

# 512 K (32 K x 16) Static RAM

## Features

- Pin-and function-compatible with CY7C1020CV33
- High speed
  - $t_{AA} = 10 \text{ ns}$
- Low active power
  - $I_{CC} = 60 \text{ mA @ } 10 \text{ ns}$
- Low CMOS standby power
  - $I_{SB2} = 3 \text{ mA}$
- 2.0 V Data retention
- Automatic power-down when deselected
- CMOS for optimum speed/power
- Independent control of upper and lower bits
- Available in Pb-free 44-pin 400-Mil wide Molded SOJ and 44-pin TSOP II packages

## Functional Description

The CY7C1020DV33 is a high-performance CMOS static RAM organized as 32,768 words by 16 bits. This device has an automatic power-down feature that significantly reduces power consumption when deselected.

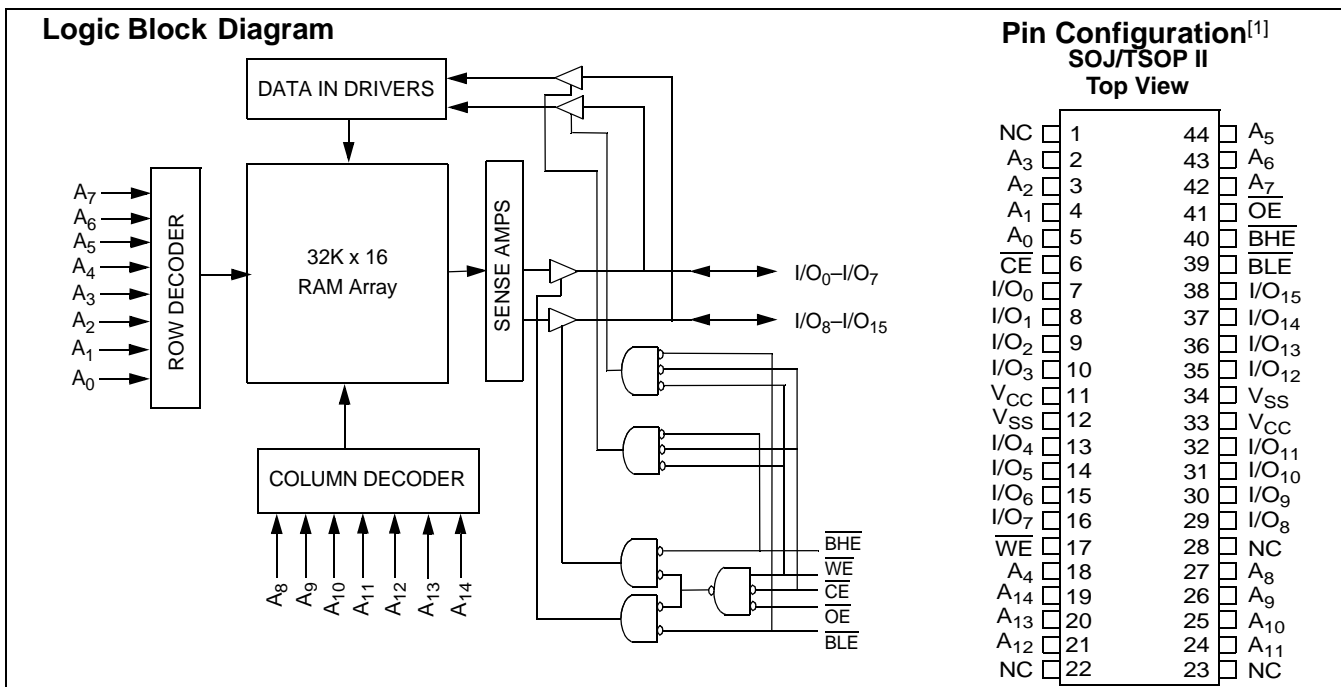
Writing to the device is accomplished by taking chip enable ( $\overline{CE}$ ) and write enable ( $\overline{WE}$ ) inputs LOW. If byte low enable ( $\overline{BLE}$ ) is LOW, then data from I/O pins ( $I/O_0$  through  $I/O_7$ ), is written into the location specified on the address pins ( $A_0$  through  $A_{14}$ ). If byte high enable ( $\overline{BHE}$ ) is LOW, then data from I/O pins ( $I/O_8$  through  $I/O_{15}$ ) is written into the location specified on the address pins ( $A_0$  through  $A_{14}$ ).

Reading from the device is accomplished by taking chip enable ( $\overline{CE}$ ) and output enable ( $\overline{OE}$ ) LOW while forcing the write enable ( $\overline{WE}$ ) HIGH. If byte low enable ( $\overline{BLE}$ ) is LOW, then data from the memory location specified by the address pins will appear on  $I/O_0$  to  $I/O_7$ . If byte high enable ( $\overline{BHE}$ ) is LOW, then data from memory will appear on  $I/O_8$  to  $I/O_{15}$ . See the truth table at the back of this data sheet for a complete description of read and write modes.

The input/output pins ( $I/O_0$  through  $I/O_{15}$ ) are placed in a high-impedance state when the device is deselected ( $\overline{CE}$  HIGH), the outputs are disabled ( $\overline{OE}$  HIGH), the  $\overline{BHE}$  and  $\overline{BLE}$  are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or during a write operation ( $\overline{CE}$  LOW, and  $\overline{WE}$  LOW).

The CY7C1020DV33 is available in Pb-free 44-pin 400-Mil wide Molded SOJ and 44-pin TSOP II packages.

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



### Notes

1. NC pins are not connected on the die.

## Selection Guide

	<b>-10 (Industrial)</b>	<b>Unit</b>
Maximum access time	10	ns
Maximum operating current	60	mA
Maximum CMOS standby current	3	mA

## 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>[2]</sup> ... -0.5 V to +4.6 V

DC voltage applied to outputs in High-Z State<sup>[2]</sup> ..... -0.5 V to  $V_{CC} + 0.5$  V

DC input voltage<sup>[2]</sup> ..... -0.5 V to  $V_{CC} + 0.5$  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 ± 0.3 V	10 ns

## Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	<b>-10 (Industrial)</b>		Unit
			Min.	Max.	
$V_{OH}$	Output HIGH voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$	2.4		V
$V_{OL}$	Output LOW voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$		0.4	V
$V_{IH}$	Input HIGH voltage		2.0	$V_{CC} + 0.3$	V
$V_{IL}$	Input LOW voltage <sup>[2]</sup>		-0.3	0.8	V
$I_{IX}$	Input Load current	$GND \leq V_I \leq V_{CC}$	-1	+1	μA
$I_{OZ}$	Output leakage current	$GND \leq V_I \leq V_{CC}$ , Output Disabled	-1	+1	μA
$I_{CC}$	$V_{CC}$ operating supply current	$V_{CC} = \text{Max.}, I_{OUT} = 0 \text{ mA}, f = f_{MAX} = 1/t_{RC}$	100 MHz	60	mA
			83 MHz	55	mA
			66 MHz	45	mA
			40 MHz	30	mA
$I_{SB1}$	Automatic CE Power-down Current—TTL Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{IH}$ $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$		10	mA
$I_{SB2}$	Automatic CE Power-down Current—CMOS Inputs	Max. $V_{CC}$ , $\overline{CE} \geq V_{CC} - 0.3 \text{ V}$ , $V_{IN} \geq V_{CC} - 0.3 \text{ V}$ , or $V_{IN} \leq 0.3 \text{ V}$ , $f = 0$		3	mA

### Notes

- $V_{IL}(\text{min.}) = -2.0 \text{ V}$  and  $V_{IH}(\text{max.}) = V_{CC} + 1 \text{ V}$  for pulse durations of less than 5 ns.

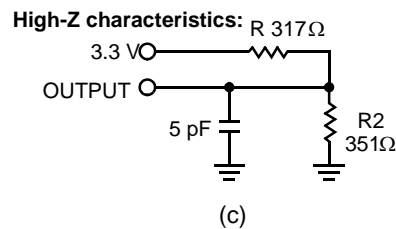
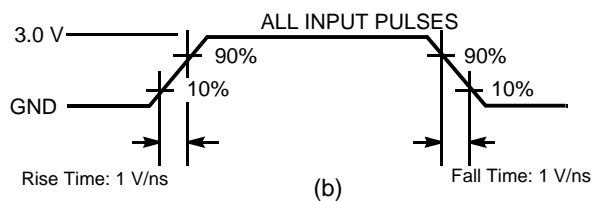
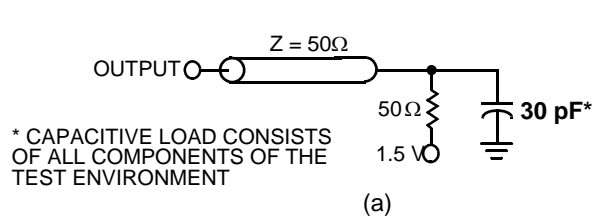
Capacitance<sup>[3]</sup>

Parameter	Description	Test Conditions	Max.	Unit
C <sub>IN</sub>	Input capacitance	T <sub>A</sub> = 25°C, f = 1 MHz, V <sub>CC</sub> = 3.3 V	8	pF
C <sub>OUT</sub>	Output capacitance		8	pF

Thermal Resistance<sup>[3]</sup>

Parameter	Description	Test Conditions	SOJ	TSOP II	Unit
Θ <sub>JA</sub>	Thermal resistance (Junction to Ambient)	Still air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	59.52	53.91	°C/W
Θ <sub>JC</sub>	Thermal resistance (Junction to Case)		36.75	21.24	°C/W

AC Test Loads and Waveforms<sup>[4]</sup>



Notes

- Tested initially and after any design or process changes that may affect these parameters.
- AC characteristics (except High-Z) are tested using the load conditions shown in Figure (a). High-Z characteristics are tested for all speeds using the test load shown in Figure (c).

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

Parameter	Description	-10 (Industrial)		Unit
		Min.	Max.	
<b>Read Cycle</b>				
$t_{power}^{[6]}$	$V_{CC}$ (typical) to the first access	100		$\mu$ S
$t_{RC}$	Read cycle time	10		ns
$t_{AA}$	Address to data valid		10	ns
$t_{OHA}$	Data Hold from Address Change	3		ns
$t_{ACE}$	$\overline{CE}$ LOW to data valid		10	ns
$t_{DOE}$	$\overline{OE}$ LOW to data valid		5	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z <sup>[7]</sup>	0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[7, 8]</sup>		5	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low-Z <sup>[7]</sup>	3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High-Z <sup>[7, 8]</sup>		5	ns
$t_{PU}^{[9]}$	$\overline{CE}$ LOW to Power-up	0		ns
$t_{PD}^{[9]}$	$\overline{CE}$ HIGH to Power-down		10	ns
$t_{DBE}$	Byte enable to data valid		5	ns
$t_{LZBE}$	Byte enable to low-Z	0		ns
$t_{HZBE}$	Byte disable to high-Z		5	ns
<b>Write Cycle<sup>[10, 11]</sup></b>				
$t_{WC}$	Write cycle time	10		ns
$t_{SCE}$	$\overline{CE}$ LOW to write end	8		ns
$t_{AW}$	Address set-up to write end	8		ns
$t_{HA}$	Address hold from write end	0		ns
$t_{SA}$	Address set-up to write start	0		ns
$t_{PWE}$	$\overline{WE}$ pulse width	7		ns
$t_{SD}$	Data set-up to write end	5		ns
$t_{HD}$	Data hold from write end	0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[7]</sup>	3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[7, 8]</sup>		5	ns
$t_{BW}$	Byte enable to end of write	7		ns

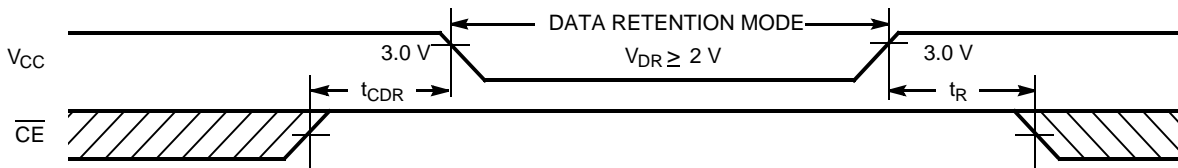
**Notes**

5. 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.
6.  $t_{POWER}$  gives the minimum amount of time that the power supply should be at typical  $V_{CC}$  values until the first memory access can be performed
7.  $t_{HZOE}$ ,  $t_{HZBE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in (c) of AC Test Loads. Transition is measured when the outputs enter a high impedance state.
8. 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.
9. This parameter is guaranteed by design and is not tested.
10. The internal Write time of the memory is defined by the overlap of  $\overline{CE}$  LOW,  $\overline{WE}$  LOW and  $\overline{BHE}/\overline{BLE}$  LOW.  $\overline{CE}$ ,  $\overline{WE}$  and  $\overline{BHE}/\overline{BLE}$  must be LOW to initiate a Write and the transition 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 3 (WE controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

**Data Retention Characteristics** (Over the Operating Range)

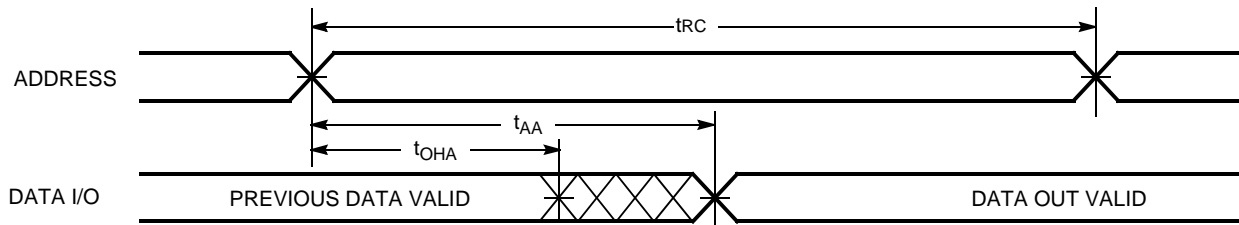
Parameter	Description	Conditions	Min.	Max.	Unit
$V_{DR}$	$V_{CC}$		2.0		V
$I_{CCDR}$	Data retention current	$V_{CC} = V_{DR} = 2.0\text{ V}$ , $\overline{CE} \geq V_{CC} - 0.3\text{ V}$ , $V_{IN} \geq V_{CC} - 0.3\text{ V}$ or $V_{IN} \leq 0.3\text{ V}$		3	mA
$t_{CDR}^{[3]}$	Chip deselect to data retention time		0		ns
$t_R^{[12]}$	Operation recovery time		$t_{RC}$		ns

**Data Retention Waveform**

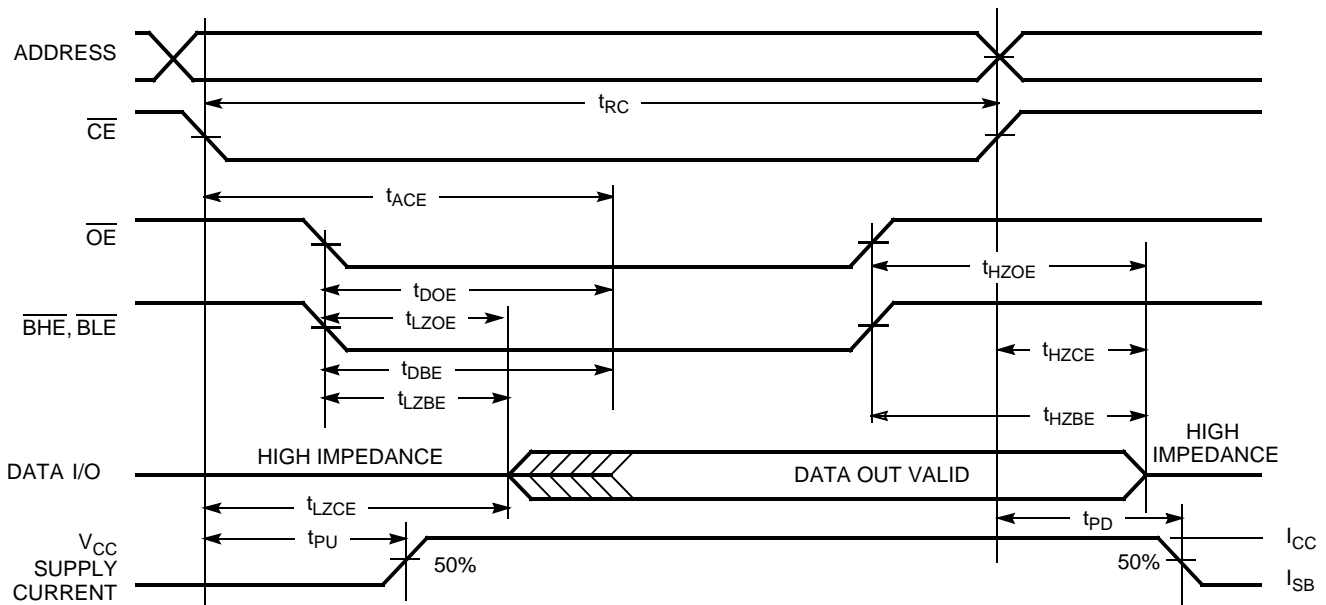


**Switching Waveforms**

**Read Cycle No. 1 (Address Transition Controlled)**<sup>[13, 14]</sup>



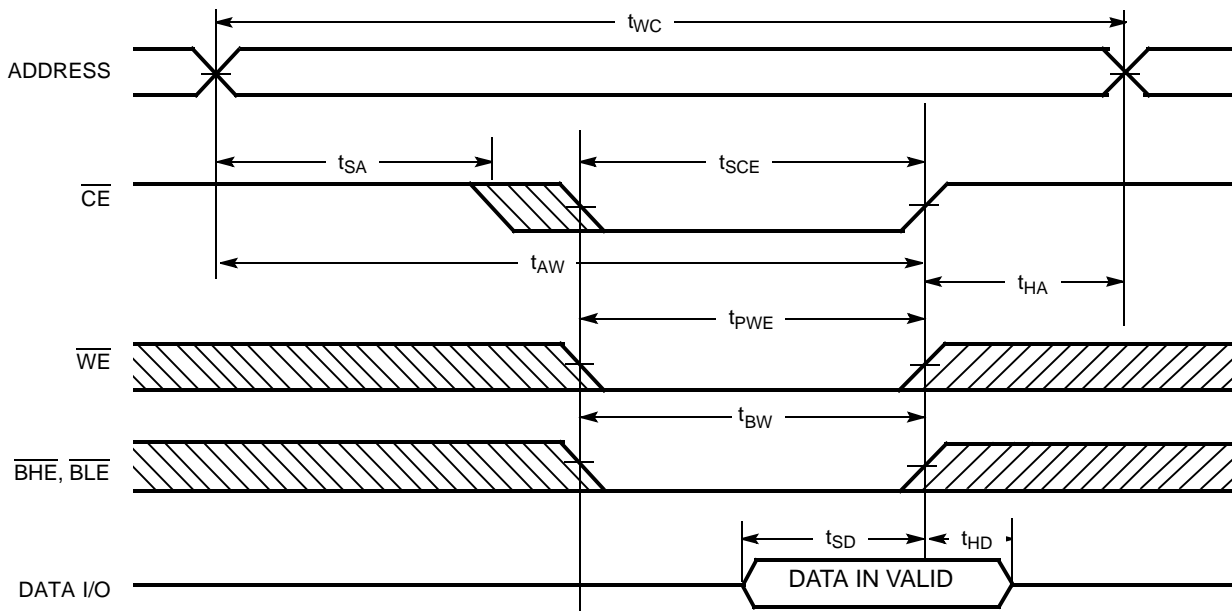
**Read Cycle No. 2 (OE Controlled)**<sup>[14, 15]</sup>



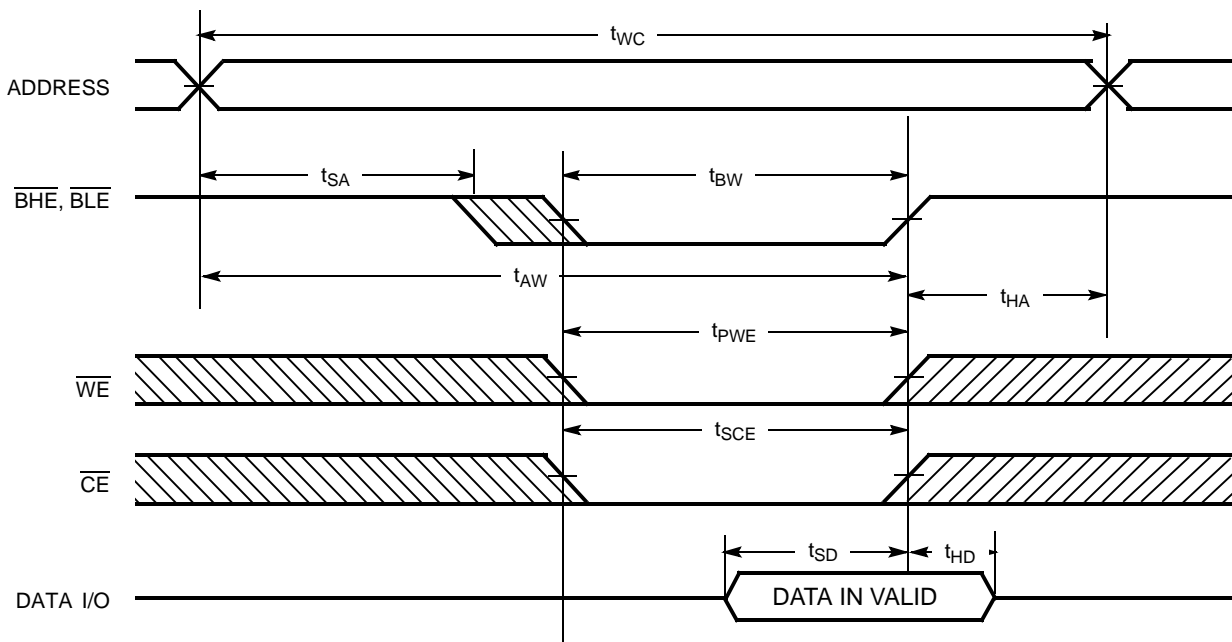
- Notes:**
- 12. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(min)}$   $\geq 50\ \mu\text{s}$  or stable at  $V_{CC(min)}$   $\geq 50\ \mu\text{s}$ .
  - 13. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$ ,  $\overline{BHE}$  and/or  $\overline{BLE} = V_{IL}$ .
  - 14.  $\overline{WE}$  is HIGH for Read cycle.
  - 15. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.

Switching Waveforms (continued)

Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled)<sup>[16, 17]</sup>



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



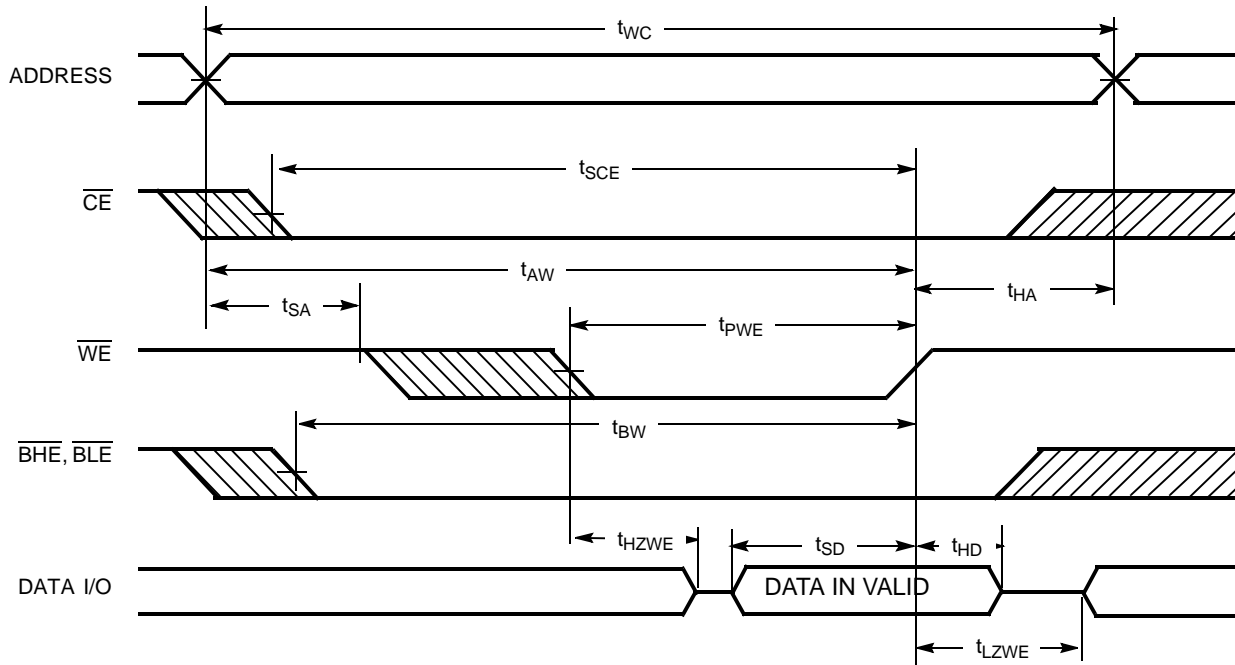
Notes:

16. Data I/O is high impedance if  $\overline{\text{OE}}$  or  $\overline{\text{BHE}}$  and/or  $\overline{\text{BLE}} = V_{IH}$ .

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

**Switching Waveforms** (continued)

**Write Cycle No. 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)**



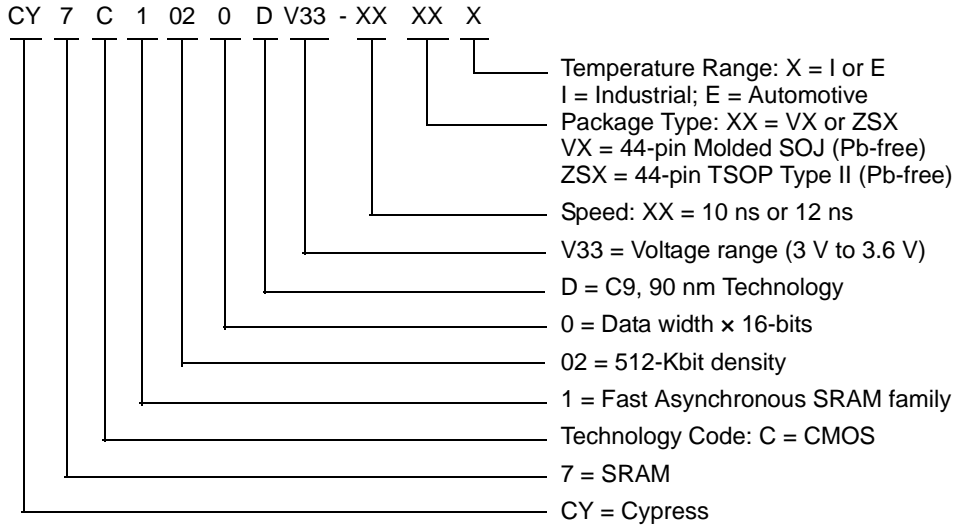
**Truth Table**

$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	$\overline{BLE}$	$\overline{BHE}$	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 ( $I_{SB}$ )
L	L	H	L	L	Data Out	Data Out	Read—All bits	Active ( $I_{CC}$ )
			L	H	Data Out	High-Z	Read—Lower bits only	Active ( $I_{CC}$ )
			H	L	High-Z	Data Out	Read—Upper bits only	Active ( $I_{CC}$ )
L	X	L	L	L	Data In	Data In	Write—All bits	Active ( $I_{CC}$ )
			L	H	Data In	High-Z	Write—Lower bits only	Active ( $I_{CC}$ )
			H	L	High-Z	Data In	Write—Upper bits only	Active ( $I_{CC}$ )
L	H	H	X	X	High-Z	High-Z	Selected, Outputs Disabled	Active ( $I_{CC}$ )
L	X	X	H	H	High-Z	High-Z	Selected, Outputs Disabled	Active ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
10	CY7C1020DV33-10ZSXI	51-85087	44-pin TSOP Type II (Pb-free)	Industrial

**Ordering Code Definitions**

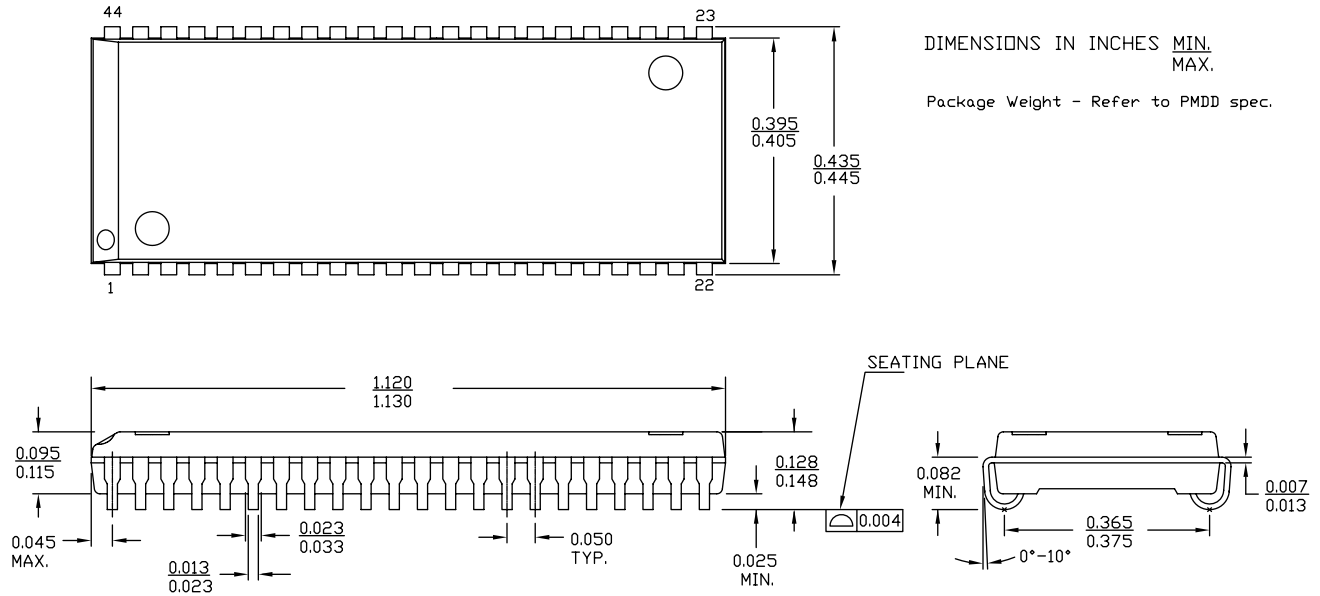


Shaded areas contain advance information. Please contact your local Cypress sales representative for availability of these parts.



Package Diagrams

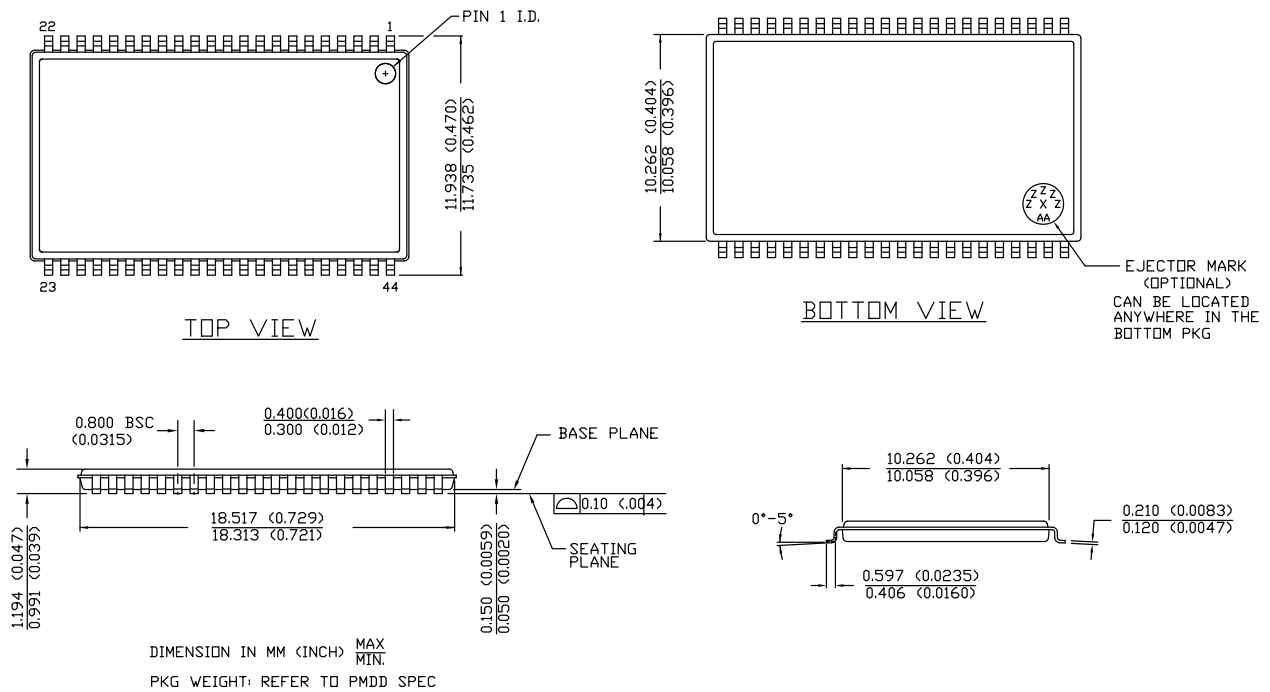
Figure 1. 44-pin (400-Mil) Molded SOJ (51-85082)



51-85082 \*E

Package Diagrams (continued)

Figure 2. 44-Pin Thin Small Outline Package Type II (51-85087)



51-85087 \*E

## Acronyms

Acronym	Description
$\overline{\text{BHE}}$	byte high enable
$\overline{\text{BLE}}$	byte low enable
$\overline{\text{CE}}$	chip enable
CMOS	complementary metal oxide semiconductor
I/O	input/output
$\overline{\text{OE}}$	output enable
SRAM	static random access memory
TSOP	thin small outline package
$\overline{\text{WE}}$	write enable

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
°C	degrees Celsius
μA	microamperes
mA	milliamperes
MHz	megahertz
ns	nanoseconds
pF	picofarads
V	volts
Ω	ohms
W	watts

**Document History Page**

Document Title: CY7C1020DV33, 512 K (32 K x 16) Static RAM				
Document Number: 38-05461				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	201560	See ECN	SWI	Advance Information data sheet for C9 IPP
*A	233695	See ECN	RKF	DC parameters modified as per EROS (Spec # 01-02165) Pb-free Offering in Ordering Information
*B	262950	See ECN	RKF	Changed I/O <sub>1</sub> – I/O <sub>16</sub> to I/O <sub>0</sub> – I/O <sub>15</sub> Added Data Retention Characteristics table Added T <sub>power</sub> spec in Switching Characteristics table Added 44-SOJ package diagram Shaded Ordering Information
*C	307596	See ECN	RKF	Reduced Speed bins to –8 and –10 ns
*D	560995	See ECN	VKN	Converted from Preliminary to Final Removed Commercial operating range Removed 8 ns speed bin Added Automotive information Added I <sub>CC</sub> values for the frequencies 83MHz, 66MHz and 40MHz Updated Thermal Resistance table Updated Ordering Information table Changed Overshoot spec from V <sub>CC</sub> +2 V to V <sub>CC</sub> +1 V in footnote #4
*E	2898399	03/24/2010	AJU	Updated Package Diagrams
*F	3109992	12/14/2010	AJU	Added <a href="#">Ordering Code Definitions</a> .
*G	3424450	10/28/2011	TAVA	Updated footnotes Updated <a href="#">Selection Guide</a> , <a href="#">Operating Range</a> , <a href="#">Electrical Characteristics Over the Operating Range</a> , <a href="#">Switching Characteristics Over the Operating Range</a> <sup>[5]</sup> , <a href="#">Data Retention Characteristics (Over the Operating Range)</a> , <a href="#">Switching Waveforms</a> , and <a href="#">Ordering Information</a> . Updated <a href="#">Package Diagrams</a> Added <a href="#">Acronyms</a> , and <a href="#">Document Conventions</a>
*H	3861347	01/08/2013	TAVA	Updated <a href="#">Ordering Information</a> (Updated part numbers). Updated <a href="#">Package Diagrams</a> : spec 51-85082 – Changed revision from *D to *E. spec 51-85087 – Changed revision from *D to *E.
*I	4574311	11/19/2014	TAVA	Added related documentation hyperlink in page 1. Added note 11 in <a href="#">Switching Characteristics Over the Operating Range</a> <sup>[5]</sup> . Added note reference in the Switching Characteristics table.

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