

# 8-Mbit (512 K × 16) Static RAM

## Features

- Temperature ranges
  - $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$
- High speed
  - $t_{AA} = 10\text{ ns}$
- Low active power
  - $I_{CC} = 110\text{ mA}$  at  $f = 100\text{ MHz}$
- Low CMOS standby power
  - $I_{SB2} = 20\text{ mA}$
- 2.0-V data retention
- Automatic power-down when deselected
- Transistor-transistor logic (TTL)-compatible inputs and outputs
- Easy memory expansion with  $\overline{\text{CE}}$  and  $\overline{\text{OE}}$  features
- Available in Pb-free 48-ball fine ball grid array (FBGA) and 44-pin thin small outline package (TSOP) II packages

## Functional Description

The CY7C1051DV33 is a high performance CMOS Static RAM organized as 512 K words by 16-bits.

To write to the device, take Chip Enable ( $\overline{\text{CE}}$ ) and Write Enable ( $\overline{\text{WE}}$ ) inputs LOW. If Byte LOW Enable ( $\overline{\text{BLE}}$ ) is LOW, then data from I/O pins ( $\text{I/O}_0\text{--I/O}_7$ ), is written into the location specified on the address pins ( $\text{A}_0\text{--A}_{18}$ ). If Byte HIGH Enable ( $\overline{\text{BHE}}$ ) is LOW, then data from I/O pins ( $\text{I/O}_8\text{--I/O}_{15}$ ) is written into the location specified on the address pins ( $\text{A}_0\text{--A}_{18}$ ).

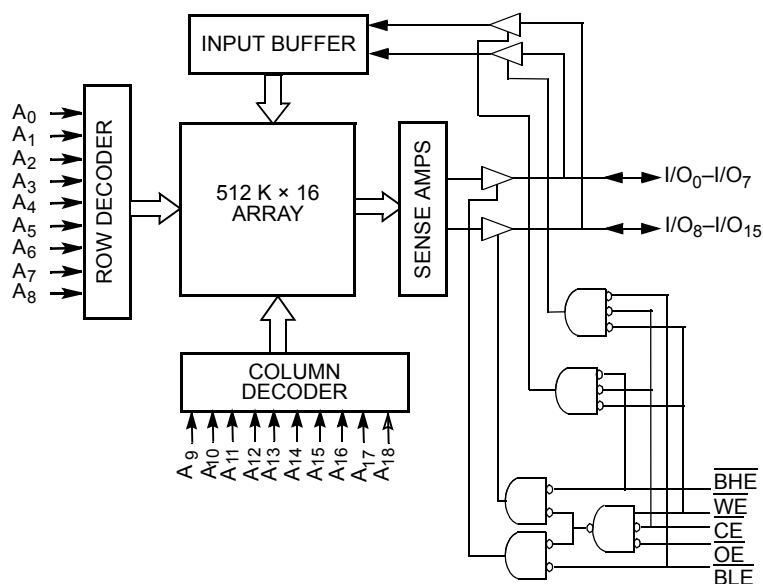
To read from the device, take Chip Enable ( $\overline{\text{CE}}$ ) and Output Enable ( $\overline{\text{OE}}$ ) LOW while forcing the Write Enable ( $\overline{\text{WE}}$ ) HIGH. If Byte LOW Enable ( $\overline{\text{BLE}}$ ) is LOW, then data from the memory location specified by the address pins appears on  $\text{I/O}_0\text{--I/O}_7$ . If Byte HIGH Enable ( $\overline{\text{BHE}}$ ) is LOW, then data from memory appears on  $\text{I/O}_8\text{ to I/O}_{15}$ . See the [Truth Table](#) on page 10 for a complete description of read and write modes.

The input/output pins ( $\text{I/O}_0\text{--I/O}_{15}$ ) are placed in a high-impedance state when the device is deselected ( $\overline{\text{CE}}$  HIGH), the outputs are disabled ( $\overline{\text{OE}}$  HIGH), the  $\overline{\text{BHE}}$  and  $\overline{\text{BLE}}$  are disabled ( $\overline{\text{BHE}}$ ,  $\overline{\text{BLE}}$  HIGH), or a write operation ( $\overline{\text{CE}}$  LOW, and  $\overline{\text{WE}}$  LOW) is in progress.

The CY7C1051DV33 is available in a 44-pin TSOP II package with center power and ground (revolutionary) pinout and a 48-ball FBGA package.

For a complete list of related documentation, click [here](#).

## Logic Block Diagram

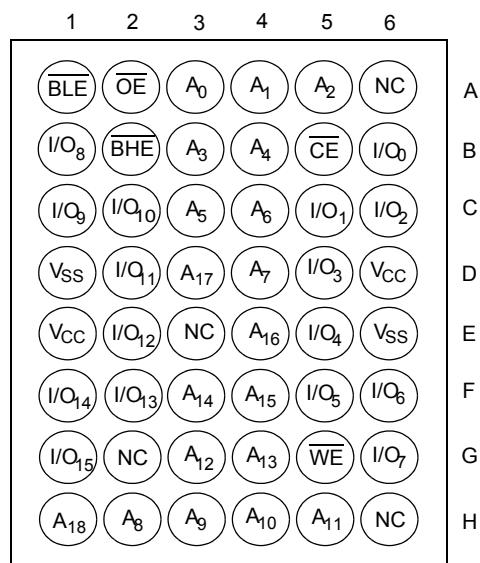


## Contents

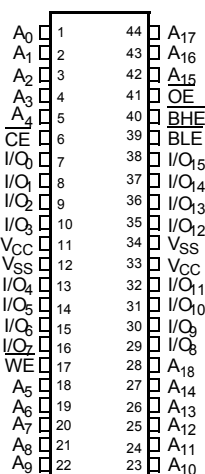
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## Pin Configurations

**Figure 1. Pin Diagram - 48-ball FBGA (Top View)<sup>[1]</sup>**



**Figure 2. Pin Diagram - 44-Pin TSOP II (Top View)<sup>[1]</sup>**



## Selection Guide

Description	-10	-12	Unit
Maximum access time	10	12	ns
Maximum operating current	110	100	mA
Maximum CMOS standby current	20	20	mA

### Note

1. NC pins are not connected on the die.

## Maximum Ratings

Exceeding the maximum ratings may shorten the useful life of the device. These user guidelines are 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>[2]</sup> .... -0.5 V to +4.6 V

DC voltage applied to outputs in high-Z state<sup>[2]</sup> ..... -0.3 V to  $V_{CC} + 0.3$  V

DC input voltage<sup>[2]</sup> ..... -0.3 V to  $V_{CC} + 0.3$  V

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

Static discharge voltage..... >2001 V

(per MIL-STD-883, Method 3015)

Latch-up current ..... >200 mA

## Operating Range

Range	Ambient Temperature	$V_{CC}$	Speed
Industrial	-40 °C to +85 °C	3.3 V $\pm$ 0.3 V	10 ns
Industrial	-40 °C to +85 °C	3.3 V $\pm$ 0.3 V	12 ns

## DC Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	-10		-12		Unit
			Min	Max	Min	Max	
$V_{OH}$	Output HIGH voltage	Min $V_{CC}$ , $I_{OH} = -4.0$ mA	2.4	—	2.4	—	V
$V_{OL}$	Output LOW voltage	Min $V_{CC}$ , $I_{OL} = 8.0$ mA	—	0.4	—	0.4	V
$V_{IH}^{[2]}$	Input HIGH voltage		2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	V
$V_{IL}^{[2]}$	Input LOW voltage		-0.3	0.8	-0.3	0.8	V
$I_{IX}$	Input leakage current	$GND \leq V_{IN} \leq V_{CC}$	-1	+1	-1	+1	$\mu$ A
$I_{OZ}$	Output leakage current	$GND \leq V_{OUT} \leq V_{CC}$ , Output Disabled	-1	+1	-1	+1	$\mu$ A
$I_{CC}$	$V_{CC}$ operating supply current	$f = f_{MAX} = 1/t_{RC}$	—	110	—	100	mA
$I_{SB1}$	Automatic CE power down current —TTL inputs	Max $V_{CC}$ , $\overline{CE} \geq V_{IH}$ , $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$	—	40	—	35	mA
$I_{SB2}$	Automatic CE Power Down Current —CMOS Inputs	Max $V_{CC}$ , $\overline{CE} \geq V_{CC} - 0.3$ V, $V_{IN} \geq V_{CC} - 0.3$ V or $V_{IN} \leq 0.3$ V, $f = 0$	—	20	—	20	mA

## Capacitance

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

Parameter	Description	Test Conditions	Max	Unit
$C_{IN}$	Input capacitance	$T_A = 25$ °C, $f = 1$ MHz, $V_{CC} = 3.3$ V	12	pF
$C_{OUT}$	I/O capacitance		12	pF

## Thermal Resistance

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

Parameter	Description	Test Conditions	FBGA Package	TSOP II Package	Unit
$\Theta_{JA}$	Thermal resistance (Junction to ambient)	Still air, soldered on a 3 $\times$ 4.5 inch, four-layer printed circuit board	28.31	51.43	°C/W
$\Theta_{JC}$	Thermal resistance (Junction to case)		11.4	15.8	°C/W

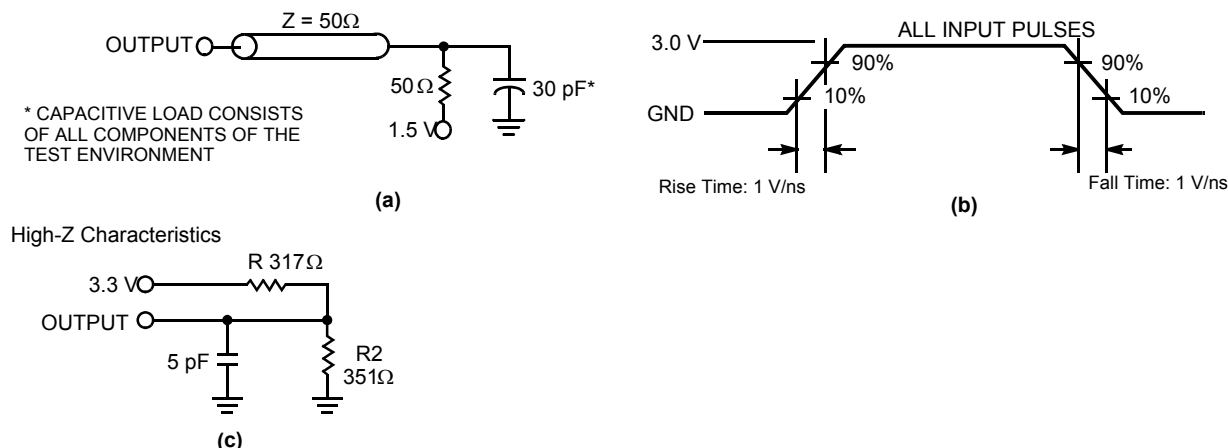
### Note

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

## AC Test Loads and Waveforms

AC characteristics (except High-Z) are tested using the load conditions shown in Figure 3 (a). High-Z characteristics are tested for all speeds using the test load shown in Figure 3 (c).

**Figure 3. AC Test Loads and Waveforms**

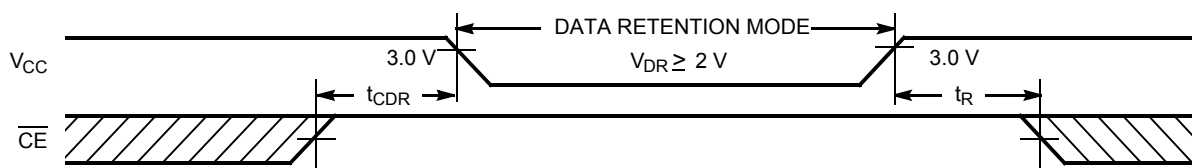


## Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions <sup>[3]</sup>	Min	Max	Unit
$V_{\text{DR}}$	$V_{\text{CC}}$ for Data Retention		2.0	—	V
$I_{\text{CCDR}}$	Data Retention Current	$V_{\text{CC}} = V_{\text{DR}} = 2.0\text{ V}$ , $\overline{\text{CE}} \geq V_{\text{CC}} - 0.3\text{ V}$ , $V_{\text{IN}} \geq V_{\text{CC}} - 0.3\text{ V}$ or $V_{\text{IN}} \leq 0.3\text{ V}$	—	20	mA
$t_{\text{CDR}}^{[4]}$	Chip Deselect to Data Retention Time		0	—	ns
$t_{\text{R}}^{[4]}$	Operation Recovery Time		$t_{\text{RC}}$	—	ns

## Data Retention Waveform



### Notes

3. No inputs may exceed  $V_{\text{CC}} + 0.3\text{ V}$

4. Full device operation requires linear  $V_{\text{CC}}$  ramp from  $V_{\text{DR}}$  to  $V_{\text{CC}}(\text{min}) \geq 50\text{ }\mu\text{s}$  or stable at  $V_{\text{CC}}(\text{min}) \geq 50\text{ }\mu\text{s}$ .

## AC Switching Characteristics

Over the Operating Range<sup>[5]</sup>

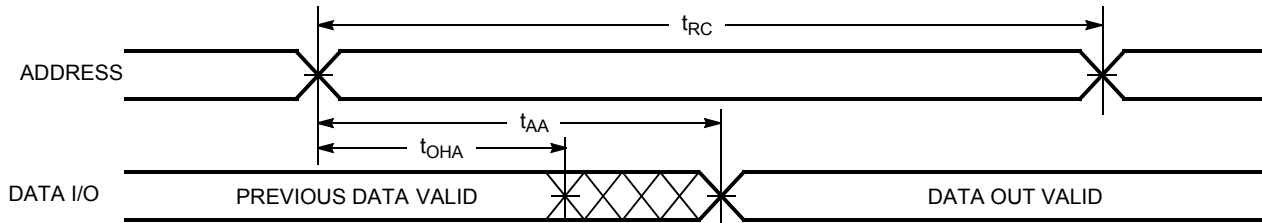
Parameter	Description	−10		−12		Unit
		Min	Max	Min	Max	
Read Cycle						
t <sub>power</sub> <sup>[6]</sup>	V <sub>CC</sub> (typical) to the First Access	100	–	100	–	μs
t <sub>RC</sub>	Read Cycle Time	10	–	12	–	ns
t <sub>AA</sub>	Address to Data Valid	–	10	–	12	ns
t <sub>OHA</sub>	Data Hold from Address Change	2.5	–	2.5	–	ns
t <sub>ACE</sub>	$\overline{\text{CE}}$ LOW to Data Valid	–	10	–	12	ns
t <sub>DOE</sub>	$\overline{\text{OE}}$ LOW to Data Valid	–	5	–	6	ns
t <sub>LZOE</sub>	$\overline{\text{OE}}$ LOW to Low-Z	0	–	0	–	ns
t <sub>HZOE</sub>	$\overline{\text{OE}}$ HIGH to High-Z <sup>[7, 8]</sup>	–	5	–	6	ns
t <sub>LZCE</sub>	$\overline{\text{CE}}$ LOW to Low-Z <sup>[8]</sup>	3	–	3	–	ns
t <sub>HZCE</sub>	$\overline{\text{CE}}$ HIGH to High-Z <sup>[7, 8]</sup>	–	5	–	6	ns
t <sub>PU</sub>	$\overline{\text{CE}}$ LOW to Power Up	0	–	0	–	ns
t <sub>PD</sub>	$\overline{\text{CE}}$ HIGH to Power Down	–	10	–	12	ns
t <sub>DBE</sub>	Byte Enable to Data Valid	–	5	–	6	ns
t <sub>LZBE</sub>	Byte Enable to Low-Z	0	–	0	–	ns
t <sub>HZBE</sub>	Byte Disable to High-Z	–	5	–	6	ns
Write Cycle <sup>[9, 10]</sup>						
t <sub>WC</sub>	Write Cycle Time	10	–	12	–	ns
t <sub>SCE</sub>	$\overline{\text{CE}}$ LOW to Write End	7	–	8	–	ns
t <sub>AW</sub>	Address Setup to Write End	7	–	8	–	ns
t <sub>HA</sub>	Address Hold from Write End	0	–	0	–	ns
t <sub>SA</sub>	Address Setup to Write Start	0	–	0	–	ns
t <sub>PWE</sub>	$\overline{\text{WE}}$ Pulse Width	7	–	8	–	ns
t <sub>SD</sub>	Data Setup to Write End	5	–	6	–	ns
t <sub>HD</sub>	Data Hold from Write End	0	–	0	–	ns
t <sub>LZWE</sub>	$\overline{\text{WE}}$ HIGH to Low-Z <sup>[8]</sup>	3	–	3	–	ns
t <sub>HZWE</sub>	$\overline{\text{WE}}$ LOW to High-Z <sup>[7, 8]</sup>	–	5		6	ns
t <sub>BW</sub>	Byte Enable to End of Write	7	–	8	–	ns

### Notes

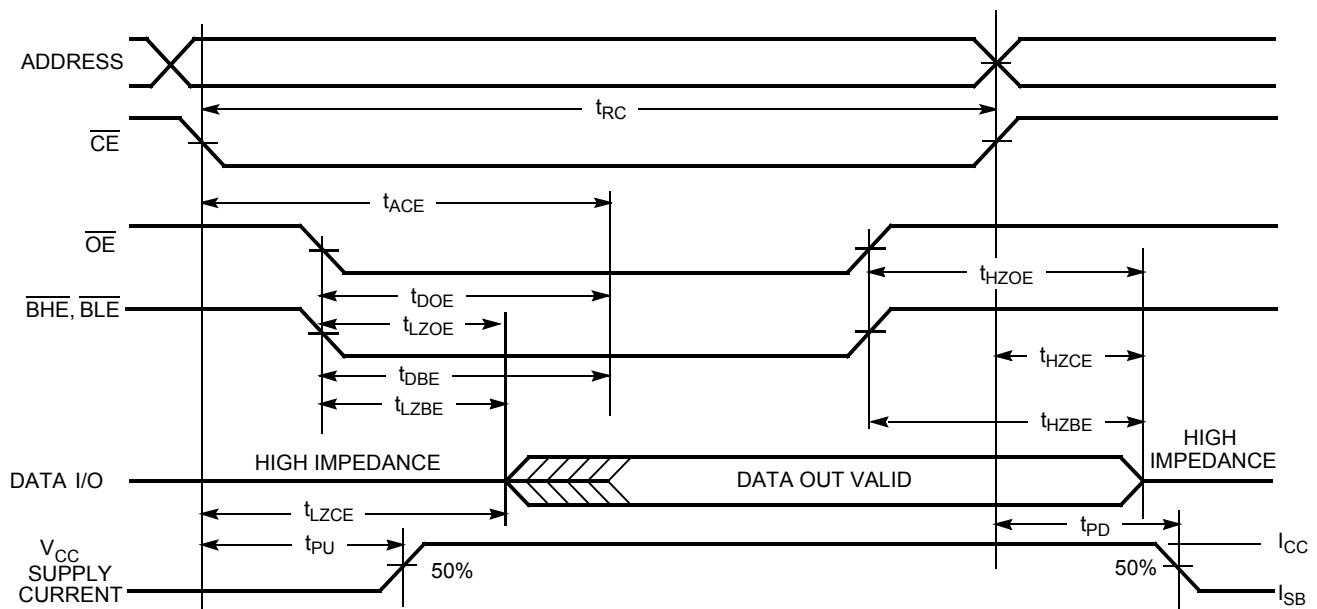
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3.0 V.
- $t_{\text{POWER}}$  gives the minimum amount of time that the power supply must be at typical  $V_{\text{CC}}$  values until the first memory access can be performed.
- $t_{\text{HZOE}}$ ,  $t_{\text{HZCE}}$ ,  $t_{\text{HZBE}}$  and  $t_{\text{HZWE}}$  are specified with a load capacitance of 5 pF as in part (d) of "AC Test Loads and Waveforms" on page 5. Transition is measured when the outputs enter a high impedance state.
- At any temperature and voltage condition,  $t_{\text{HZCE}}$  is less than  $t_{\text{LZCE}}$ ,  $t_{\text{HZOE}}$  is less than  $t_{\text{LZOE}}$ ,  $t_{\text{HZBE}}$  is less than  $t_{\text{LZBE}}$ , and  $t_{\text{HZWE}}$  is less than  $t_{\text{LZWE}}$  for any device.
- The internal write time of the memory is defined by the overlap of  $\overline{\text{CE}}$  LOW, and  $\overline{\text{WE}}$  LOW.  $\overline{\text{CE}}$  and  $\overline{\text{WE}}$  must be LOW to initiate a write, and the transition of either of these signals can terminate the write. The input data setup and hold timing must refer to the leading edge of the signal that terminates the write.
- The minimum write cycle time for Write Cycle No. 3 ( $\overline{\text{WE}}$  controlled,  $\overline{\text{OE}}$  LOW) is the sum of  $t_{\text{HZWE}}$  and  $t_{\text{SD}}$ .

## Switching Waveforms

**Figure 4. Read Cycle No. 1<sup>[11, 12]</sup>**



**Figure 5. Read Cycle No. 2 ( $\overline{OE}$  Controlled)<sup>[12, 13]</sup>**

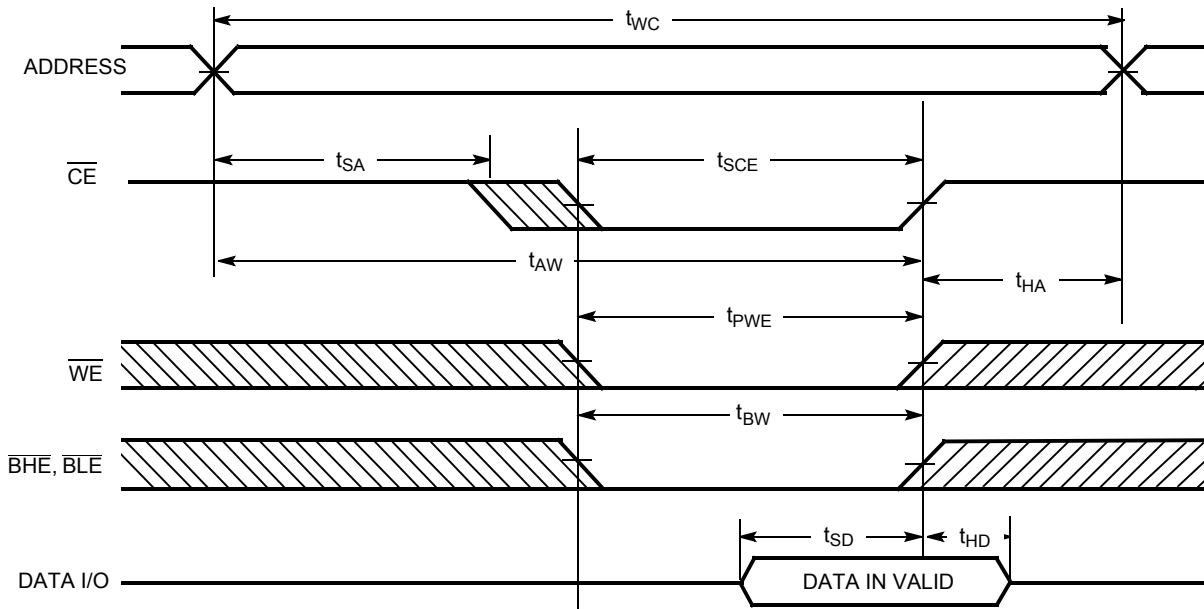


### Notes

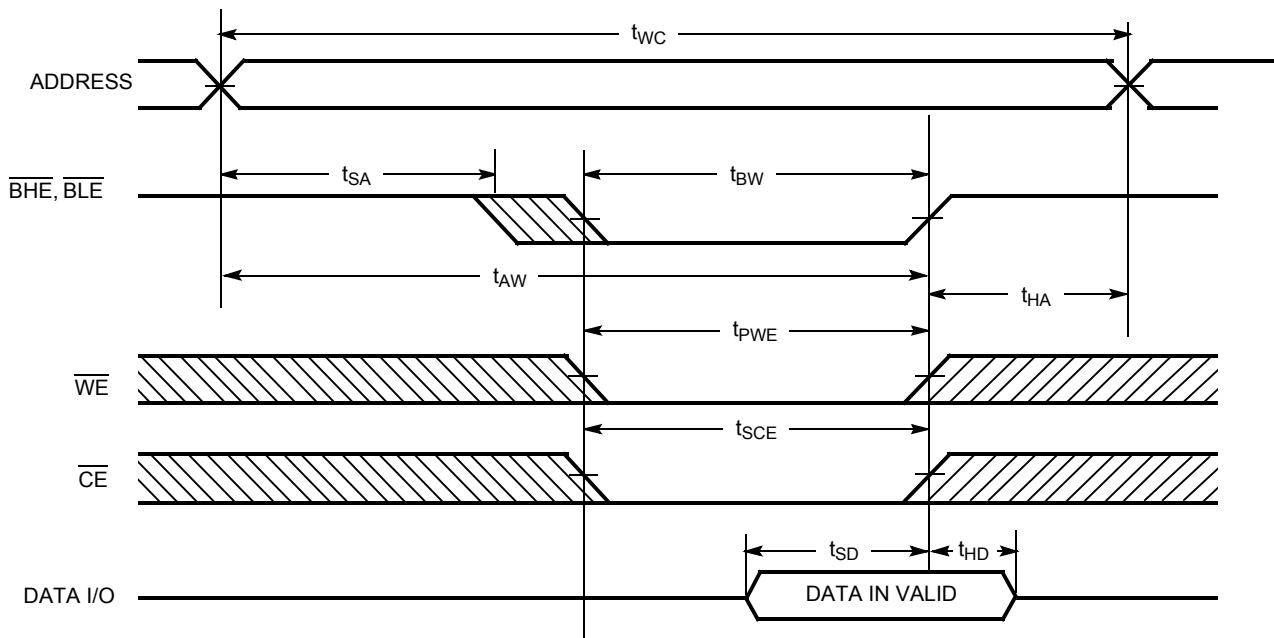
11. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$  =  $V_{IL}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$ , or both =  $V_{IL}$ .
12.  $\overline{WE}$  is HIGH for Read cycle.
13. Address valid before or coincident with  $\overline{CE}$  transition LOW.

## Switching Waveforms (continued)

**Figure 6. Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled)** [14, 15]



**Figure 7. Write Cycle No. 2 ( $\overline{\text{BLE}}$  or  $\overline{\text{BHE}}$  Controlled)**



### Notes

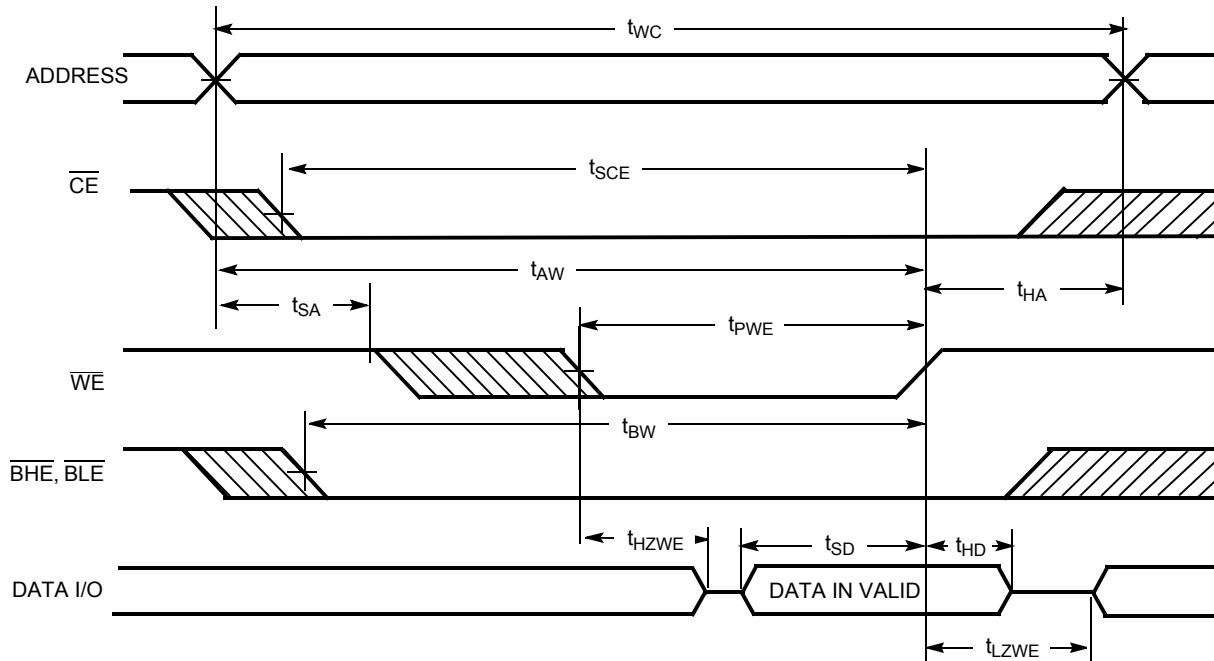
14. Data I/O is high-impedance if  $\overline{\text{OE}}$ , or  $\overline{\text{BHE}}$ ,  $\overline{\text{BLE}}$ , or both =  $V_{IH}$ .

15. If  $\overline{\text{CE}}$  goes HIGH simultaneously with  $\overline{\text{WE}}$  going HIGH, the output remains in a high-impedance state.



**Switching Waveforms** (continued)

**Figure 8. Write Cycle No. 3 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  LOW) [16]**



**Note**

16. The minimum write cycle time for Write Cycle No. 3 ( $\overline{\text{WE}}$  controlled,  $\overline{\text{OE}}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

**Truth Table**

$\overline{\text{CE}}$	$\overline{\text{OE}}$	$\overline{\text{WE}}$	$\overline{\text{BLE}}$	$\overline{\text{BHE}}$	I/O <sub>0</sub> –I/O <sub>7</sub>	I/O <sub>8</sub> –I/O <sub>15</sub>	Mode	Power
H	X	X	X	X	High-Z	High-Z	Power Down	Standby (I <sub>SB</sub> )
L	L	H	L	L	Data Out	Data Out	Read All Bits	Active (I <sub>CC</sub> )
L	L	H	L	H	Data Out	High-Z	Read Lower Bits Only	Active (I <sub>CC</sub> )
L	L	H	H	L	High-Z	Data Out	Read Upper Bits Only	Active (I <sub>CC</sub> )
L	X	L	L	L	Data In	Data In	Write All Bits	Active (I <sub>CC</sub> )
L	X	L	L	H	Data In	High-Z	Write Lower Bits Only	Active (I <sub>CC</sub> )
L	X	L	H	L	High-Z	Data In	Write Upper Bits Only	Active (I <sub>CC</sub> )
L	H	H	X	X	High-Z	High-Z	Selected, Outputs Disabled	Active (I <sub>CC</sub> )

## Ordering Information

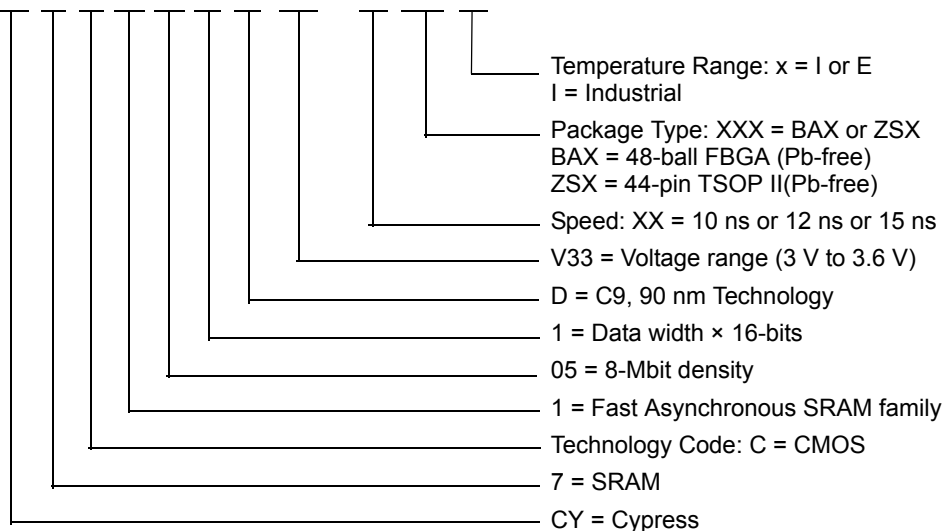
Cypress offers other versions of this type of product in many different configurations and features. The following table contains only the list of parts that are currently available. For a complete listing of all options, visit the Cypress website at [www.cypress.com](http://www.cypress.com) and refer to the product summary page at <http://www.cypress.com/products> or contact your local sales representative. Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives and distributors. To find the office closest to you, visit us at <http://www.cypress.com/go/datasheet/offices>.

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
10	CY7C1051DV33-10BAXI	51-85193	48-ball FBGA (Pb-free)	Industrial
	CY7C1051DV33-10ZSXI	51-85087	44-pin TSOP II (Pb-free)	
12	CY7C1051DV33-12ZSXI	51-85087	44-pin TSOP II (Pb-free)	Industrial

Contact your local Cypress sales representative for availability of these parts.

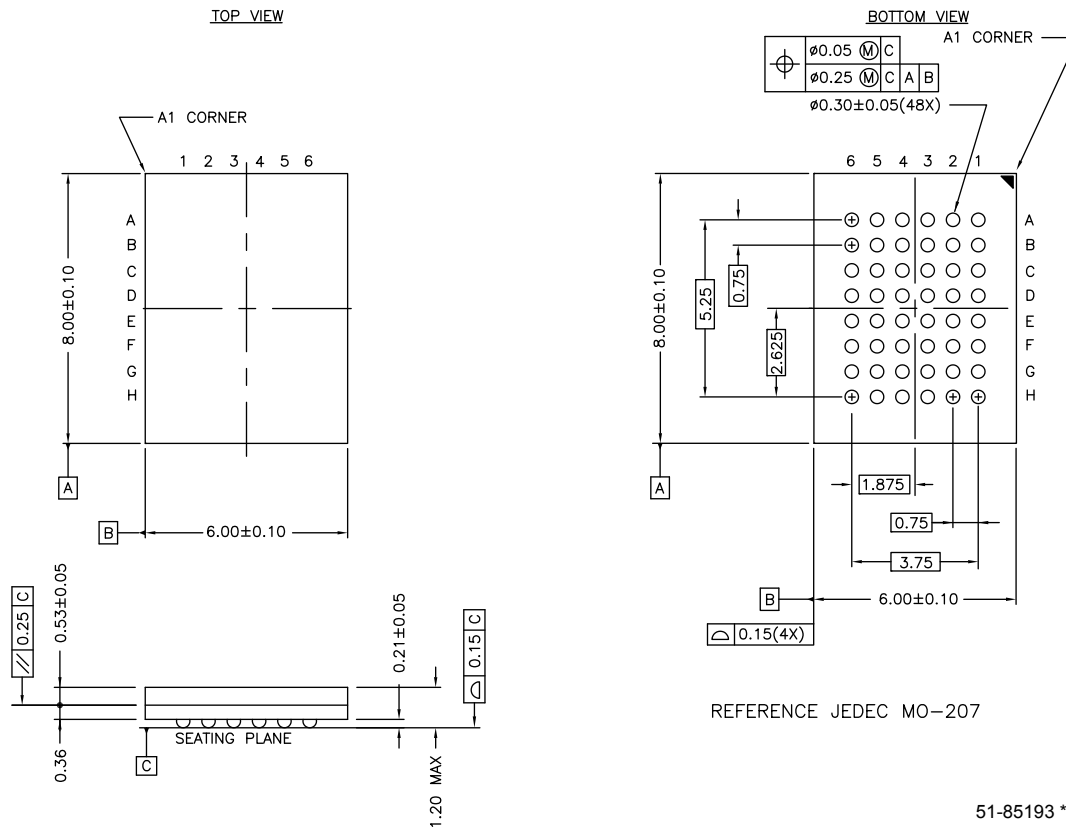
## Ordering Code Definitions

CY 7 C 1 05 1 D V33 - XX XXX X



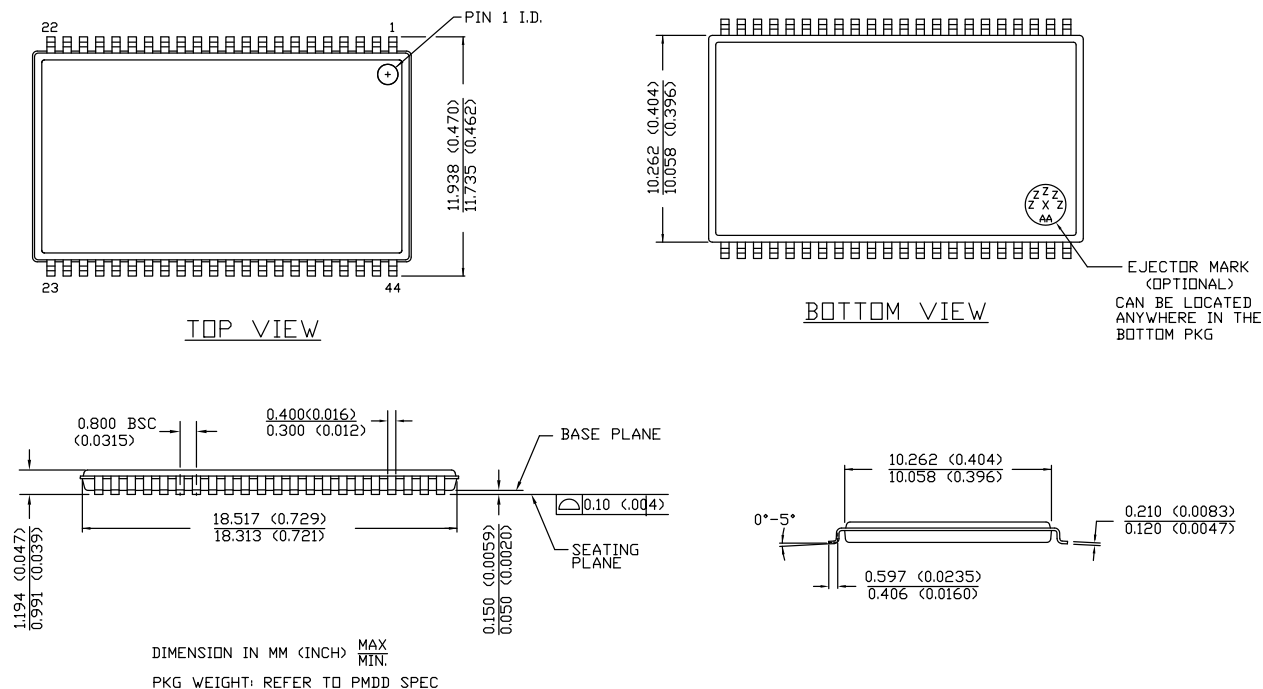
## Package Diagrams

Figure 9. 48-Ball FBGA (6 x 8 x 1.2 mm), 51-85193



## Package Diagrams (continued)

Figure 10. 44-Pin Thin Small Outline Package Type II, 51-85087



## Acronyms

Acronym	Description
CE	chip enable
CMOS	complementary metal oxide semiconductor
I/O	input/output
OE	output enable
SRAM	static random access memory
SOJ	small outline J-lead
TSOP	thin small outline package
VFBGA	very fine-pitch ball grid array

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
ns	nanosecond
V	volt
μA	microampere
mA	milliampere
mV	millivolt
mW	milliwatt
MHz	megahertz
pF	picofarad
°C	degree Celsius
W	watt

## Document History Page

**Document Title: CY7C1051DV33, 8-Mbit (512 K × 16) Static RAM**  
**Document Number: 001-00063**

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	342195	PCI	See ECN	New Datasheet
*A	380574	SYT	See ECN	Redefined I <sub>CC</sub> values for Com'I and Ind'I temperature ranges I <sub>CC</sub> (Com'I): Changed from 110, 90 and 80 mA to 110, 100 and 95 mA for 8, 10 and 12 ns speed bins respectively I <sub>CC</sub> (Ind'I): Changed from 110, 90 and 80 mA to 120, 110 and 105 mA for 8, 10 and 12 ns speed bins respectively Changed the Capacitance values from 8 pF to 10 pF on Page # 3
*B	485796	NXR	See ECN	Changed address of Cypress Semiconductor Corporation on Page# 1 from "3901 North First Street" to "198 Champion Court" Removed -8 and -12 Speed bins from product offering, Removed Commercial Operating Range option, Modified Maximum Ratings for DC input voltage from -0.5 V to -0.3 V and V <sub>CC</sub> + 0.5 V to V <sub>CC</sub> + 0.3 V Changed the Description of I <sub>LX</sub> from Input Load Current to Input Leakage Current. Changed t <sub>HZBE</sub> from 5 ns to 6 ns Updated footnote #7 on High-Z parameter measurement Added footnote #11 Updated the Ordering Information table and Replaced Package Name column with Package Diagram.
*C	866000	NXR	See ECN	Changed ball E3 from V <sub>SS</sub> to NC in FBGA pin configuration
*D	1513285	VKN/AESA	See ECN	Converted from preliminary to final Changed t <sub>HZBE</sub> from 6 ns to 5 ns for 10 ns speed bin Added 12 ns speed bin Changed t <sub>OHA</sub> spec from 3 ns to 2.5 ns Updated Ordering information table
*E	2911009	VKN	04/12/10	Replaced 48-Ball (7 x 8.5 x 1.2 mm) FBGA with 48-Ball (6 x 8 x 1.2mm) FBGA, Updated Package diagrams, Updated ordering information.
*F	3086522	PRAS	11/15/2010	Included Auto-E information (preliminary) in <a href="#">Ordering Information</a> .
*G	3112625	AJU	12/16/2010	Added <a href="#">Ordering Code Definitions</a> .
*H	3369149	TAVA	09/12/2011	Removed all references to Automotive information.
*I	4530449	MEMJ	10/10/2014	Updated <a href="#">Switching Waveforms</a> : Added Note 16 and referred the same note in <a href="#">Figure 8</a> . Updated <a href="#">Package Diagrams</a> : spec 51-85087 – Changed revision from *D to *E. Updated in new template. Completing Sunset Review.
*J	4578447	MEMJ	01/16/2015	Added related documentation hyperlink in page 1. Removed the prune part number CY7C1051DV33-12BAXI in <a href="#">Ordering Information</a> .

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