



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 μW 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**

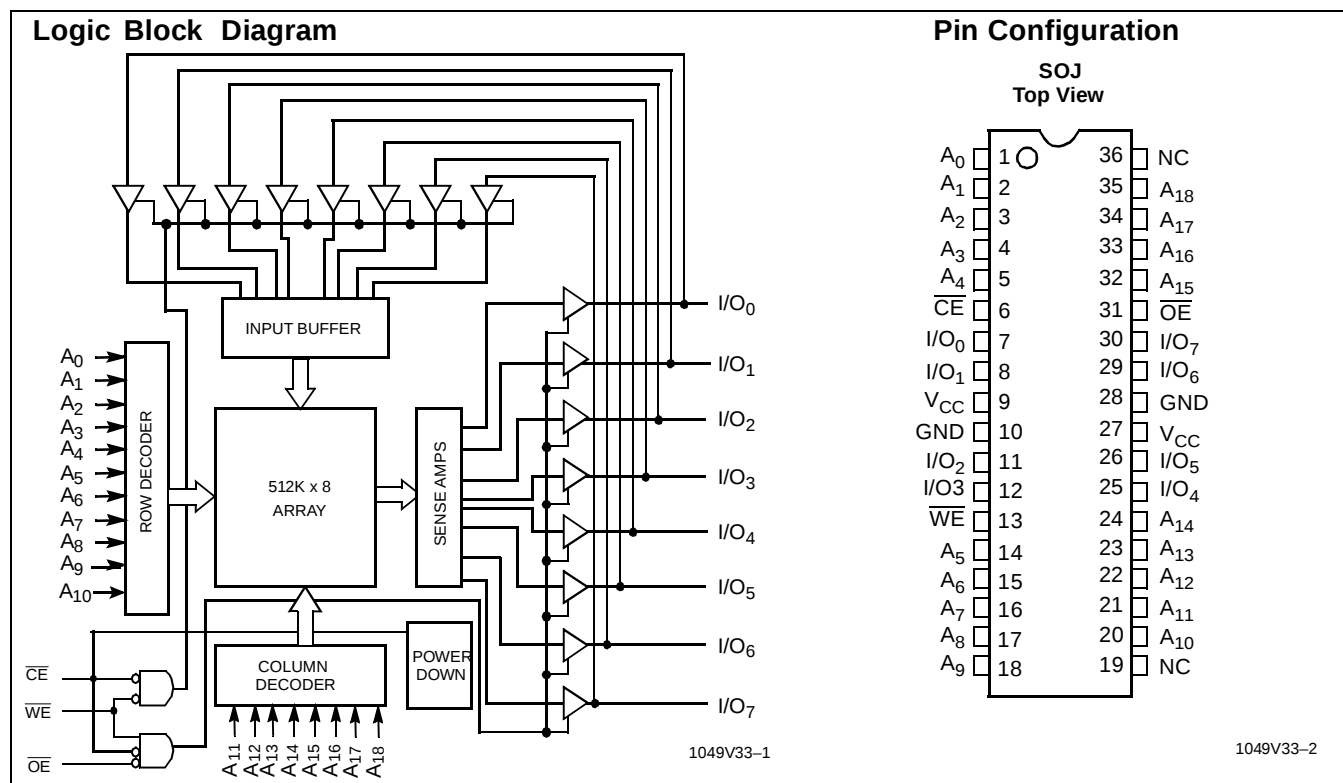
Functional Description

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_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 ($\overline{\text{CE}}$) 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_0 through 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 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	8
	Com'l L	0.5	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^[1] -0.5V to +4.6V

DC Voltage Applied to Outputs
in High Z State^[1] -0.5V to $V_{CC} + 0.5V$

DC Input Voltage^[1] -0.5V to $V_{CC} + 0.5V$

Current into Outputs (LOW) 20 mA

Operating Range

Range	Ambient Temperature ^[2]	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 ^[1]		-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'I/Ind'I			8		8	mA
			Com'I	L		0.5		0.5	mA

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)

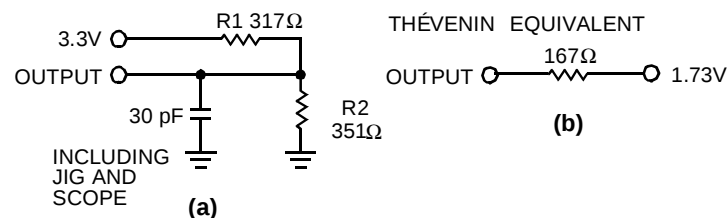
Parameter	Description	Test Conditions	7C1049V33-20		7C1049V33-25		Unit
			Min.	Max.	Min.	Max.	
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$	2.4		2.4		V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$		0.4		0.4	V
V_{IH}	Input HIGH Voltage		2.2	$V_{CC} + 0.5$	2.2	$V_{CC} + 0.5$	V
V_{IL}	Input LOW Voltage ^[1]		-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	μA
I_{OZ}	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC},$ Output Disabled	-1	+1	-1	+1	μA
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^[3]

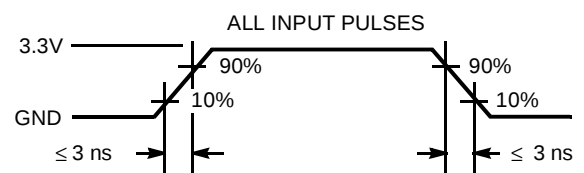
Parameter	Description	Test Conditions	Max.	Unit
C_{IN}	Input Capacitance	$T_A = 25^\circ\text{C}, f = 1 \text{ MHz},$ $V_{CC} = 3.3V$	8	pF
C_{OUT}	I/O Capacitance		8	pF

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^[5] Over the Operating Range

Parameter	Description	7C1049V33-12		7C1049V33-15		7C1049V33-17		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
READ CYCLE								
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 ^[5, 6]		6		7		8	ns
t _{LZCE}	$\overline{CE}$ LOW to Low Z ^[6]	3		3		3		ns
t _{HZCE}	$\overline{CE}$ HIGH to High Z ^[5, 6]		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
WRITE CYCLE ^[7, 8]								
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 ^[6]	3		3		3		ns
t _{HZWE}	$\overline{WE}$ LOW to High Z ^[5, 6]		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 ± 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^[5] Over the Operating Range (continued)

Parameter	Description	7C1049V33-20		7C1049V33-25		Unit
		Min.	Max.	Min.	Max.	
READ CYCLE						
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	0		0		ns
t _{HZOE}	$\overline{OE}$ HIGH to High Z ^[5, 6]		8		10	ns
t _{LZCE}	$\overline{CE}$ LOW to Low Z ^[6]	3		5		ns
t _{HZCE}	$\overline{CE}$ HIGH to High Z ^[5, 6]		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
WRITE CYCLE ^[7]						
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 ^[6]	3		5		ns
t _{HZWE}	$\overline{WE}$ LOW to High Z ^[5, 6]		8		10	ns

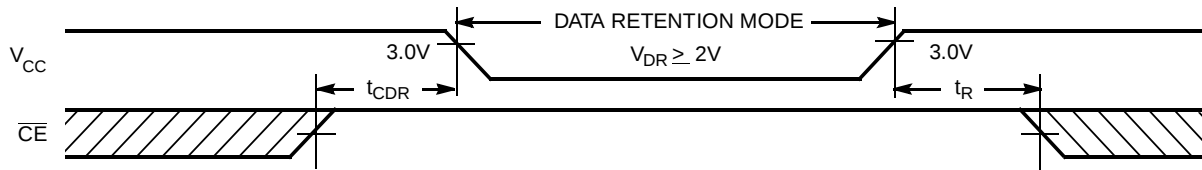
Data Retention Characteristics Over the Operating Range (For L version only)

Parameter	Description	Conditions ^[10]	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 $V_{IN} \leq 0.3V$		330	μA
$t_{CDR}^{[3]}$	Chip Deselect to Data Retention Time		0		ns
$t_R^{[9]}$	Operation Recovery Time		t_{RC}		ns

Notes:

9. $t_r \leq 3$ ns for the -12 and -15 speeds. $t_r \leq 5$ ns for the -20 ns and slower speeds.
10. No input may exceed $V_{CC} + 0.5V$.

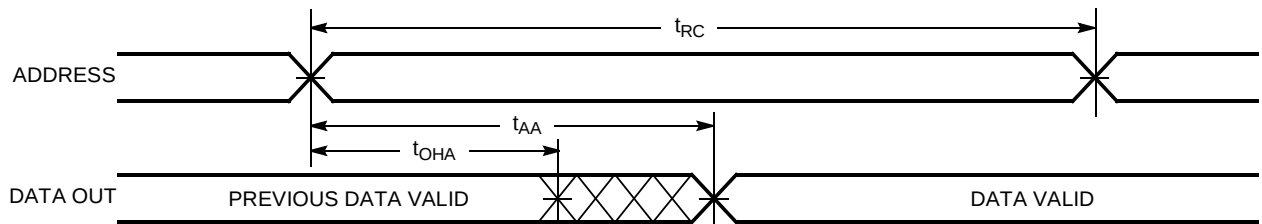
Data Retention Waveform



1049V33-5

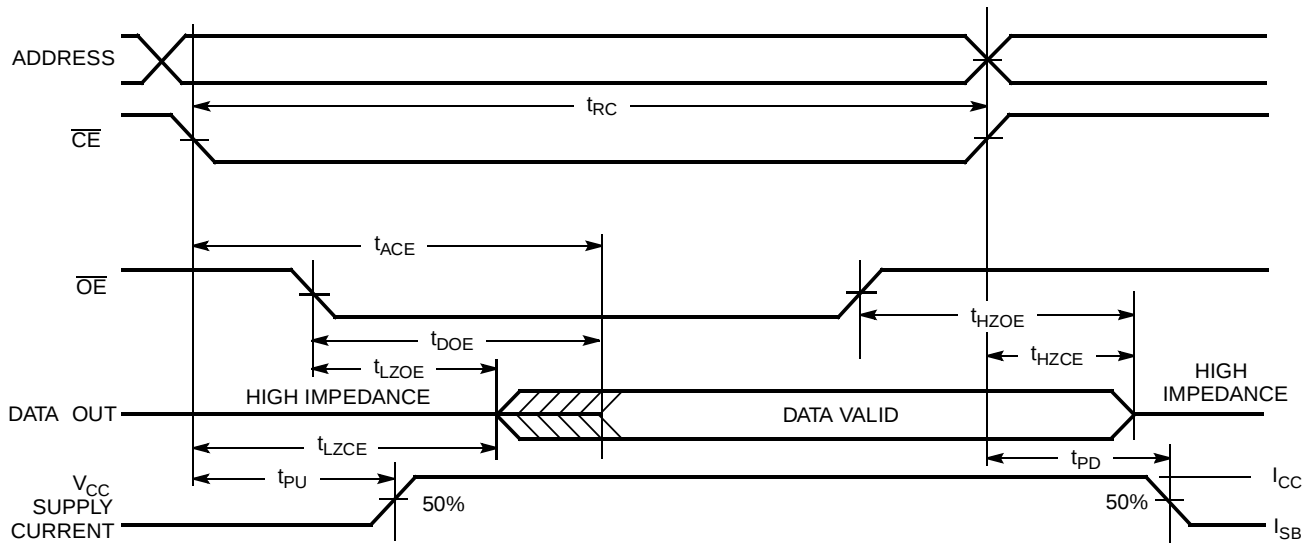
Switching Waveforms

Read Cycle No. 1^[11, 12]



1049V33-6

Read Cycle No. 2 ($\overline{OE}$ Controlled)^[12, 13]



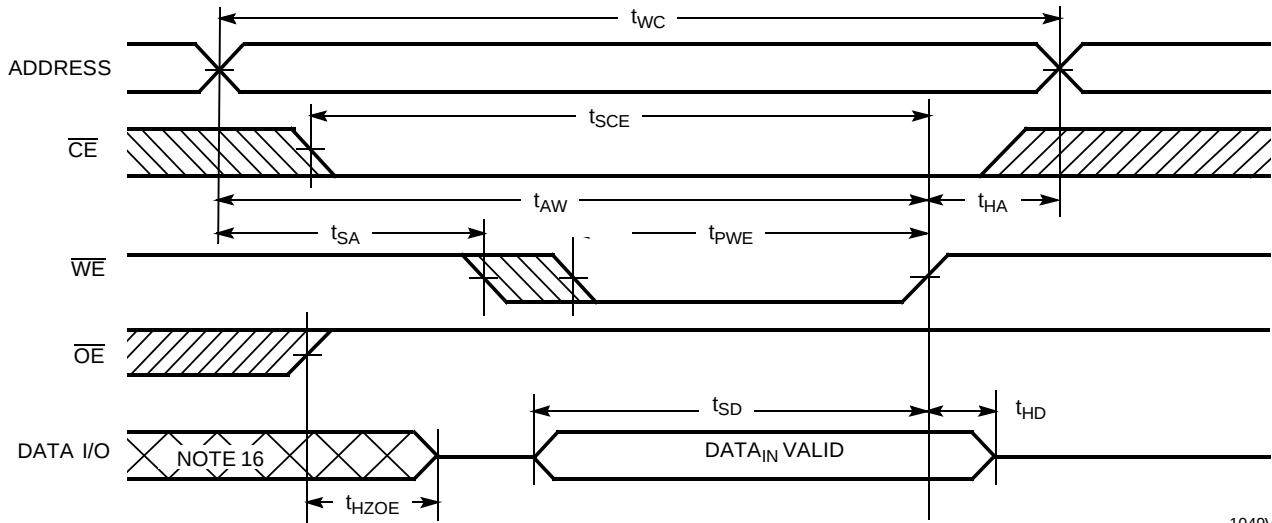
1049V33-7

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.

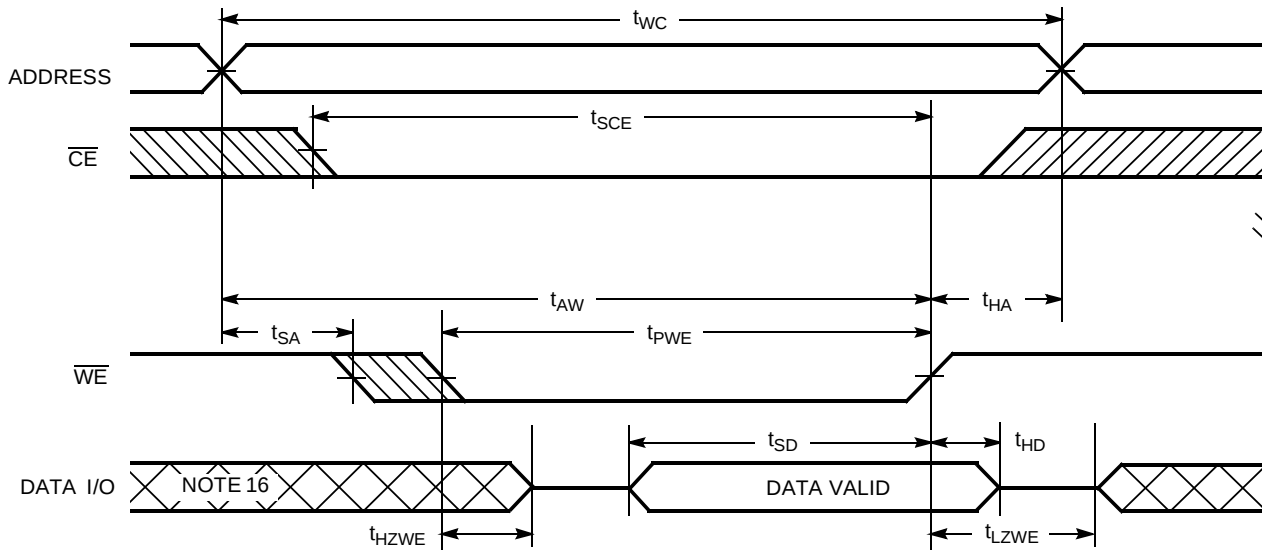
Switching Waveforms (continued)

Write Cycle No. 1 ($\overline{WE}$ Controlled, $\overline{OE}$ HIGH During Write)^[14, 15]



1049V33-8

Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW)^[15]



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 ₀ – I/O ₇	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	Industrial
	CY7C1049V33L-20VC	V36	36-Lead (400-Mil) Molded SOJ	
	CY7C1049V33-20VI	V36	36-Lead (400-Mil) Molded SOJ	
25	CY7C1049V33-25VC	V36	36-Lead (400-Mil) Molded SOJ	Commercial
	CY7C1049V33-25VI	v36	36-Lead (400-Mil) Molded SOJ	Industrial

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Package Diagram

36-Lead (400-Mil) Molded SOJ V36

