CY7C1049CV33

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[1]

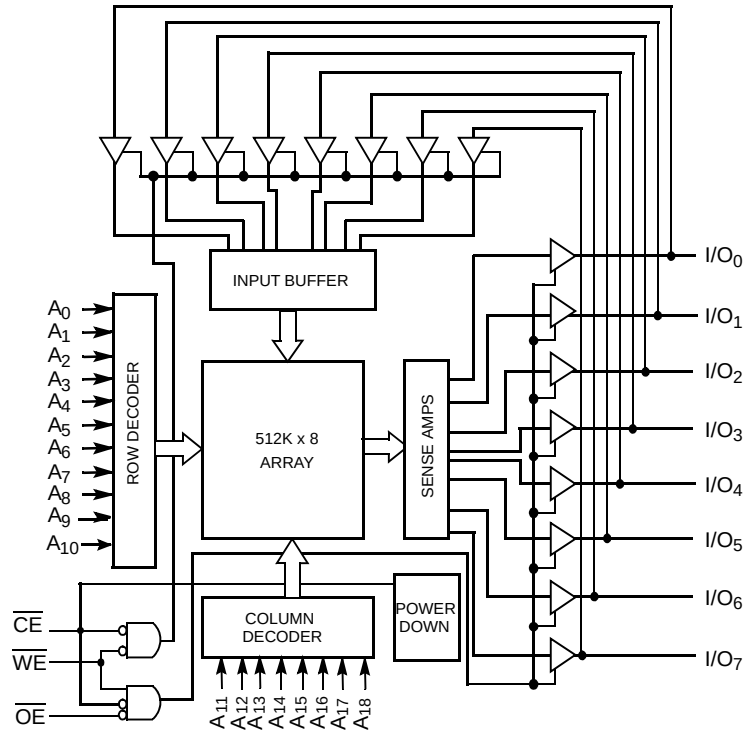
The CY7C1049CV33 is a high-performance CMOS Static RAM organized as 524,288 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ($\overline{CE}$), an active LOW Output Enable ($\overline{OE}$), and three-state drivers. Writing to the device is accomplished by taking Chip Enable ($\overline{CE}$) 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.

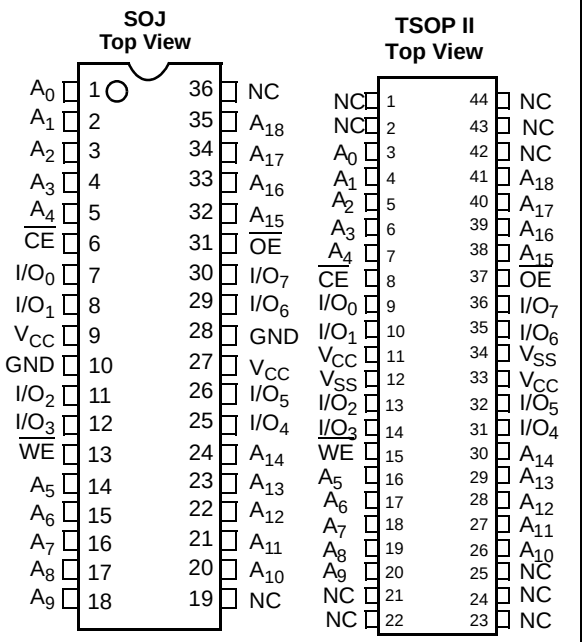
The eight input/output pins (I/O_0 through I/O_7) are placed in a high-impedance state when the device is deselected ($\overline{CE}$ HIGH), the outputs are disabled ($\overline{OE}$ HIGH), or during a Write operation ($\overline{CE}$ LOW, and $\overline{WE}$ LOW).

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.

Logic Block Diagram



Pin Configuration



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.

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_0–A_{18}	1–5,14–18, 20–24,32–35	3–7,16–20, 26–30,38–41	Input	**Address Inputs used to select one of the address locations.**
I/O_0–I/O_7	7,8,11,12,25, 26,29,30	9,10,13,14, 31,32,35,36	Input/Output	**Bidirectional Data I/O lines.** Used as input or output lines depending on operation
NC[2]	19,36	1,2,21,22,23, 24,25,42,43, 44	No Connect	**No Connects.** This pin is not connected to the die
$\overline{WE}$	13	15	Input/Control	**Write Enable Input, active LOW.** When selected LOW, a WRITE is conducted. When selected HIGH, a READ is conducted.
$\overline{CE}$	6	8	Input/Control	**Chip Enable Input, active LOW.** When LOW, selects the chip. When HIGH, deselects the chip.
$\overline{OE}$	31	37	Input/Control	**Output Enable, active LOW.** 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_{SS}, GND	10,28	12,34	Ground	**Ground for the device.** Should be connected to ground of the system.
V_{CC}	9,27	11,33	Power Supply	**Power Supply inputs to the device.**

Notes:
2. 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[3].....–0.5V to +4.6VDC

Voltage Applied to Outputs in High-Z State[3].....–0.5V to V_{CC} + 0.5V

Input Voltage[3].....–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 Min.	-8 Max.	-10 Min.	-10 Max.	-12 Min.	-12 Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min.; I_{OH} = –4.0 mA		2.4		2.4		2.4		V
V_{OL}	Output LOW Voltage	V_{CC} = Min.,; I_{OL} = 8.0 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[3]			–0.3	0.8	–0.3	0.8	–0.3	0.8	V
I_{IX}	Input Load Current	GND ≤ V_I ≤ V_{CC}	Com'l/Ind'l	–1	+1	–1	+1	–1	+1	µA
I_{OZ}	Output Leakage Current	GND ≤ V_{OUT} ≤ V_{CC}, Output Disabled	Com'l/Ind'l	–1	+1	–1	+1	–1	+1	µA
I_{CC}	V_{CC} Operating Supply Current	V_{CC} = 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}, $\overline{CE}$ ≥ V_{IH}; V_{IN} ≥ V_{IH} or V_{IN} ≤ 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}, $\overline{CE}$ ≥ V_{CC} – 0.3V, V_{IN} ≥ V_{CC} – 0.3V, or V_{IN} ≤ 0.3V, f = 0	Com'l/Ind'l		10		10		10	mA

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions		-15 Min.	-15 Max.	-20 Min.	-20 Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min.; I_{OH} = –4.0 mA		2.4		2.4		V
V_{OL}	Output LOW Voltage	V_{CC} = Min.,; I_{OL} = 8.0 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[3]			–0.3	0.8	–0.3	0.8	V
I_{IX}	Input Load Current	GND ≤ V_I ≤ V_{CC}	Com'l / Ind'l	–1	+1	–1	+1	µA
			Automotive	–20	+20	-	-	µA
I_{OZ}	Output Leakage Current	GND ≤ V_{OUT} ≤ 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} = Max., f = f_{MAX} = $1/t_{RC}$	Com'l		80		80	mA
			Ind'l		90		90	mA
			Automotive		95		-	mA

Note:
3. V_{IL} (min.) = –2.0V and V_{IH}(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 Min.	-15 Max.	-20 Min.	-20 Max.	Unit
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}, $\overline{CE} \geq V_{CC} - 0.3V$, $V_{IN} \geq V_{CC} - 0.3V$, or $V_{IN} \leq 0.3V$, f = 0	Com'l/Ind'l		10		10	mA
			Automotive		15		-	mA

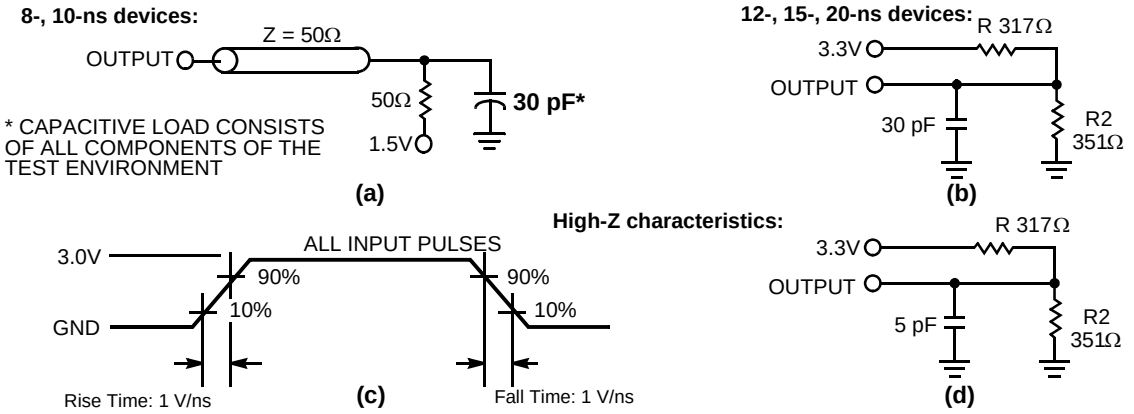
Thermal Resistance[4]

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
Θ_{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	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		18.8	18.8	10.56	10.56	°C/W

Capacitance[4]

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

AC Test Loads and Waveforms[5]



Notes:

4. Tested initially and after any design or process changes that may affect these parameters.
5. 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 [6]

Parameter	Description	-8		-10		-12		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle								
t_{power}[7]	V_{CC}(typical) to the first access	1		1		1		µs
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[8, 9]		4		5		6	ns
t_{LZCE}	$\overline{CE}$ LOW to Low-Z[9]	3		3		3		ns
t_{HZCE}	$\overline{CE}$ HIGH to High-Z[8, 9]		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
Write Cycle[10, 11]								
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[9]	3		3		3		ns
t_{HZWE}	$\overline{WE}$ LOW to High-Z[8, 9]		4		5		6	ns

Shaded areas contain advance information.

AC Switching Characteristics Over the Operating Range [6]

Parameter	Description	-15		-20		Unit
		Min.	Max.	Min.	Max.	
Read Cycle						
t_{power}[7]	V_{CC}(typical) to the first access	1		1		µs
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:

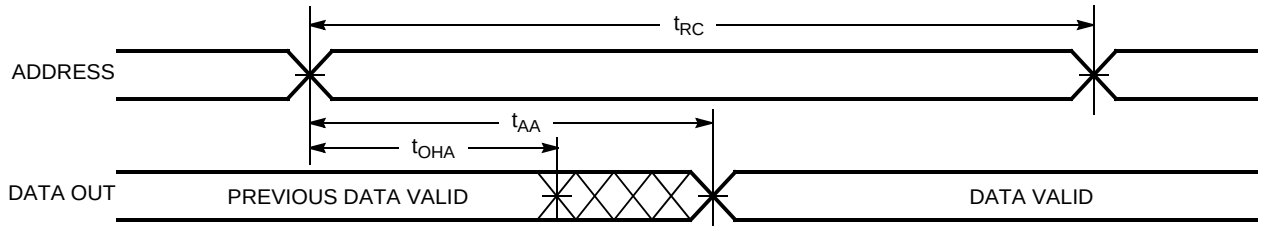
6. Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V.
7. t_{POWER} gives the minimum amount of time that the power supply should be at stable, typical V_{CC} values until the first memory access can be performed.
8. t_{HZOE},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

AC Switching Characteristics Over the Operating Range (continued)[6]

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[8, 9]		7		8	ns
t_{LZCE}	$\overline{CE}$ LOW to Low-Z[9]	3		3		ns
t_{HZCE}	$\overline{CE}$ HIGH to High-Z[8, 9]		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
Write Cycle[10, 11]						
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[9]	3		3		ns
t_{HZWE}	$\overline{WE}$ LOW to High-Z[8, 9]		7		8	ns

Switching Waveforms

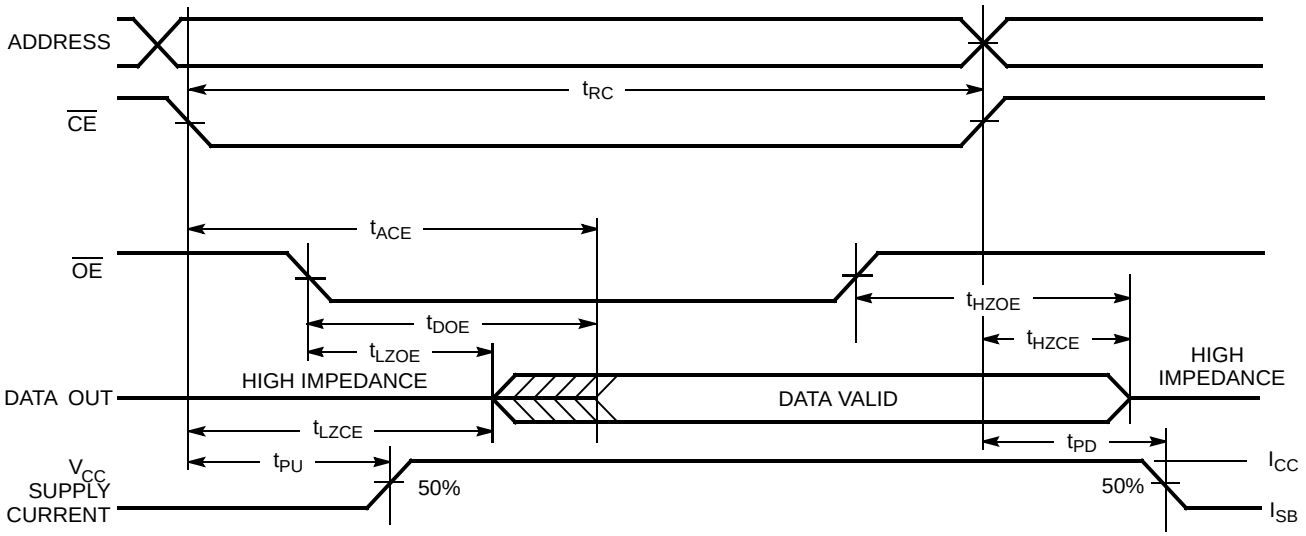
Read Cycle No. 1[12, 13]



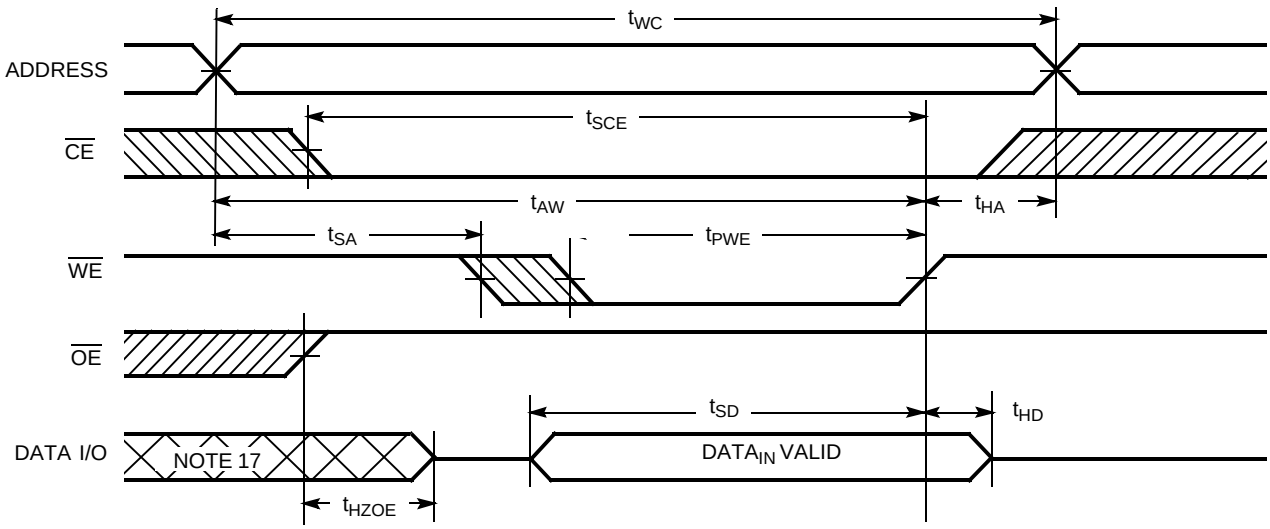
Notes:
12. Device is continuously selected. $\overline{OE}$, $\overline{CE}$ = V_{IL}.
13. $\overline{WE}$ is HIGH for Read cycle.

Switching Waveforms (continued)

Read Cycle No. 2 ($\overline{OE}$ Controlled)[13, 14]



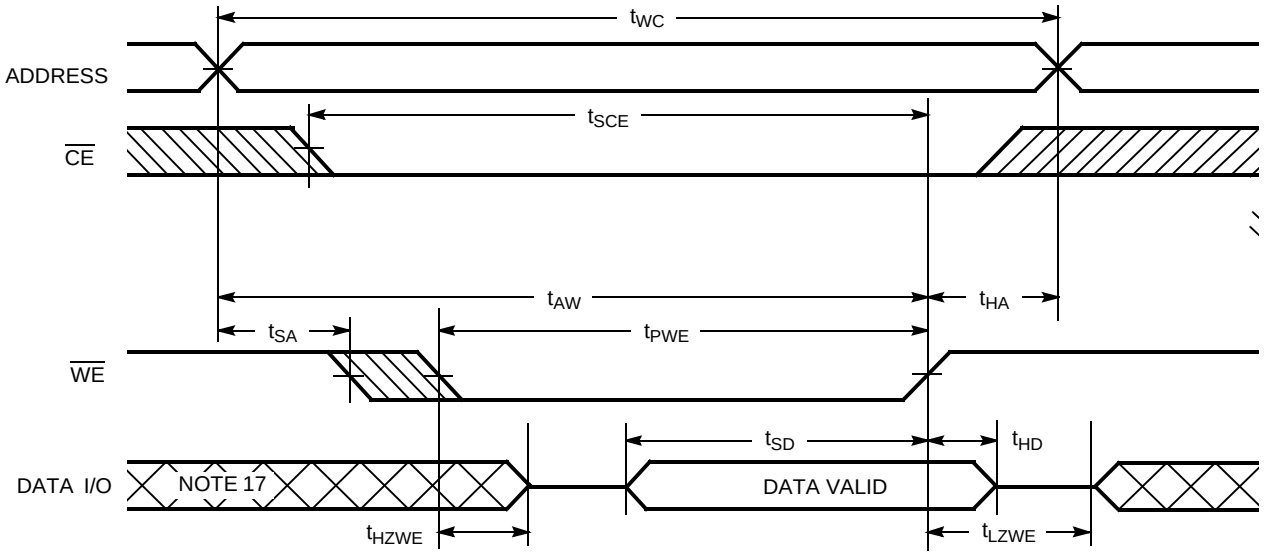
Write Cycle No. 1($\overline{WE}$ Controlled, $\overline{OE}$ HIGH During Write)[15, 16]



Notes:
14. Address valid prior to or coincident with $\overline{CE}$ transition LOW.
15. Data I/O is high-impedance if $\overline{OE} = V_{IH}$.
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)[16]



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})

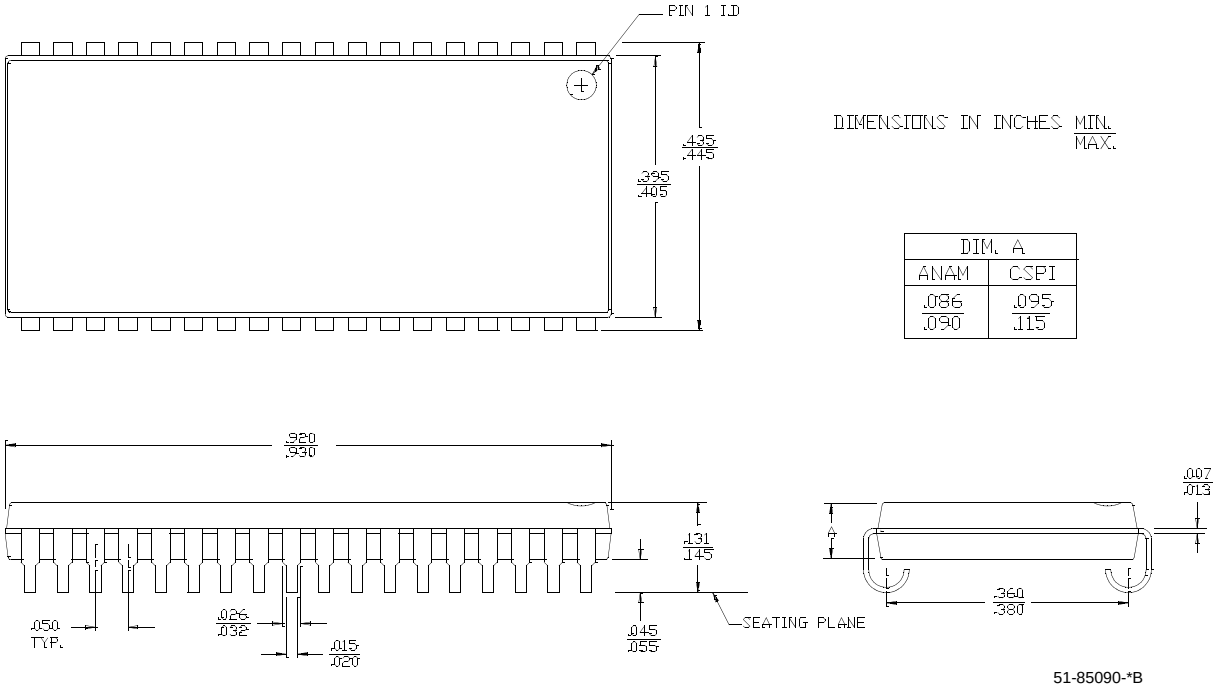
Ordering Information

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
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

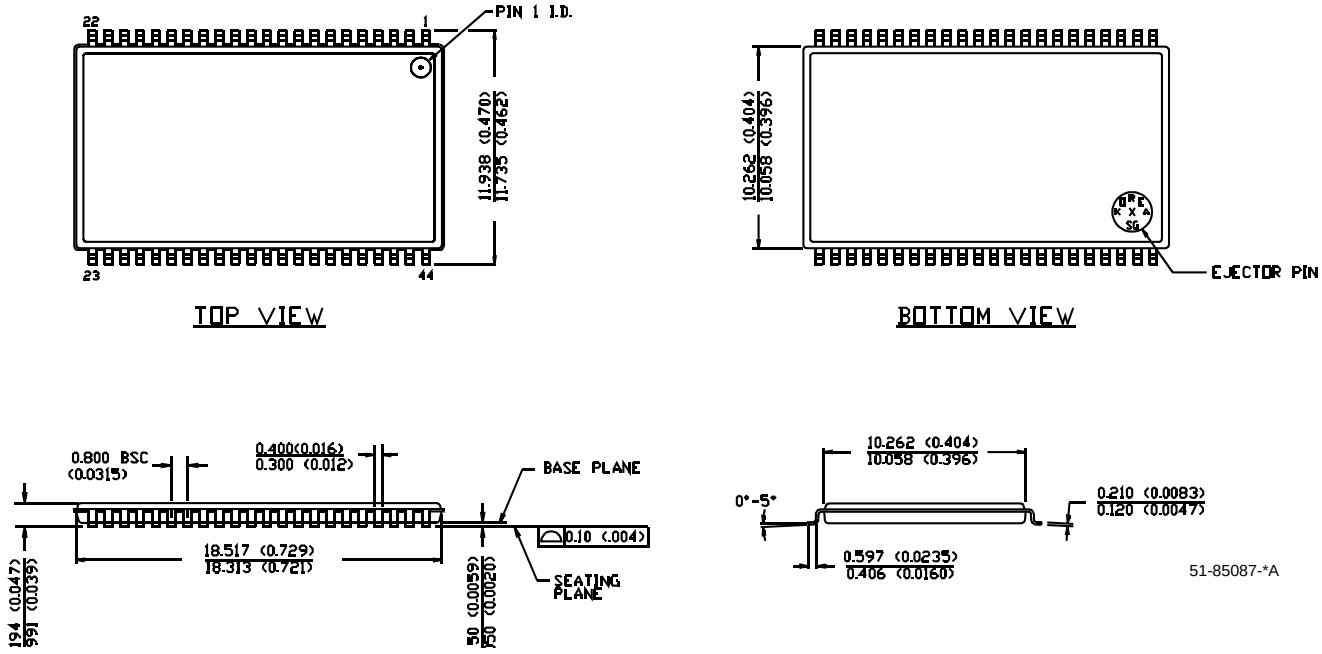
Shaded areas contain advance information. Please contact your local Cypress Sales representative for availability of these parts.

Package Diagrams

36-Lead (400-Mil) Molded SOJ V36



44-pin TSOP II Z44



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 μs
*B	116479	09/16/02	CEA	Add applications foot note to data sheet, page 1.
*C	262949	See ECN	RKF	Added Automotive Specs Added Θ_{JA} and Θ_{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