

## Features

- 3.3 V operation (3.0 V–3.6 V)
- High speed
  - $t_{AA} = 15$  ns
- CMOS for optimum speed/power
- Low Active Power
  - 576 mW (max)
- Low CMOS Standby Power
  - 1.80 mW (max)
- Automatic power-down when deselected
- Independent control of upper and lower bits
- Available in 44-pin TSOP II and 48-ball Mini BGA package

## Functional Description

The CY7C1021BNV33 <sup>[1]</sup> is a high-performance CMOS static RAM organized as 65,536 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 (WE) inputs LOW. If Byte Low Enable (BLE) is LOW, then data from I/O pins (I/O<sub>0</sub> through I/O<sub>7</sub>), is written into the location specified on the address pins (A<sub>0</sub> through A<sub>15</sub>). If Byte High Enable (BHE) is LOW, then data from I/O pins (I/O<sub>8</sub> through I/O<sub>15</sub>) is written into the location specified on the address pins (A<sub>0</sub> through A<sub>15</sub>).

Reading from the device is accomplished by taking Chip Enable ( $\overline{CE}$ ) and Output Enable ( $\overline{OE}$ ) LOW while forcing the Write Enable (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by the address pins will appear on I/O<sub>0</sub> to I/O<sub>7</sub>. If Byte High Enable (BHE) is LOW, then data from memory will appear on I/O<sub>8</sub> to I/O<sub>15</sub>. 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<sub>0</sub> through I/O<sub>15</sub>) are placed in a high-impedance state when the device is deselected ( $\overline{CE}$  HIGH), the outputs are disabled ( $\overline{OE}$  HIGH), the BHE and BLE are disabled (BHE, BLE HIGH), or during a write operation ( $\overline{CE}$  LOW, and WE LOW).

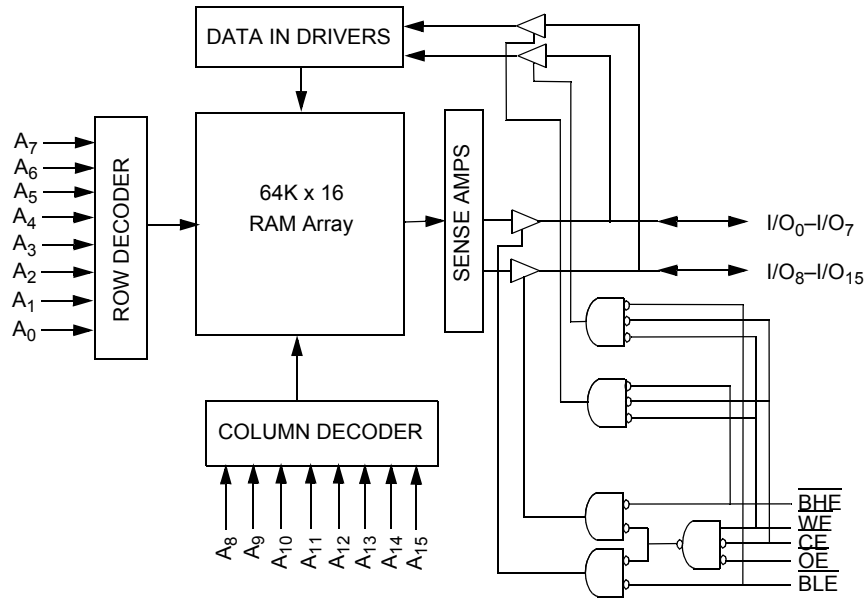
The CY7C1021BNV33 is available in standard 44-pin TSOP Type II and 48-ball mini BGA packages.

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

### Note

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](http://www.cypress.com).

**Logic Block Diagram**



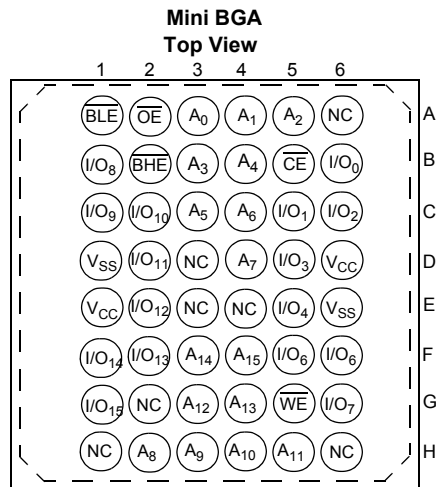
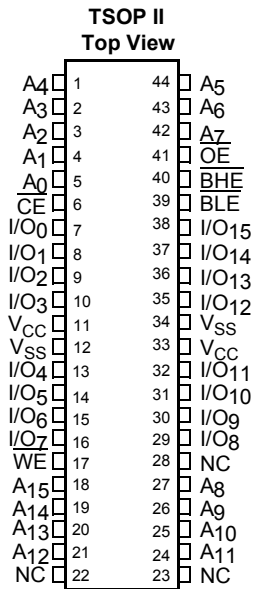
**Selection Guide**

	<b>-15</b>
Maximum Access Time (ns)	15
Maximum Operating Current (mA)	160
Maximum CMOS Standby Current (mA)	0.5

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Pin Configurations



## Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. 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 [2] ..... -0.5 V to +4.6 V  
 DC Voltage Applied to Outputs  
 in High Z State [2] ..... -0.5 V to  $V_{CC} + 0.5$  V

DC Input Voltage [2] ..... -0.5 V to  $V_{CC} + 0.5$  V  
 Current into Outputs (LOW) ..... 20 mA  
 Static Discharge Voltage  
 (per MIL-STD-883, Method 3015) ..... > 2001 V  
 Latch-Up Current ..... > 200 mA

## Operating Range

Range	Ambient Temperature	$V_{CC}$
Industrial	-40 °C to +85 °C	3.3 V ± 10%

## Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	-15		Unit
			Min	Max	
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min}, I_{OH} = -4.0$ mA	2.4	–	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min}, I_{OL} = 8.0$ mA	–	0.4	V
$V_{IH}$	Input HIGH Voltage		2.2	$V_{CC} + 0.3$	V
$V_{IL}$	Input LOW Voltage [2]		-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	$V_{CC} = \text{Max}, I_{OUT} = 0$ mA, $f = f_{MAX} = 1/t_{RC}$	–	160	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	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, $f = 0$	–	500	µA

## Capacitance

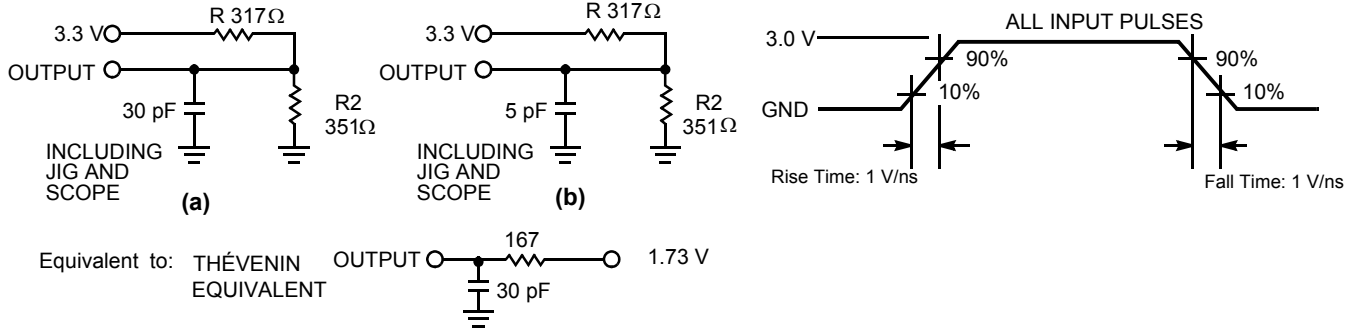
Parameter [3]	Description	Test Conditions	Max	Unit
$C_{IN}$	Input capacitance	$T_A = 25$ °C, $f = 1$ MHz	6	pF
$C_{OUT}$	Output capacitance		8	pF

### Notes

- Minimum voltage is -2.0 V for pulse durations of less than 20 ns.
- Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms

Figure 1. AC Test Loads and Waveforms



## Switching Characteristics

Over the Operating Range

Parameter <sup>[4]</sup>	Description	-15		Unit
		Min	Max	
<b>READ CYCLE</b>				
$t_{RC}$	Read Cycle Time	15	–	ns
$t_{AA}$	Address to Data Valid	–	15	ns
$t_{OHA}$	Data Hold from Address Change	3	–	ns
$t_{ACE}$	CE LOW to Data Valid	–	15	ns
$t_{DOE}$	OE LOW to Data Valid	–	7	ns
$t_{LZOE}$	OE LOW to Low Z	0	–	ns
$t_{HZOE}$	OE HIGH to High Z <sup>[5, 6]</sup>	–	7	ns
$t_{LZCE}$	CE LOW to Low Z <sup>[6]</sup>	3	–	ns
$t_{HZCE}$	CE HIGH to High Z <sup>[5, 6]</sup>	–	7	ns
$t_{PU}$	CE LOW to Power-Up	0	–	ns
$t_{PD}$	CE HIGH to Power-Down	–	15	ns
$t_{DBE}$	Byte Enable to Data Valid	–	7	ns
$t_{LZBE}$	Byte Enable to Low Z	0	–	ns
$t_{HZBE}$	Byte Disable to High Z	–	7	ns
<b>WRITE CYCLE <sup>[7, 8]</sup></b>				
$t_{WC}$	Write Cycle Time	15	–	ns
$t_{SCE}$	CE LOW to Write End	10	–	ns
$t_{AW}$	Address Set-Up to Write End	10	–	ns
$t_{HA}$	Address Hold from Write End	0	–	ns
$t_{SA}$	Address Set-Up to Write Start	0	–	ns
$t_{PWE}$	WE Pulse Width	10	–	ns
$t_{SD}$	Data Set-Up to Write End	8	–	ns
$t_{HD}$	Data Hold from Write End	0	–	ns
$t_{LZWE}$	WE HIGH to Low Z <sup>[6]</sup>	3	–	ns
$t_{HZWE}$	WE LOW to High Z <sup>[5, 6]</sup>	–	7	ns
$t_{BW}$	Byte Enable to End of Write	9	–	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, and output loading of the specified  $I_{OL}/I_{OH}$  and 30-pF load capacitance.
- $t_{HZOE}$ ,  $t_{HZBE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (b) of [Figure 1 on page 6](#). 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 CE LOW, WE LOW and BHE / BLE LOW. CE, WE and BHE / BLE must be LOW to initiate a write, and LOW to HIGH transition on any 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) should be equal to the sum of  $t_{SD}$  and  $t_{HZWE}$ .

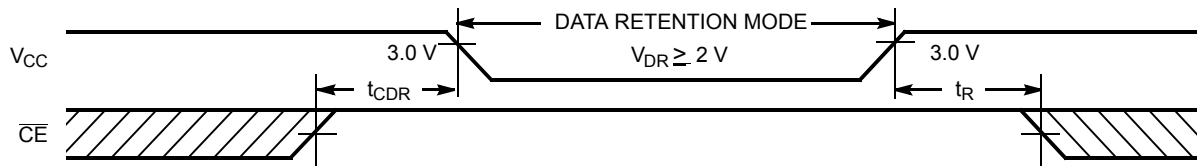
## Data Retention Characteristics

Over the Operating Range (L version only)

Parameter	Description	Conditions <sup>[9]</sup>	Min	Max	Unit
$V_{DR}$	$V_{CC}$ for Data Retention		2.0	–	V
$I_{CCDR}$	Data Retention Current	$V_{CC} = V_{DR} = 2.0\text{ V}$ , $CE \geq V_{CC} - 0.3\text{ V}$ , $V_{IN} \geq V_{CC} - 0.3\text{ V}$ or $V_{IN} \leq 0.3\text{ V}$	–	100	$\mu\text{A}$
$t_{CDR}^{[10]}$	Chip Deselect to Data Retention Time		0	–	ns
$t_R^{[11]}$	Operation Recovery Time		15	–	ns

## Data Retention Waveform

Figure 2. Data Retention Waveform



### Notes

9. No input may exceed  $V_{CC} + 0.5\text{ V}$ .
10. Tested initially and after any design or process changes that may affect these parameters.
11.  $t_r \leq 3\text{ ns}$  for the -12 and -15 speeds.  $t_r \leq 5\text{ ns}$  for the -20 and slower speeds.



Switching Waveforms

Figure 3. Read Cycle No. 1 [12, 13]

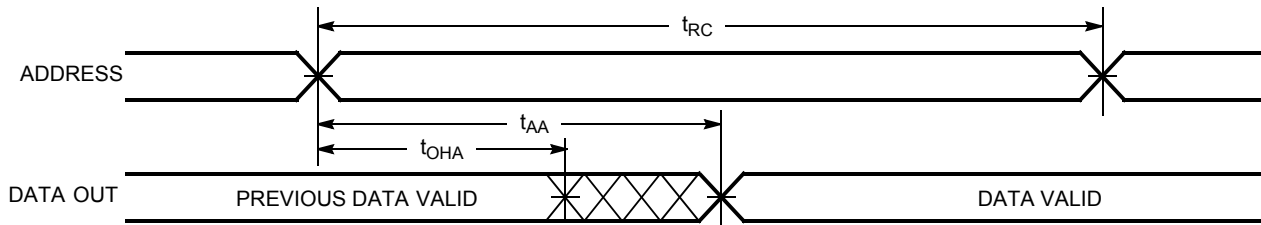
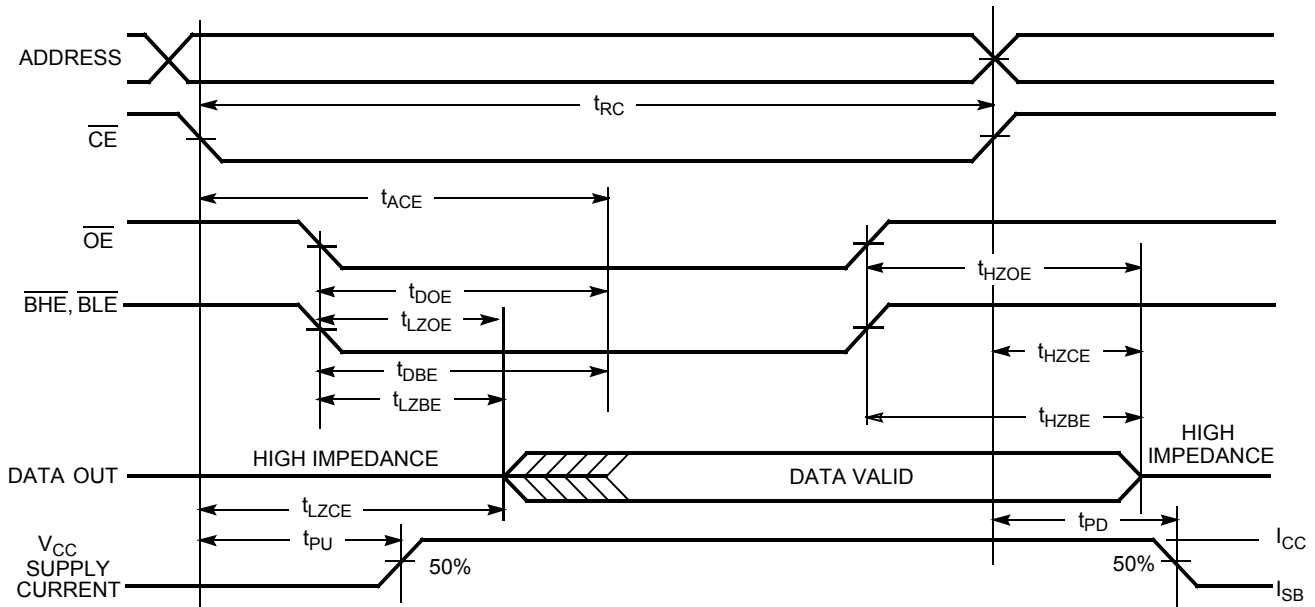


Figure 4. Read Cycle No. 2 ( $\overline{OE}$  Controlled) [13, 14]



Notes

- 12. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$ ,  $\overline{BHE}$  and/or  $\overline{BLE}$  =  $V_{IL}$ .
- 13.  $\overline{WE}$  is HIGH for read cycle.
- 14. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.

Switching Waveforms(continued)

Figure 5. Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled) [15, 16, 17]

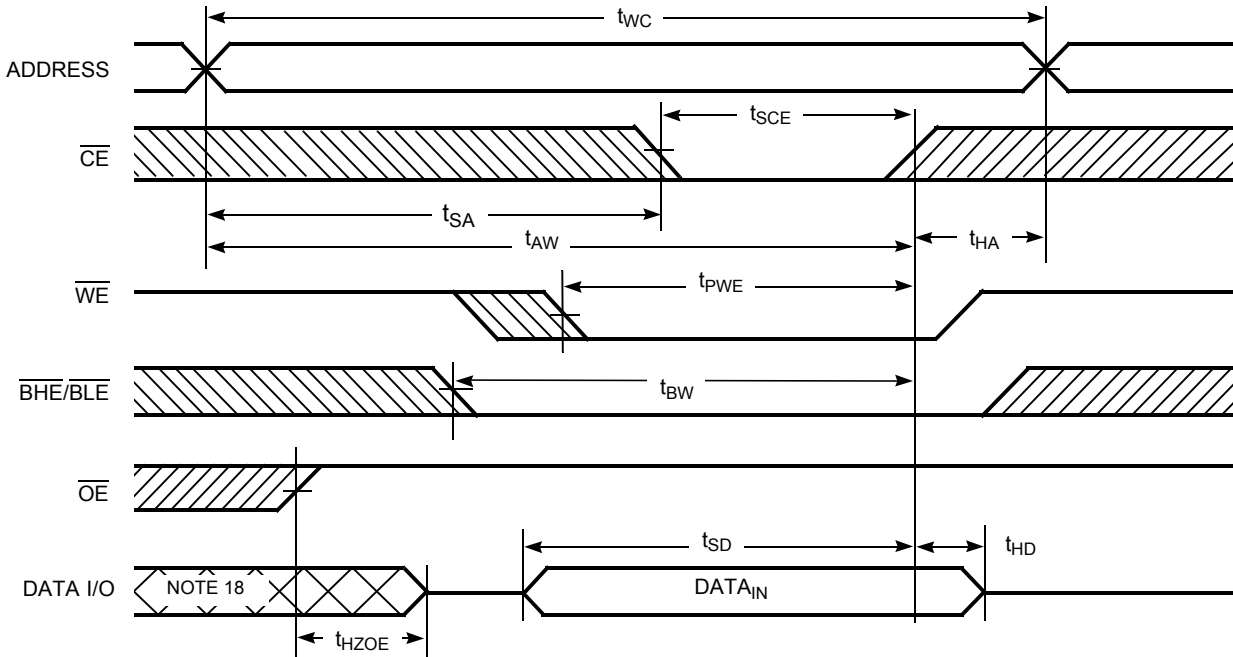
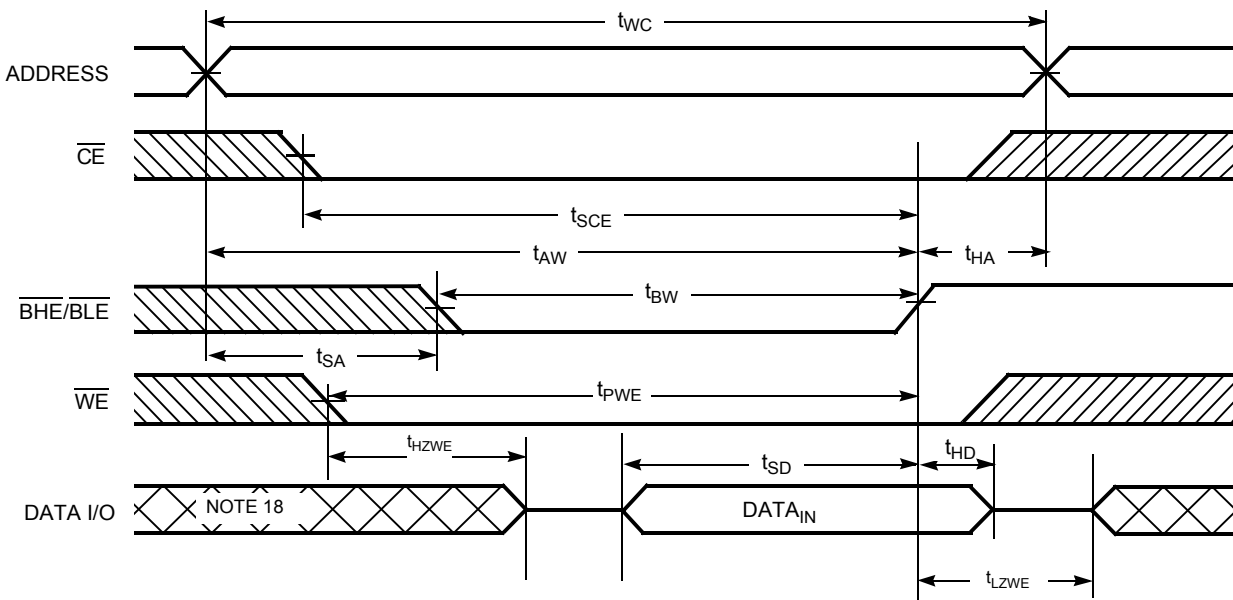


Figure 6. Write Cycle No. 2 ( $\overline{\text{BLE}}$  or  $\overline{\text{BHE}}$  Controlled) [15, 16, 17]

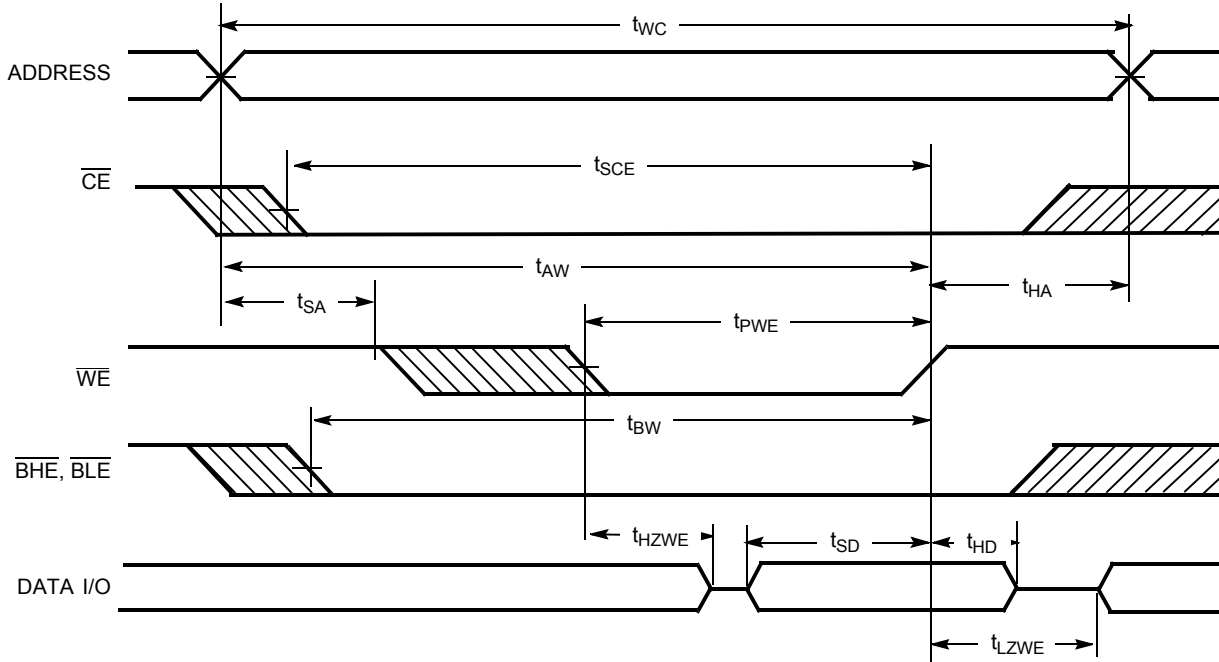


Notes

- 15. The internal write time of the memory is defined by the overlap of  $\overline{\text{WE}}$ ,  $\overline{\text{CE}} = V_{IL}$ ,  $\overline{\text{BHE}}$ ,  $\overline{\text{BLE}}$ , or both =  $V_{IL}$ . All signals must be active to initiate a write and any of these signals can terminate a write by going inactive. The data input setup and hold timing must be referenced to the edge of the signal that terminates the write.
- 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.
- 18. During this period, the I/Os are in output state. Do not apply input signals.

Switching Waveforms(continued)

Figure 7. Write Cycle No. 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW) [19, 20, 21]



Notes

- 19. The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $\overline{CE} = V_{IL}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$ , or both =  $V_{IL}$ . All signals must be active to initiate a write and any of these signals can terminate a write by going inactive. The data input setup and hold timing must be referenced to the edge of the signal that terminates the write.
- 20. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE}$  going HIGH, the output remains in a high-impedance state.
- 21. The minimum write cycle pulse width should be equal to the sum of  $t_{SD}$  and  $t_{HZWE}$ .

**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	H	Data Out	High Z	Read - Lower bits only	Active (I <sub>CC</sub> )
			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	H	Data In	High Z	Write - Lower bits only	Active (I <sub>CC</sub> )
			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> )
L	X	X	H	H	High Z	High Z	Selected, Outputs Disabled	Active (I <sub>CC</sub> )

## Ordering Information

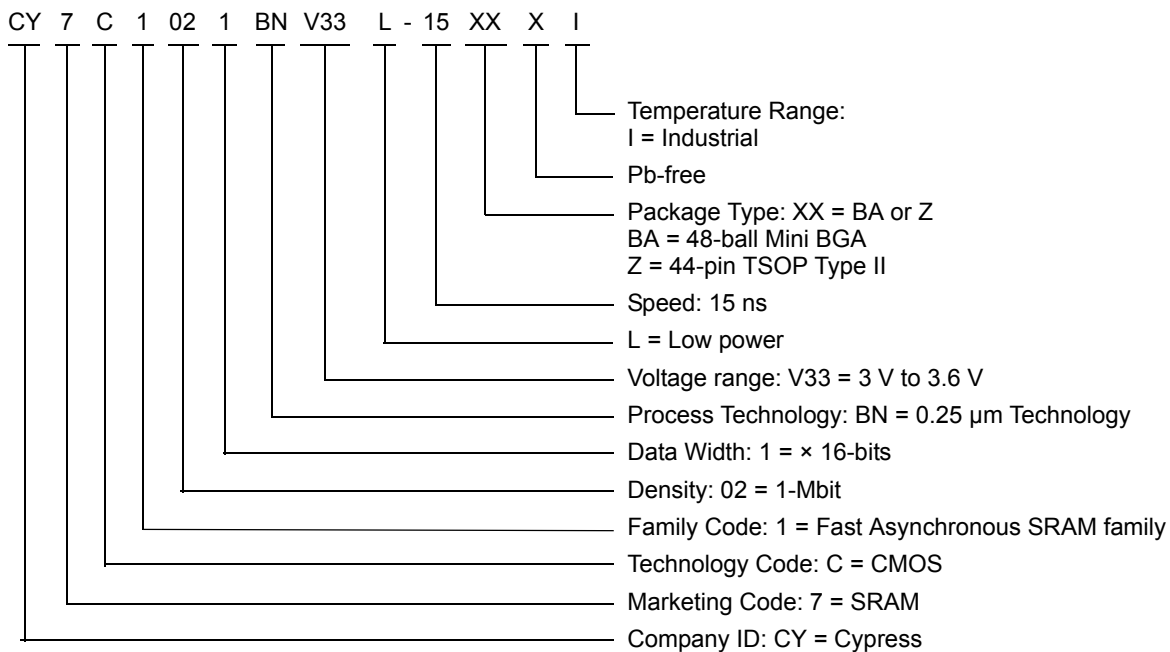
Cypress offers other versions of this type of product in many different configurations and features. The following table contains only the list of parts that are currently available. For a complete listing of all options, visit the Cypress website at <http://www.cypress.com> and refer to the product summary page at <http://www.cypress.com/products> or contact your local sales representative.

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Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
15	CY7C1021BNV33L-15BAI	51-85096	48-ball Mini BGA (7 mm × 7 mm)	Industrial
	CY7C1021BNV33L-15ZXI	51-85087	44-pin TSOP Type II (Pb-free)	

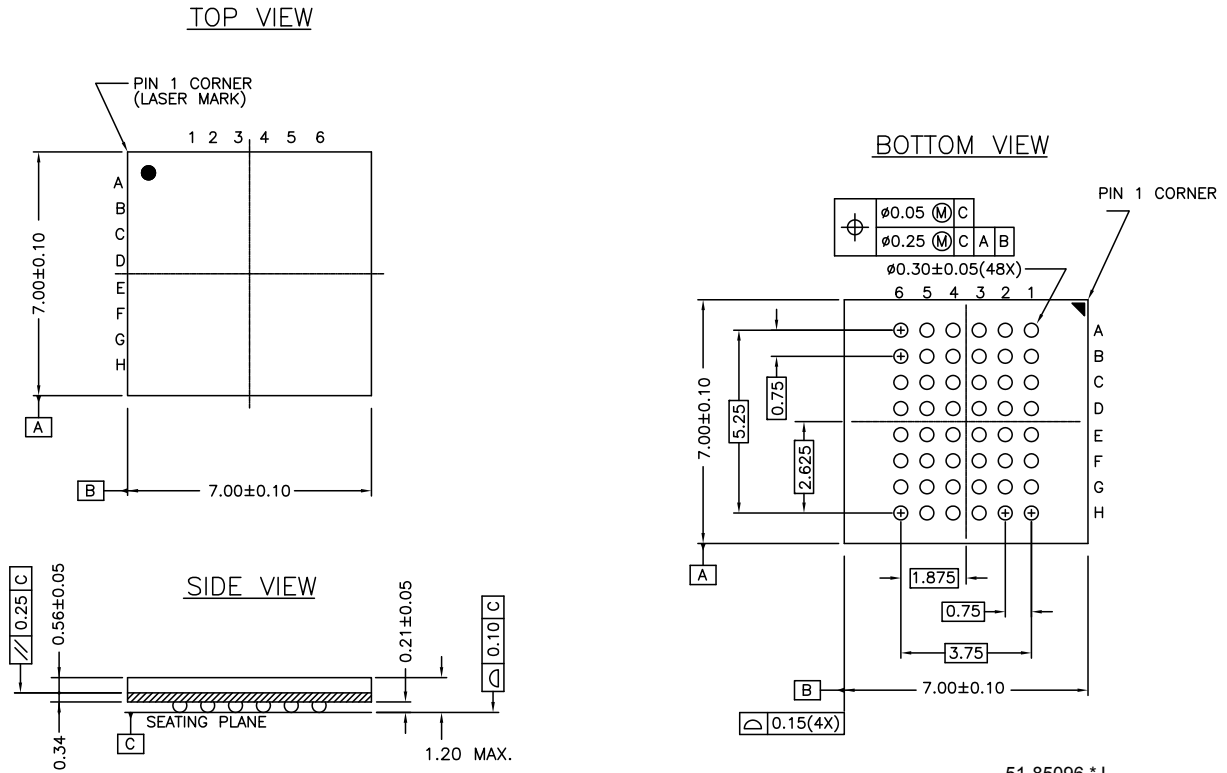
Please contact local sales representative regarding availability of these parts.

## Ordering Code Definitions



Package Diagrams

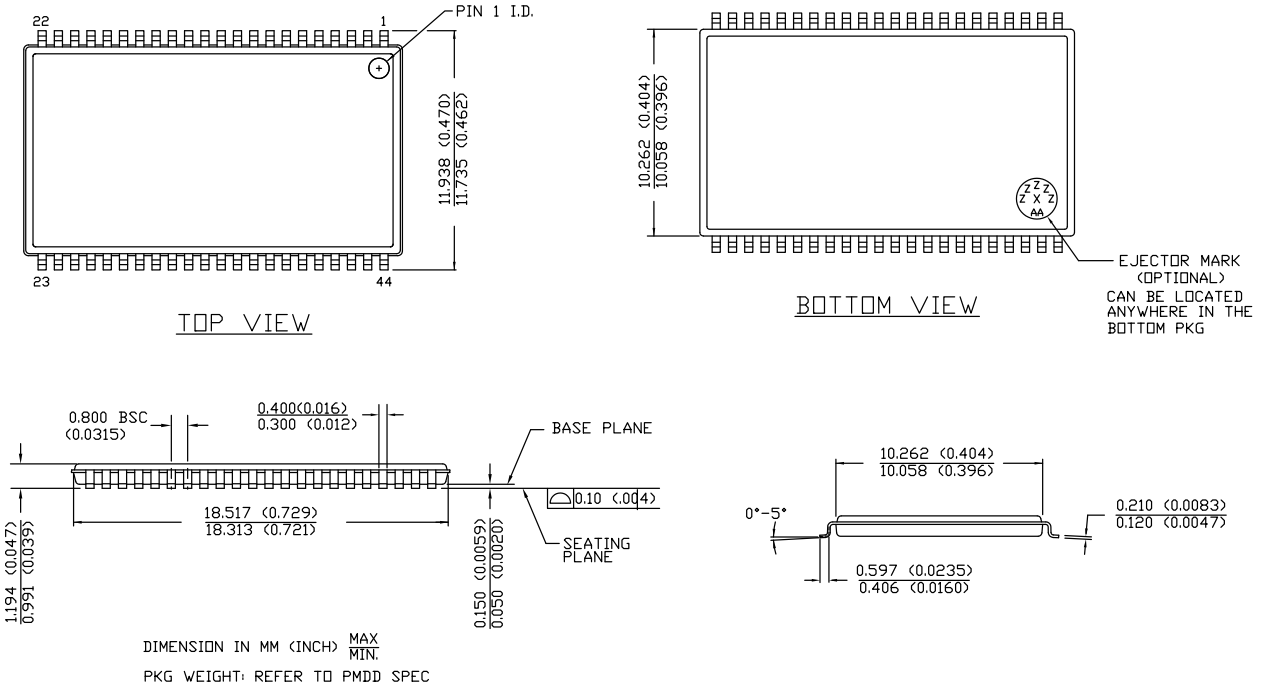
Figure 8. 48-ball FBGA (7 mm × 7 mm × 1.2 mm) BA48 Package Outline, 51-85096



51-85096 \*J

Package Diagrams(continued)

Figure 9. 44-pin TSOP Z44-II Package Outline, 51-85087



51-85087 \*E

**Acronyms**

Acronym	Description
BGA	Ball Grid Array
$\overline{CE}$	Chip Enable
CMOS	Complementary Metal Oxide Semiconductor
FBGA	Fine-pitch Ball Grid Array
I/O	Input/Output
$\overline{OE}$	Output Enable
SRAM	Static Random Access Memory
TSOP	Thin Small-Outline Package
TTL	Transistor-Transistor Logic
$\overline{WE}$	Write Enable

**Document Conventions**

**Units of Measure**

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
μA	microampere
μs	microsecond
mA	milliampere
mm	millimeter
mW	milliwatt
ns	nanosecond
Ω	ohm
%	percent
pF	picofarad
V	volt
W	watt



Document History Page

Document Title: CY7C1021BNV33, 64 K × 16 Static RAM Document Number: 001-06433				
Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
**	423847	See ECN	NXR	New data sheet.
*A	2897061	03/22/10	AJU	Updated <a href="#">Ordering Information</a> (Removed obsolete parts from ordering information table). Updated <a href="#">Package Diagrams</a> .
*B	3109897	12/14/2010	AJU	Added <a href="#">Ordering Code Definitions</a> .
*C	3103073	03/08/2011	PRAS	Updated <a href="#">Package Diagrams</a> . Added <a href="#">Acronyms</a> and <a href="#">Units of Measure</a> . Updated in new template.
*D	3403051	10/12/2011	AJU	Updated <a href="#">Ordering Information</a> (Removed prune part number CY7C1021BNV33L-15VXI). Updated <a href="#">Package Diagrams</a> .
*E	3937949	03/19/2013	MEMJ	Removed all references of 400-mil SOJ package in the document. Updated <a href="#">Switching Characteristics</a> : Updated Note 7. Updated <a href="#">Switching Waveforms</a> : Updated <a href="#">Figure 5</a> , <a href="#">Figure 6</a> . Added Note 15, 18 and referred the same notes in <a href="#">Figure 5</a> , <a href="#">Figure 6</a> . Referred Note 16, 17 in <a href="#">Figure 6</a> . Referred Note 19, 20 in <a href="#">Figure 7</a> . Updated <a href="#">Package Diagrams</a> : spec 51-85087 – Changed revision from *D to *E.
*F	4578447	01/16/2015	MEMJ	Added related documentation hyperlink in page 1. Updated <a href="#">Figure 8</a> in <a href="#">Package Diagrams</a> (spec 51-85096 *I to *J). Added Note 8 in <a href="#">Switching Characteristics</a> . Added note reference 8 in the <a href="#">Switching Characteristics</a> table. Added Note 21 in <a href="#">Switching Waveforms</a> . Added note reference 21 in <a href="#">Figure 7</a> .

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