

## Features

- Temperature ranges
  - Automotive-E: -40 °C to 125 °C
- High speed
  - $t_{AA} = 10$  ns
- Low active power
  - 468 mW (max)
- 2.0 V data retention
- Automatic power down when deselected
- Independent control of upper and lower bits
- Easy memory expansion with Chip Enable ( $\overline{CE}$ ) and Output Enable ( $\overline{OE}$ ) features
- Available in Pb-free 48-ball grid array (BGA) package

## Functional Description

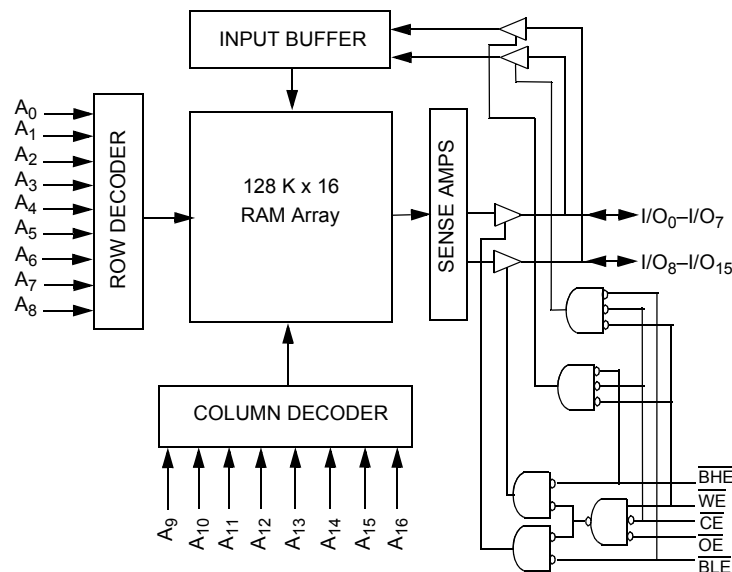
The CY7C1011CV33 Automotive is a high performance complementary metal oxide semiconductor (CMOS) static RAM organized as 131,072 words by 16 bits. This device has an automatic power down feature that significantly reduces power consumption when deselected.

To write to the device, take  $\overline{CE}$  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  $A_{16}$ ). 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  $A_{16}$ ).

To read from the device, take  $\overline{CE}$  and  $\overline{OE}$  LOW while forcing the Write Enable ( $\overline{WE}$ ) HIGH. If  $\overline{BLE}$  is LOW, then data from the memory location specified by the address pins appear on  $I/O_0$  to  $I/O_7$ . If Byte High Enable ( $\overline{BHE}$ ) is LOW, then data from memory appears on  $I/O_8$  to  $I/O_{15}$ . For more information, see the [Truth Table on page 10](#) for a complete description of Read and Write modes.

The input and 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).

## Logic Block Diagram

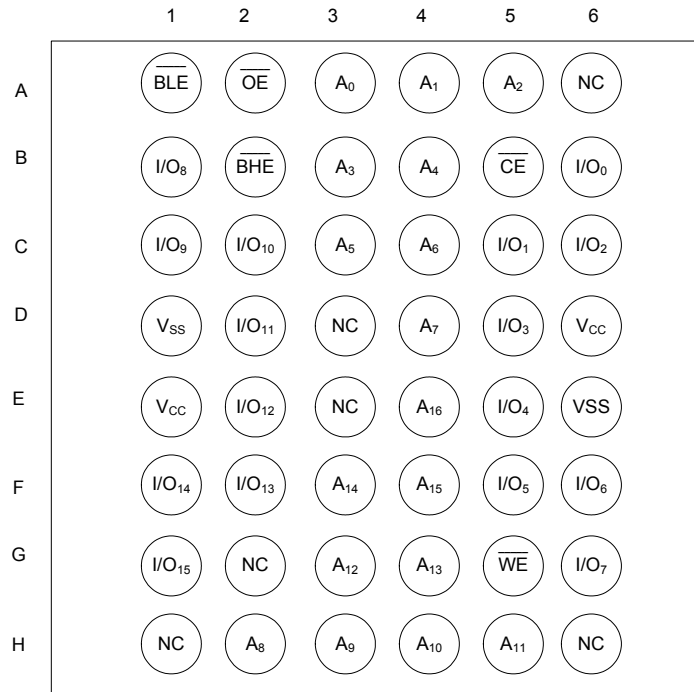


**Contents**

<b>Pin Configuration .....</b>	<b>3</b>	<b>Package Diagrams .....</b>	<b>12</b>
<b>Selection Guide .....</b>	<b>3</b>	<b>Acronyms .....</b>	<b>13</b>
<b>Maximum Ratings .....</b>	<b>4</b>	<b>Document Conventions .....</b>	<b>13</b>
<b>Operating Range .....</b>	<b>4</b>	Units of Measure .....	13
<b>Electrical Characteristics .....</b>	<b>4</b>	<b>Document History Page .....</b>	<b>14</b>
<b>Capacitance .....</b>	<b>5</b>	<b>Sales, Solutions, and Legal Information .....</b>	<b>15</b>
<b>Thermal Resistance .....</b>	<b>5</b>	Worldwide Sales and Design Support .....	15
<b>AC Test Loads and Waveforms .....</b>	<b>5</b>	Products .....	15
<b>Switching Characteristics .....</b>	<b>6</b>	PSoC® Solutions .....	15
<b>Switching Waveforms .....</b>	<b>7</b>	Cypress Developer Community .....	15
<b>Truth Table .....</b>	<b>10</b>	Technical Support .....	15
<b>Ordering Information .....</b>	<b>11</b>		
Ordering Code Definitions .....	11		

**Pin Configuration**

**Figure 1. 48 ball BGA pinout [1]**



**Selection Guide**

Description		-10	Unit
Maximum access time		10	ns
Maximum operating current	Automotive-E	130	mA
Maximum CMOS standby current	Automotive-E	15	mA

**Note**

1. NC pins are not connected on the die.

## Maximum Ratings

Exceeding 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  $V_{CC}$  relative to 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 (MIL-STD-883, method 3015) ..... > 2001 V  
 Latch up current ..... > 200 mA

## Operating Range

Range	Ambient Temperature ( $T_A$ )	$V_{CC}$
Automotive-E	-40 °C to +125 °C	3.3 V ± 10%

## Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	-10		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 leakage current	$GND \leq V_I \leq V_{CC}$	Automotive-E	-20	+20	μA
$I_{OZ}$	Output leakage current	$GND \leq V_I \leq V_{CC}$ , Output disabled	Automotive-E	-20	+20	μA
$I_{CC}$	$V_{CC}$ operating supply current	$V_{CC} = \text{Max}, I_{OUT} = 0 \text{ mA},$ $f = f_{MAX} = 1/t_{RC}$	Automotive-E		130	mA
$I_{SB1}$	Automatic CE power down current – TTL Inputs	Max $V_{CC}$ , $CE \geq V_{IH}$ , $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$	Automotive-E		45	mA
$I_{SB2}$	Automatic CE power down current – CMOS inputs	Max $V_{CC}$ , $CE \geq V_{CC} - 0.3 \text{ V},$ $V_{IN} \geq V_{CC} - 0.3 \text{ V}$ , or $V_{IN} \leq 0.3 \text{ V}, f = 0$	Automotive-E		15	mA

**Note**

2.  $V_{IL}(\text{min}) = -2.0 \text{ V}$  for pulse durations of less than 20 ns.

### Capacitance

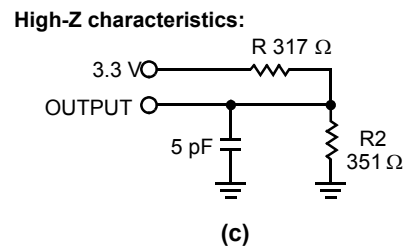
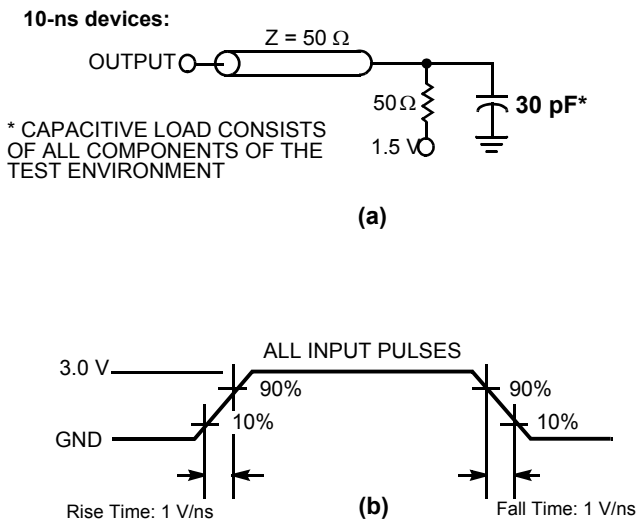
Parameter <sup>[3]</sup>	Description	Test Conditions	Max	Unit
C <sub>IN</sub>	Input capacitance	T <sub>A</sub> = 25 °C, f = 1 MHz, V <sub>CC</sub> = 3.3 V	8	pF
C <sub>OUT</sub>	Output capacitance		8	pF

### Thermal Resistance

Parameter <sup>[3]</sup>	Description	Test Conditions	48-pin BGA	Unit
Θ <sub>JA</sub>	Thermal resistance (junction to ambient)	Still air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	38.15	°C/W
Θ <sub>JC</sub>	Thermal resistance (junction to case)		9.15	°C/W

### AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms <sup>[4]</sup>



**Notes**

- 3. Tested initially and after any design or process changes that may affect these parameters.
- 4. AC characteristics (except High Z) for 10-ns parts are tested using the load conditions shown in Figure 2 (a). High Z characteristics are tested for all speeds using the test load shown in Figure 2 (b).

## Switching Characteristics

Over the Operating Range

Parameter <sup>[5]</sup>	Description	-10		Unit
		Min	Max	
<b>Read Cycle</b>				
$t_{power}^{[6]}$	$V_{CC}$ (typical) to the first access	1	–	$\mu s$
$t_{RC}$	Read cycle time	10	–	ns
$t_{AA}$	Address to data valid	–	10	ns
$t_{OHA}$	Data hold from address change	3	–	ns
$t_{ACE}$	CE LOW to data valid	–	10	ns
$t_{DOE}$	OE LOW to data valid	–	6	ns
$t_{LZOE}$	OE LOW to Low Z <sup>[7]</sup>	0	–	ns
$t_{HZOE}$	OE HIGH to High Z <sup>[7, 8]</sup>	–	5	ns
$t_{LZCE}$	CE LOW to Low Z <sup>[7]</sup>	3	–	ns
$t_{HZCE}$	CE HIGH to High Z <sup>[7, 8]</sup>	–	5	ns
$t_{PU}$	CE LOW to power up	0	–	ns
$t_{PD}$	CE HIGH to power down	–	10	ns
$t_{DBE}$	Byte enable to data valid	–	6	ns
$t_{LZBE}$	Byte enable to Low Z	0	–	ns
$t_{HZBE}$	Byte disable to High Z	–	6	ns
<b>Write Cycle <sup>[9, 10]</sup></b>				
$t_{WC}$	Write cycle time	10	–	ns
$t_{SCE}$	CE LOW to write end	7	–	ns
$t_{AW}$	Address setup to write end	7	–	ns
$t_{HA}$	Address hold from write end	0	–	ns
$t_{SA}$	Address setup to write start	0	–	ns
$t_{PWE}$	WE pulse width	7	–	ns
$t_{SD}$	Data setup to write end	5	–	ns
$t_{HD}$	Data hold from write end	0	–	ns
$t_{LZWE}$	WE HIGH to Low Z <sup>[7]</sup>	3	–	ns
$t_{HZWE}$	WE LOW to High Z <sup>[7, 8]</sup>	–	5	ns
$t_{BW}$	Byte enable to end of write	7	–	ns

### Notes

- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5 V, and input pulse levels of 0 to 3.0 V.
- $t_{POWER}$  gives the minimum amount of time that the power supply is at typical  $V_{CC}$  values until the first memory access is performed.
- At any 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 device.
- $t_{HZOE}$ ,  $t_{HZBE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (c) of [Figure 2 on page 5](#). Transition is measured  $\pm 500$  mV from steady state voltage.
- 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. The transition of these signals terminate the write. The input data setup and hold timing is referenced to the leading edge of the signal that terminates the write.
- The minimum write cycle time for Write Cycle No. 3 (WE controlled, OE LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

### Switching Waveforms

Figure 3. Read Cycle No. 1 (Address Transition Controlled) [11, 12]

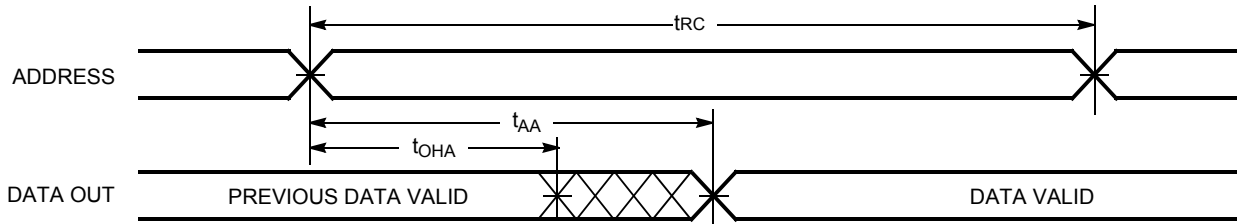
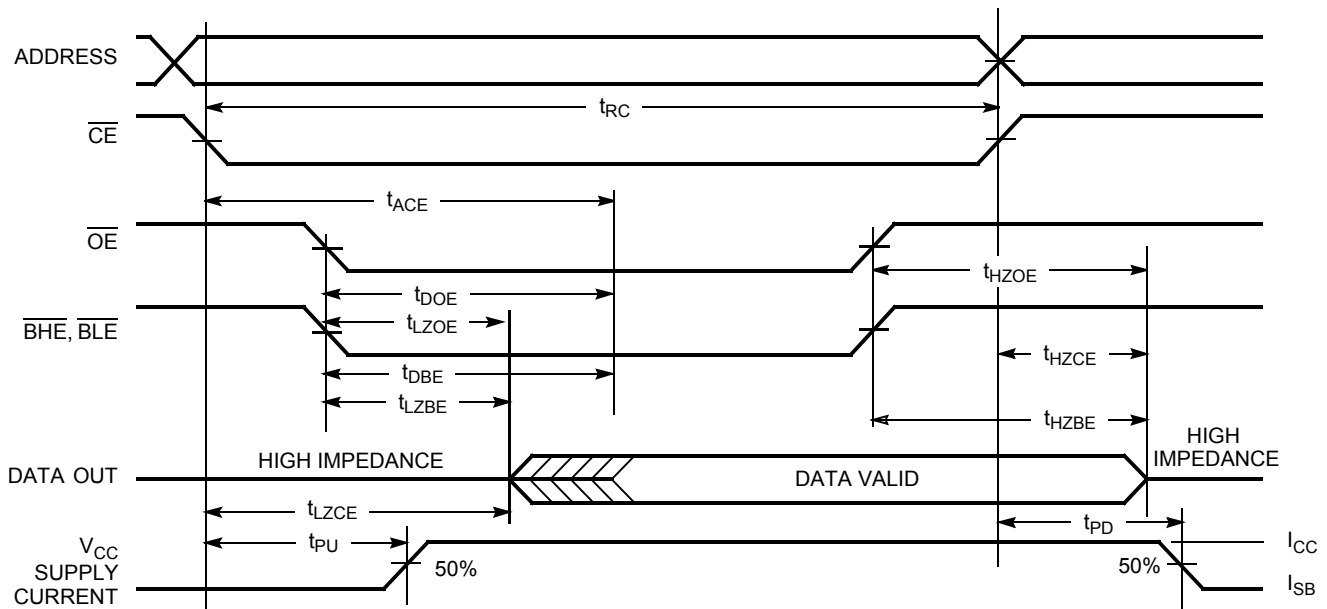


Figure 4. Read Cycle No. 2 ( $\overline{OE}$  Controlled) [12, 13]



**Notes**

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

Switching Waveforms (continued)

Figure 5. Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled) [14, 15]

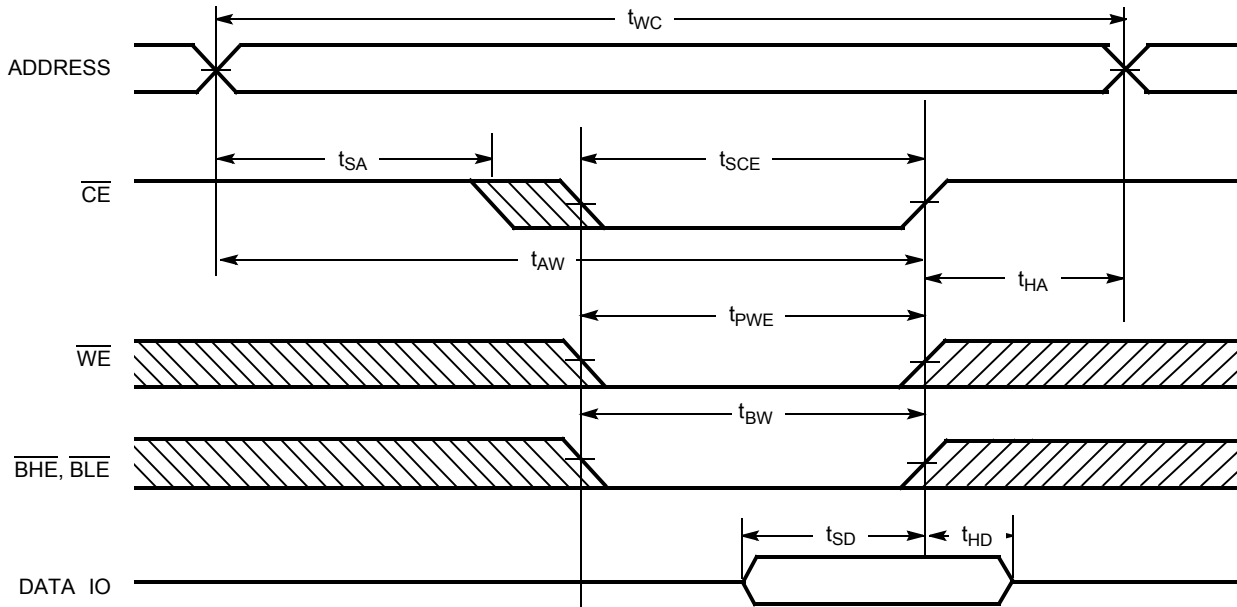
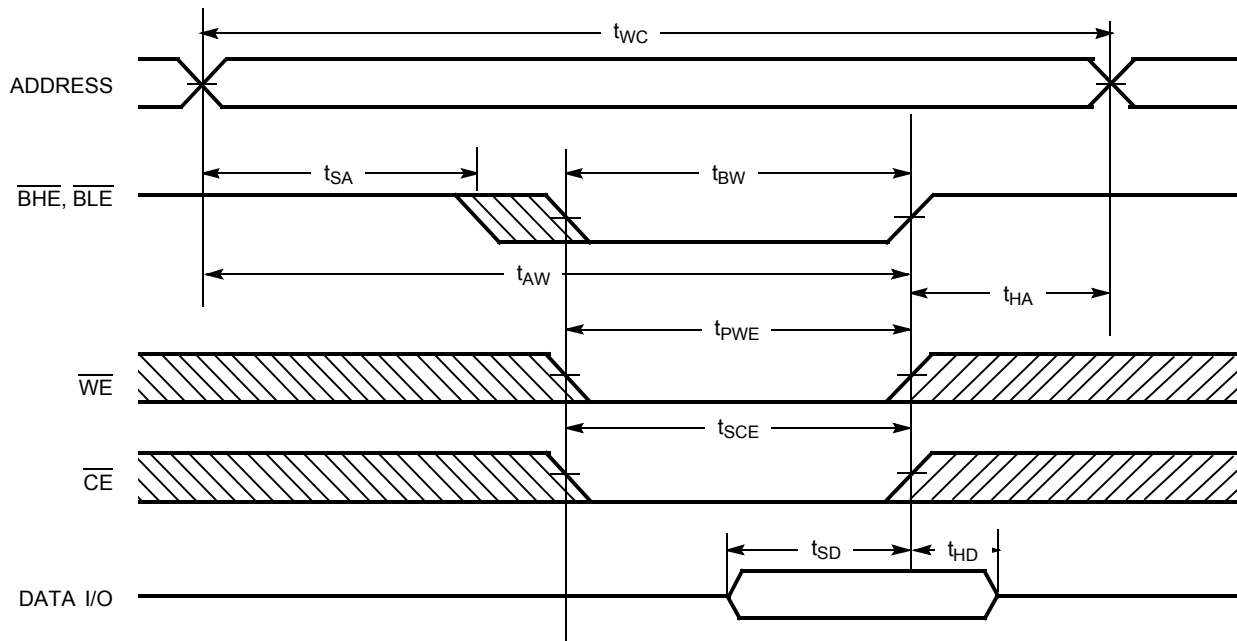


Figure 6. Write Cycle No. 2 ( $\overline{\text{BLE}}$  or  $\overline{\text{BHE}}$  Controlled)



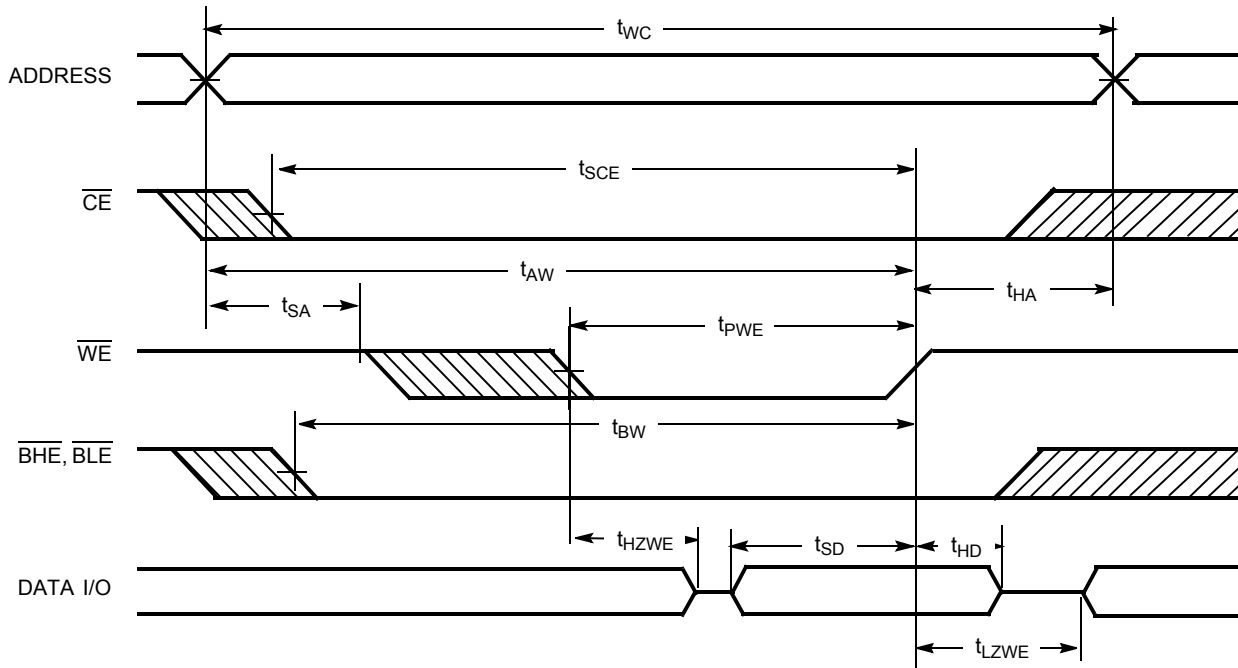
Notes

- 14. Data I/O is high impedance if  $\overline{\text{OE}}$ ,  $\overline{\text{BHE}}$ , and/or  $\overline{\text{BLE}} = V_{IH}$ .
- 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 7. Write Cycle No. 3 ( $\overline{\text{WE}}$  Controlled, LOW)**



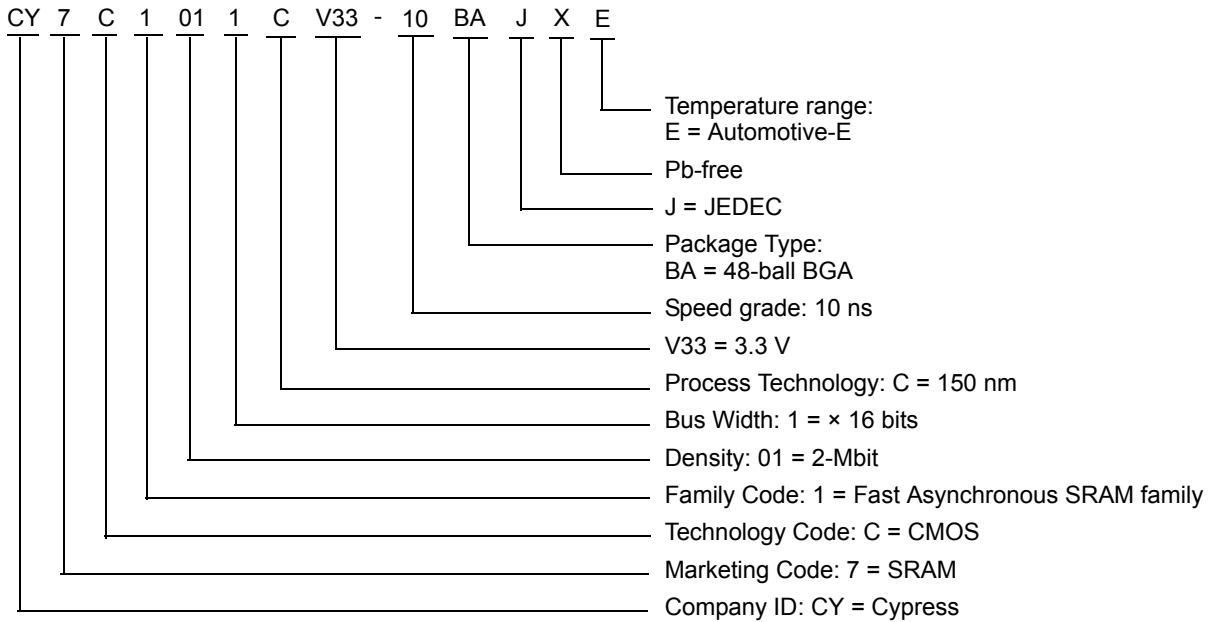
**Truth Table**

CE	OE	WE	BLE	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**

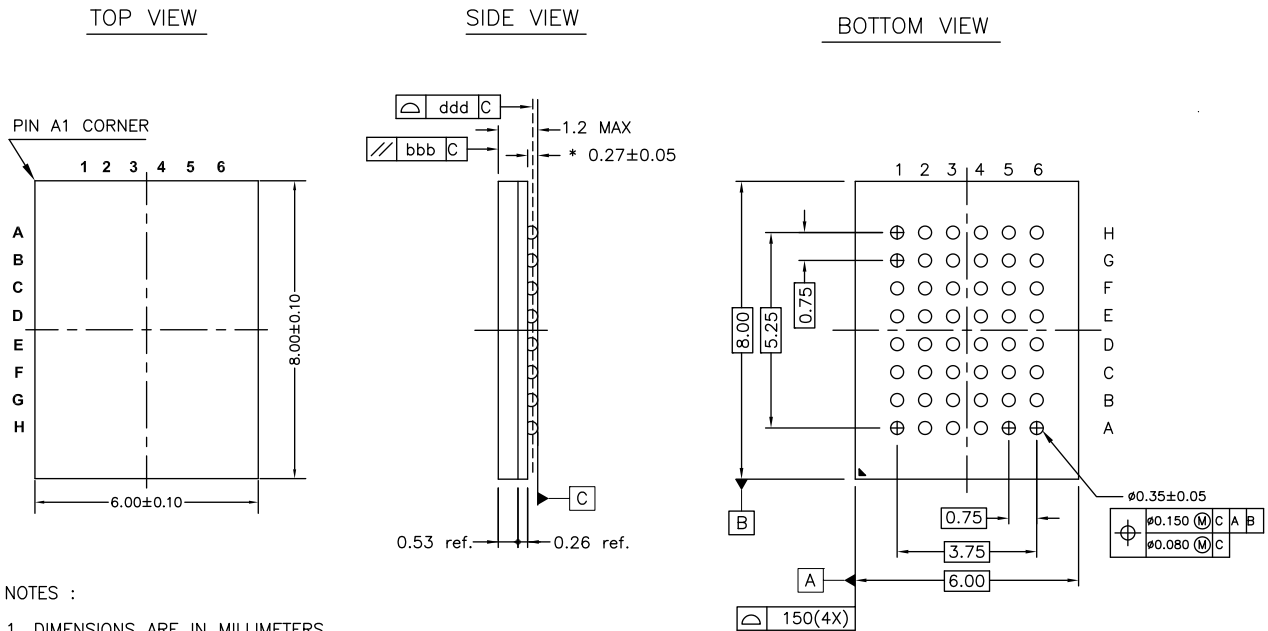
Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
10	CY7C1011CV33-10BAJXE	001-85259	48-ball BGA (Pb-free)	Automotive-E

**Ordering Code Definitions**



**Package Diagrams**

**Figure 8. 48-ball FBGA (6 × 8 × 1.2 mm) BA48M/BK48M (0.35 mm Ball Diameter) Package Outline, 001-85259**



NOTES :

1. DIMENSIONS ARE IN MILLIMETERS
2. REFERENCE JEDEC STD : MO-216
3. \* 0.32±0.05 FOR RAMTRON DEVICES

001-85259 \*A

## Acronyms

Acronym	Description
$\overline{\text{BHE}}$	Byte High Enable
$\overline{\text{BLE}}$	Byte Low Enable
CMOS	Complementary Metal Oxide Semiconductor
$\overline{\text{CE}}$	Chip Enable
I/O	Input/Output
$\overline{\text{OE}}$	Output Enable
SRAM	Static Random Access Memory
TQFP	Thin Quad Flat Pack
TSOP	Thin Small Outline Package
TTL	Transistor-Transistor Logic
VFBGA	Very Fine-Pitch Ball Grid Array
$\overline{\text{WE}}$	Write Enable

## Document Conventions

### Units of Measure

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

**Document History Page**

Document Title: CY7C1011CV33 Automotive, 2-Mbit (128 K × 16) Static RAM Document Number: 001-86374				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	3924592	TAVA	03/12/2013	New data sheet.
*A	4055409	MEMJ	07/10/2013	Changed status from Preliminary to Final.  Updated <a href="#">Package Diagrams</a> : spec 001-85259 – Changed revision from ** to *A.  Updated in new template.
*B	4075559	MEMJ	07/24/2013	Updated <a href="#">Ordering Information</a> : No change in part numbers. Changed package diagram spec number from “51-85087” to “001-85259” in “Package Diagram” column.

## Sales, Solutions, and Legal Information

### Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at [Cypress Locations](#).

#### Products

<a href="#">Automotive</a>	<a href="http://cypress.com/go/automotive">cypress.com/go/automotive</a>
<a href="#">Clocks &amp; Buffers</a>	<a href="http://cypress.com/go/clocks">cypress.com/go/clocks</a>
<a href="#">Interface</a>	<a href="http://cypress.com/go/interface">cypress.com/go/interface</a>
<a href="#">Lighting &amp; Power Control</a>	<a href="http://cypress.com/go/powerpsoc">cypress.com/go/powerpsoc</a> <a href="http://cypress.com/go/plc">cypress.com/go/plc</a>
<a href="#">Memory</a>	<a href="http://cypress.com/go/memory">cypress.com/go/memory</a>
<a href="#">PSoC</a>	<a href="http://cypress.com/go/psoc">cypress.com/go/psoc</a>
<a href="#">Touch Sensing</a>	<a href="http://cypress.com/go/touch">cypress.com/go/touch</a>
<a href="#">USB Controllers</a>	<a href="http://cypress.com/go/USB">cypress.com/go/USB</a>
<a href="#">Wireless/RF</a>	<a href="http://cypress.com/go/wireless">cypress.com/go/wireless</a>

#### PSoC<sup>®</sup> Solutions

[psoc.cypress.com/solutions](http://psoc.cypress.com/solutions)  
[PSoC 1](#) | [PSoC 3](#) | [PSoC 4](#) | [PSoC 5LP](#)

#### Cypress Developer Community

[Community](#) | [Forums](#) | [Blogs](#) | [Video](#) | [Training](#)

#### Technical Support

[cypress.com/go/support](http://cypress.com/go/support)

---

© Cypress Semiconductor Corporation, 2013. The information contained herein is subject to change without notice. Cypress Semiconductor Corporation assumes no responsibility for the use of any circuitry other than circuitry embodied in a Cypress product. Nor does it convey or imply any license under patent or other rights. Cypress products are not warranted nor intended to be used for medical, life support, life saving, critical control or safety applications, unless pursuant to an express written agreement with Cypress. Furthermore, Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress products in life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Any Source Code (software and/or firmware) is owned by Cypress Semiconductor Corporation (Cypress) and is protected by and subject to worldwide patent protection (United States and foreign), United States copyright laws and international treaty provisions. Cypress hereby grants to licensee a personal, non-exclusive, non-transferable license to copy, use, modify, create derivative works of, and compile the Cypress Source Code and derivative works for the sole purpose of creating custom software and or firmware in support of licensee product to be used only in conjunction with a Cypress integrated circuit as specified in the applicable agreement. Any reproduction, modification, translation, compilation, or representation of this Source Code except as specified above is prohibited without the express written permission of Cypress.

Disclaimer: CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Cypress reserves the right to make changes without further notice to the materials described herein. Cypress does not assume any liability arising out of the application or use of any product or circuit described herein. Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress' product in a life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Use may be limited by and subject to the applicable Cypress software license agreement.