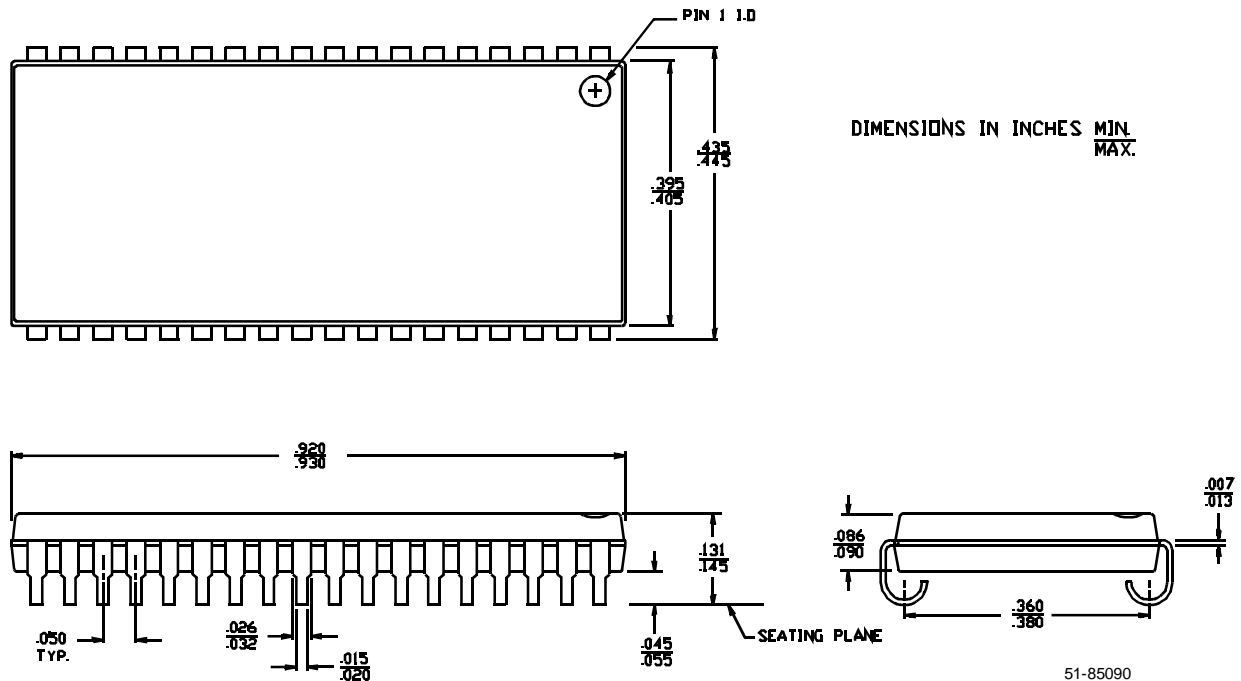
**Truth Table**

$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	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
12	CY7C1049V33-12VC	V36	36-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1049V33L-12VC	V36	36-Lead (400-Mil) Molded SOJ	
15	CY7C1049V33-15VC	V36	36-Lead (400-Mil) Molded SOJ	
	CY7C1049V33L-15VC	V36	36-Lead (400-Mil) Molded SOJ	
17	CY7C1049V33-17VC	V36	36-Lead (400-Mil) Molded SOJ	
	CY7C1049V33L-17VC	V36	36-Lead (400-Mil) Molded SOJ	
20	CY7C1049V33-20VC	V36	36-Lead (400-Mil) Molded SOJ	
	CY7C1049V33L-20VC	V36	36-Lead (400-Mil) Molded SOJ	
	CY7C1049V33-20VI	V36	36-Lead (400-Mil) Molded SOJ	Industrial
25	CY7C1049V33-25VC	V36	36-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1049V33-25VI	v36	36-Lead (400-Mil) Molded SOJ	Industrial

Document #: 38-00643-B

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


51-85090