

## 16-Mbit (1M x 16) Static RAM

### Features

- High speed
  - $t_{AA} = 10 \text{ ns}$
- Low active power
  - 990 mW (max)
- Operating voltages of  $3.3 \pm 0.3\text{V}$
- 2.0V data retention
- Automatic power down when deselected
- TTL compatible inputs and outputs
- Easy memory expansion with  $\overline{CE}_1$  and  $CE_2$  features
- Available in Pb-free and non Pb-free 54-pin TSOP II package and non Pb-free 60-ball fine pitch ball grid array (FBGA) package

### Functional Description

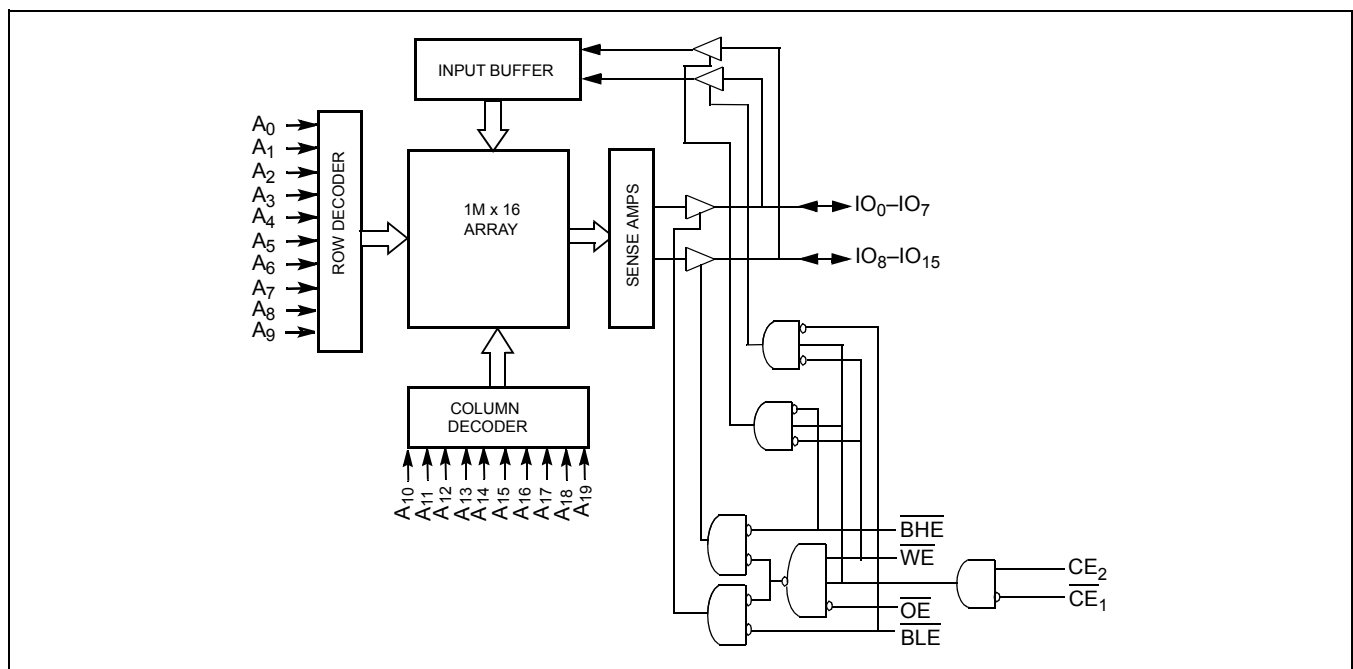
The CY7C1061AV33 is a high performance CMOS Static RAM organized as 1,048,576 words by 16 bits.

To write to the device, enable the chip ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH) while forcing the Write Enable ( $\overline{WE}$ ) input LOW. If Byte Low Enable ( $\overline{BLE}$ ) is LOW, then data from IO pins ( $IO_0$  through  $IO_7$ ), is written into the location specified on the address pins ( $A_0$  through  $A_{19}$ ). If Byte High Enable ( $\overline{BHE}$ ) is LOW, then data from IO pins ( $IO_8$  through  $IO_{15}$ ) is written into the location specified on the address pins ( $A_0$  through  $A_{19}$ ).

To read from the device, enable the chip by taking  $\overline{CE}_1$  LOW and  $CE_2$  HIGH while forcing the Output Enable ( $\overline{OE}$ ) LOW and 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  $IO_0$  to  $IO_7$ . If Byte High Enable ( $\overline{BHE}$ ) is LOW, then data from memory will appear on  $IO_8$  to  $IO_{15}$ . See "Truth Table" on page 7 for a complete description of Read and Write modes.

The input/output pins ( $IO_0$  through  $IO_{15}$ ) are placed in a high-impedance state when the device is deselected ( $\overline{CE}_1$  HIGH/ $CE_2$  LOW), the outputs are disabled ( $\overline{OE}$  HIGH), the  $\overline{BHE}$  and  $\overline{BLE}$  are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or a Write operation is in progress ( $\overline{CE}_1$  LOW,  $CE_2$  HIGH, and  $\overline{WE}$  LOW).

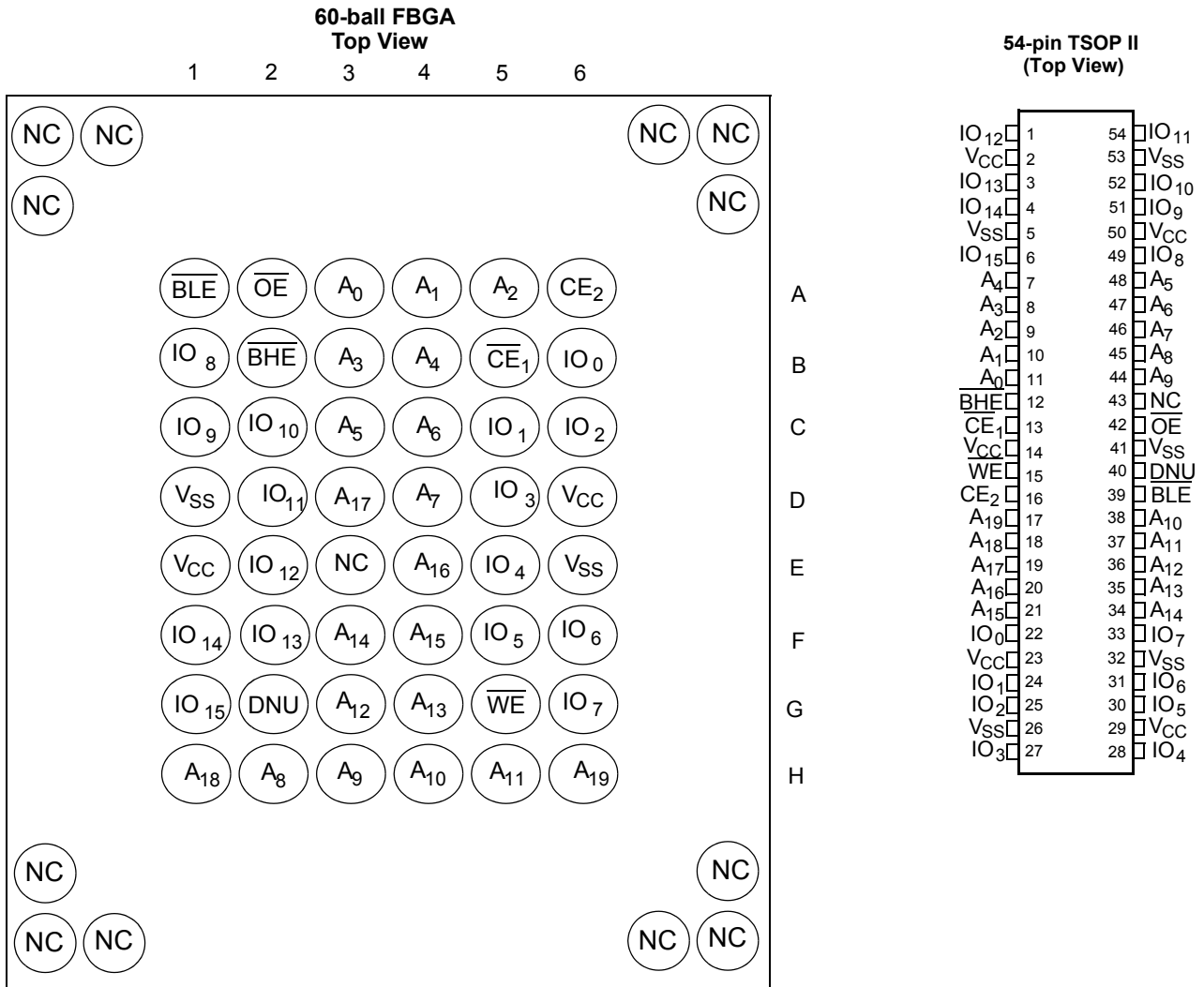
### Logic Block Diagram



**Selection Guide**

		-10	-12	Unit
Maximum Access Time		10	12	ns
Maximum Operating Current	Commercial	275	260	mA
	Industrial	275	260	
Maximum CMOS Standby Current	Commercial/Industrial	50	50	mA

**Pin Configurations** [1, 2]



**Notes**

1. NC pins are not connected on the die.
2. DNU (Do Not Use) pins have to be left floating or tied to VSS to ensure proper operation.

**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<sub>CC</sub> to Relative GND [3] ... -0.5V to +4.6V
- DC Voltage Applied to Outputs in High-Z State [3] ..... -0.5V to V<sub>CC</sub> + 0.5V

- DC Input Voltage [3] ..... -0.5V to V<sub>CC</sub> + 0.5V
- Current into Outputs (LOW) ..... 20 mA

**Operating Range**

Range	Ambient Temperature	V <sub>CC</sub>
Commercial	0°C to +70°C	3.3V ± 0.3V
Industrial	-40°C to +85°C	

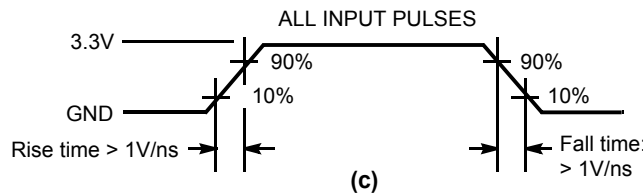
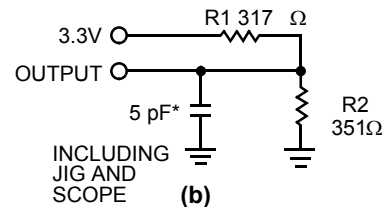
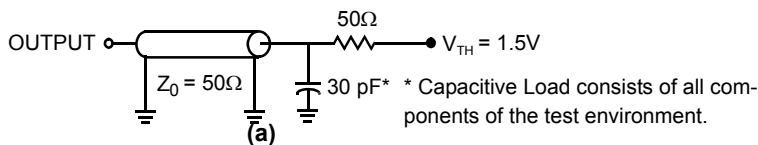
**DC Electrical Characteristics** (Over the Operating Range)

Parameter	Description	Test Conditions	-10		-12		Unit	
			Min	Max	Min	Max		
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -4.0 mA	2.4		2.4		V	
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 8.0 mA		0.4		0.4	V	
V <sub>IH</sub>	Input HIGH Voltage		2.0	V <sub>CC</sub> + 0.3	2.0	V <sub>CC</sub> + 0.3	V	
V <sub>IL</sub>	Input LOW Voltage [3]		-0.3	0.8	-0.3	0.8	V	
I <sub>IX</sub>	Input Leakage Current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-1	+1	-1	+1	µA	
I <sub>OZ</sub>	Output Leakage Current	GND ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , Output Disabled	-1	+1	-1	+1	µA	
I <sub>CC</sub>	V <sub>CC</sub> Operating Supply Current	V <sub>CC</sub> = max, f = f <sub>max</sub> = 1/t <sub>RC</sub>	Commercial		275		260	mA
			Industrial		275		260	mA
I <sub>SB1</sub>	Automatic CE Power-down Current —TTL Inputs	CE <sub>2</sub> ≤ V <sub>IL</sub> , max V <sub>CC</sub> , CE ≥ V <sub>IH</sub> , V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>IL</sub> , f = f <sub>max</sub>		70		70	mA	
I <sub>SB2</sub>	Automatic CE Power-down Current —CMOS Inputs	CE <sub>2</sub> ≤ 0.3V max V <sub>CC</sub> , CE ≥ V <sub>CC</sub> - 0.3V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.3V, or V <sub>IN</sub> ≤ 0.3V, f = 0	Commercial/Industrial	50		50	mA	

**Capacitance** [4]

Parameter	Description	Test Conditions	TSOP II	FBGA	Unit
C <sub>IN</sub>	Input Capacitance	T <sub>A</sub> = 25°C, f = 1 MHz, V <sub>CC</sub> = 3.3V	6	8	pF
C <sub>OUT</sub>	IO Capacitance		8	10	pF

**AC Test Loads and Waveforms** [5]



**Notes**

3. V<sub>IL</sub> (min) = -2.0V for pulse durations of less than 20 ns.
4. Tested initially and after any design or process changes that may affect these parameters.
5. Valid SRAM operation does not occur until the power supplies have reached the minimum operating V<sub>DD</sub> (3.0V). As soon as 1 ms (T<sub>power</sub>) after reaching the minimum operating V<sub>DD</sub>, normal SRAM operation can begin including reduction in V<sub>DD</sub> to the data retention (V<sub>CCDR</sub>, 2.0V) voltage.

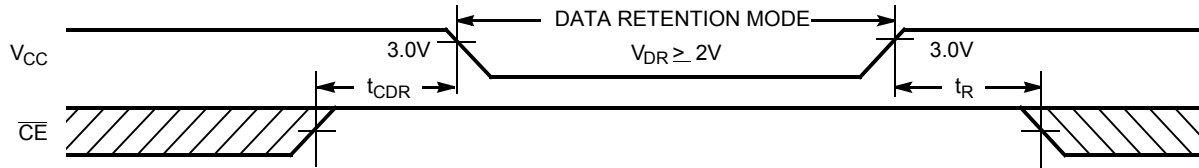
**AC Switching Characteristics** (Over the Operating Range) <sup>[6]</sup>

Parameter	Description	-10		-12		Unit
		Min	Max	Min	Max	
<b>Read Cycle</b>						
$t_{power}$	$V_{CC}$ (typical) to the first access <sup>[7]</sup>	1		1		ms
$t_{RC}$	Read Cycle Time	10		12		ns
$t_{AA}$	Address to Data Valid		10		12	ns
$t_{OHA}$	Data Hold from Address Change	3		3		ns
$t_{ACE}$	$\overline{CE}_1$ LOW/ $CE_2$ HIGH to Data Valid		10		12	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		5		6	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z	1		1		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[8]</sup>		5		6	ns
$t_{LZCE}$	$\overline{CE}_1$ LOW/ $CE_2$ HIGH to Low-Z <sup>[8]</sup>	3		3		ns
$t_{HZCE}$	$\overline{CE}_1$ HIGH/ $CE_2$ LOW to High-Z <sup>[8]</sup>		5		6	ns
$t_{PU}$	$\overline{CE}_1$ LOW/ $CE_2$ HIGH to Power Up <sup>[9]</sup>	0		0		ns
$t_{PD}$	$\overline{CE}_1$ HIGH/ $CE_2$ LOW to Power Down <sup>[9]</sup>		10		12	ns
$t_{DBE}$	Byte Enable to Data Valid		5		6	ns
$t_{LZBE}$	Byte Enable to Low-Z	1		1		ns
$t_{HZBE}$	Byte Disable to High-Z		5		6	ns
<b>Write Cycle</b> <sup>[10, 11]</sup>						
$t_{WC}$	Write Cycle Time	10		12		ns
$t_{SCE}$	$\overline{CE}_1$ LOW/ $CE_2$ HIGH to Write End	7		8		ns
$t_{AW}$	Address Setup to Write End	7		8		ns
$t_{HA}$	Address Hold from Write End	0		0		ns
$t_{SA}$	Address Setup to Write Start	0		0		ns
$t_{PWE}$	$\overline{WE}$ Pulse Width	7		8		ns
$t_{SD}$	Data Setup to Write End	5.5		6		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[8]</sup>	3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[8]</sup>		5		6	ns
$t_{BW}$	Byte Enable to End of Write	7		8		ns

**Notes**

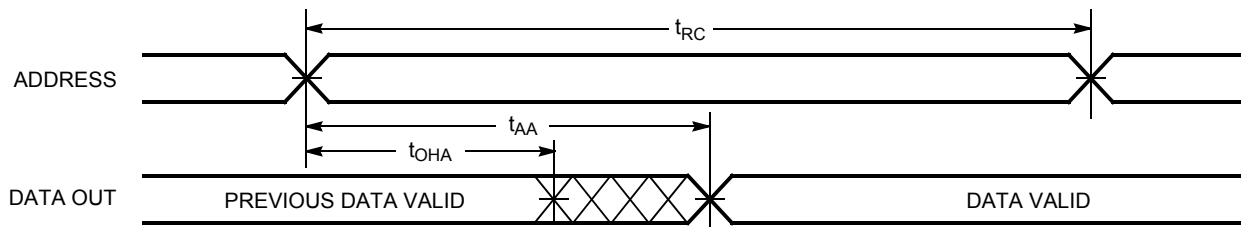
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified  $I_{OL}/I_{OH}$  and specified transmission line loads. Test conditions for the Read cycle use output loading shown in (a) of the "AC Test Loads and Waveforms <sup>[5]</sup>" on page 3, unless specified otherwise.
- This part has a voltage regulator that steps down the voltage from 3V to 2V internally.  $t_{power}$  time must be provided initially before a Read/Write operation is started.
- $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZWE}$ ,  $t_{HZBE}$  and  $t_{LZOE}$ ,  $t_{LZCE}$ ,  $t_{LZWE}$ ,  $t_{LZBE}$  are specified with a load capacitance of 5 pF as in (b) of "AC Test Loads and Waveforms <sup>[5]</sup>" on page 3. Transition is measured  $\pm 200$  mV from steady-state voltage.
- These parameters are guaranteed by design and are not tested.
- The internal Write time of the memory is defined by the overlap of  $\overline{CE}_1$  LOW ( $CE_2$  HIGH) and  $\overline{WE}$  LOW. Chip enables must be active and  $\overline{WE}$  and byte enables must be LOW to initiate a Write, and the transition of any of these signals can terminate the Write. The input data setup 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. 2 ( $\overline{WE}$  controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

**Data Retention Waveform**

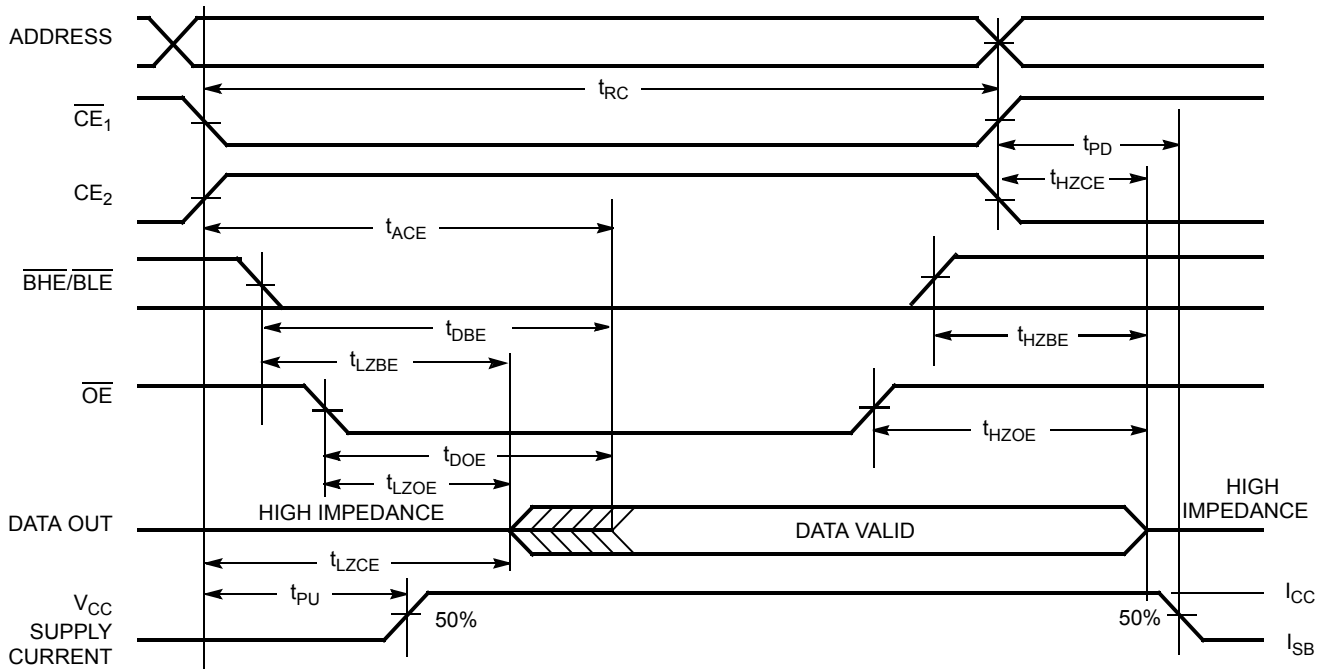


**Switching Waveforms**

**Read Cycle No. 1 (Address Transition Controlled)** [12, 13]



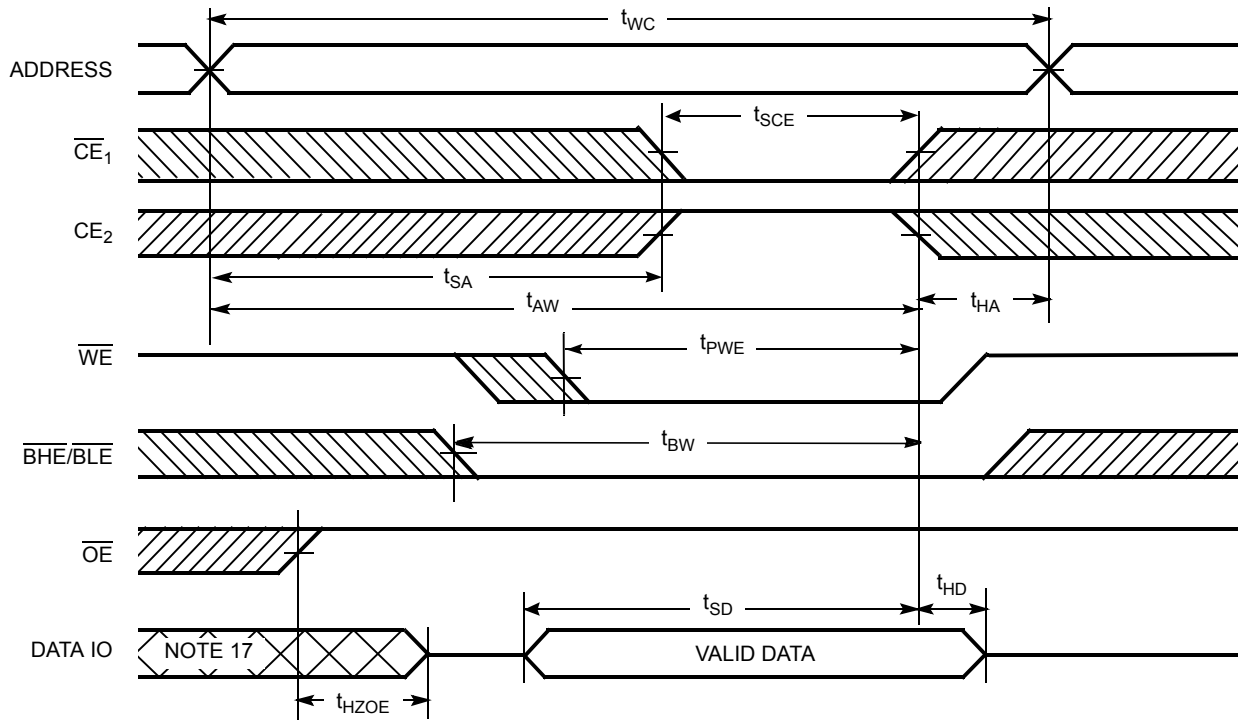
**Read Cycle No. 2 ( $\overline{OE}$  Controlled)** [13, 14]



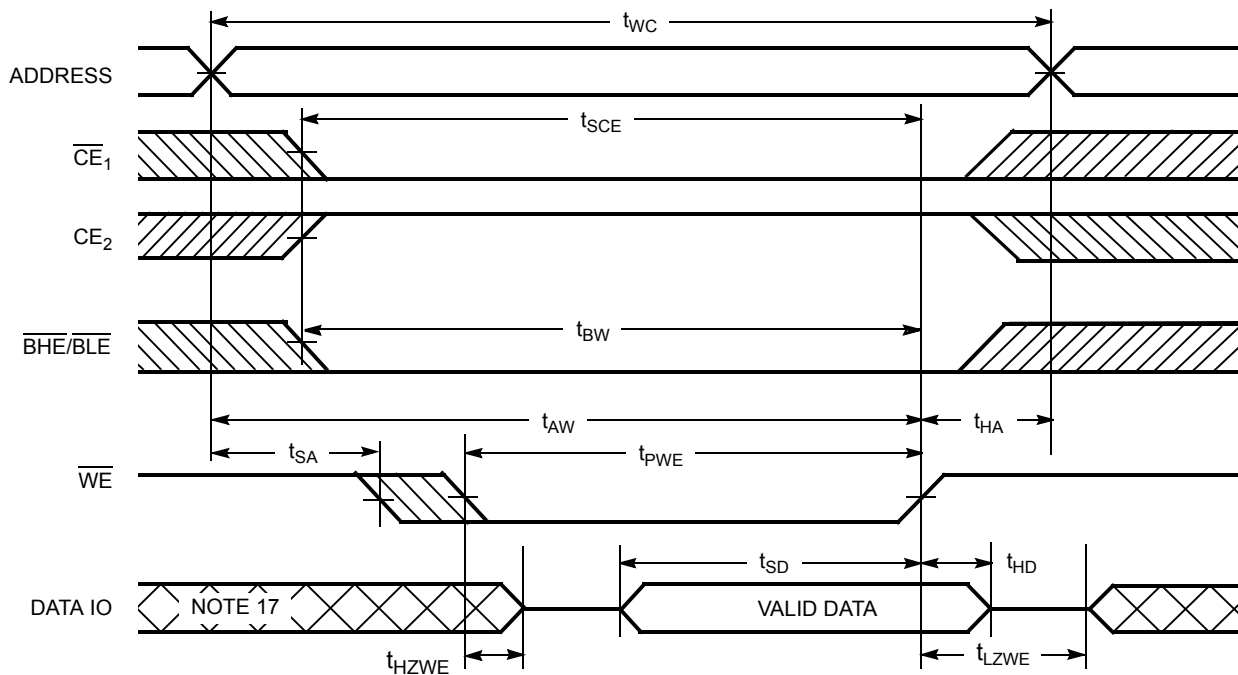
- Notes**
- 12. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$ ,  $\overline{BHE}$  or  $\overline{BHE}$ , or both =  $V_{IL}$ .  $CE2 = V_{IH}$ .
  - 13.  $\overline{WE}$  is HIGH for Read cycle.
  - 14. Address valid prior to or coincident with  $\overline{CE}_1$  transition LOW and  $CE_2$  transition HIGH.

Switching Waveforms (continued)

Write Cycle No. 1 ( $\overline{CE}_1$  or  $CE_2$  Controlled) [15, 16]



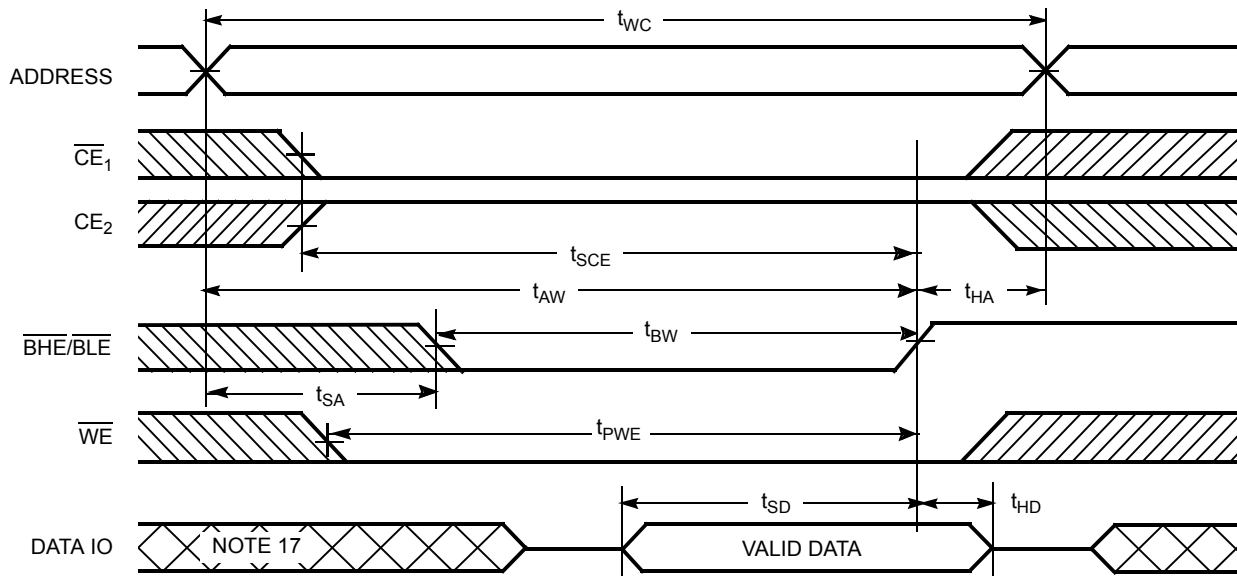
Write Cycle No. 2 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW) [15, 16]



Notes

- 15. Data IO is high impedance if  $\overline{OE}$ , or  $\overline{BHE}$  or  $\overline{BLE}$  or both =  $V_{IH}$ .
- 16. If  $\overline{CE}_1$  goes HIGH simultaneously with  $\overline{WE}$  going HIGH, the output remains in a high impedance state.
- 17. During this period, the IOs are in output state and input signals should not be applied.

**Switching Waveforms** (continued)

**Write Cycle No. 3 ( $\overline{\text{BHE}}/\overline{\text{BLE}}$  Controlled)**

**Truth Table**

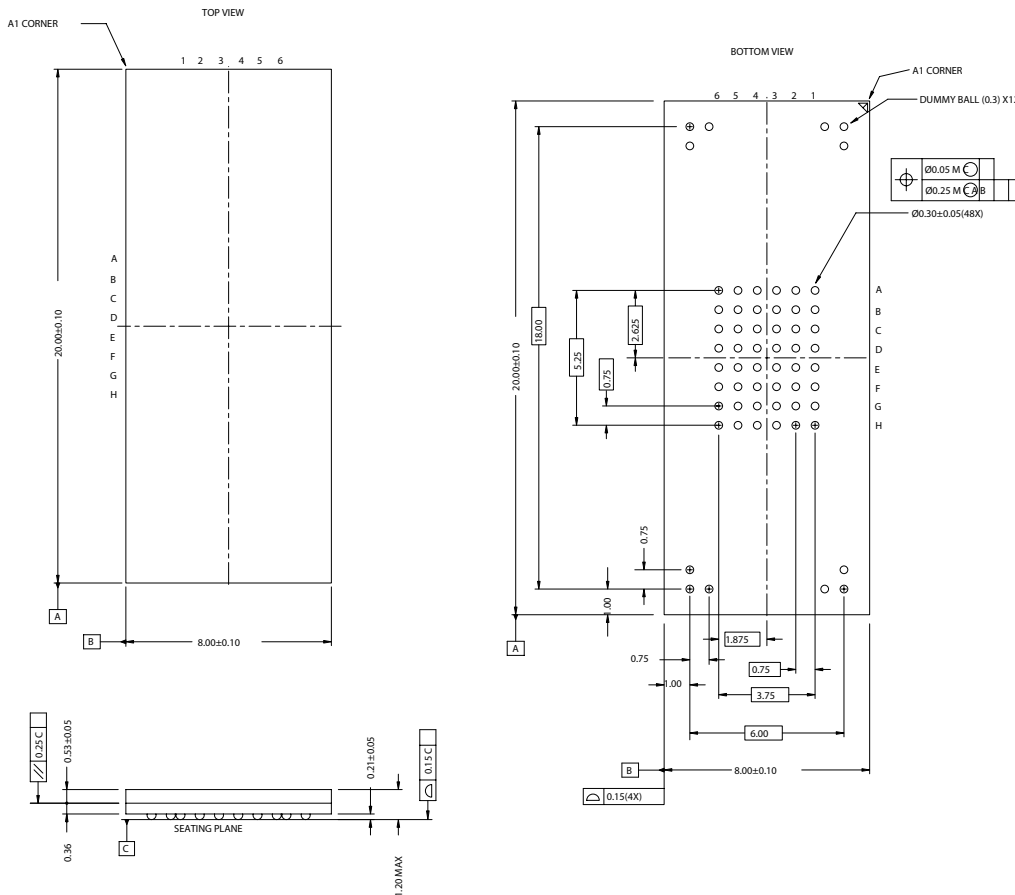
$\overline{\text{CE}}_1$	$\overline{\text{CE}}_2$	$\overline{\text{OE}}$	$\overline{\text{WE}}$	$\overline{\text{BLE}}$	$\overline{\text{BHE}}$	$\text{IO}_0\text{-IO}_7$	$\text{IO}_8\text{-IO}_{15}$	Mode	Power
H	X	X	X	X	X	High-Z	High-Z	Power Down	Standby ( $I_{\text{SB}}$ )
X	L	X	X	X	X	High-Z	High-Z	Power Down	Standby ( $I_{\text{SB}}$ )
L	H	L	H	L	L	Data Out	Data Out	Read All Bits	Active ( $I_{\text{CC}}$ )
L	H	L	H	L	H	Data Out	High-Z	Read Lower Bits Only	Active ( $I_{\text{CC}}$ )
L	H	L	H	H	L	High-Z	Data Out	Read Upper Bits Only	Active ( $I_{\text{CC}}$ )
L	H	X	L	L	L	Data In	Data In	Write All Bits	Active ( $I_{\text{CC}}$ )
L	H	X	L	L	H	Data In	High-Z	Write Lower Bits Only	Active ( $I_{\text{CC}}$ )
L	H	X	L	H	L	High-Z	Data In	Write Upper Bits Only	Active ( $I_{\text{CC}}$ )
L	H	H	H	X	X	High-Z	High-Z	Selected, Outputs Disabled	Active ( $I_{\text{CC}}$ )





Package Diagrams (continued)

Figure 2. 60-ball FBGA (8 x 20 x 1.2 mm), 51-85162



51-85162-\*D

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Document History Page

Document Title: CY7C1061AV33 16-Mbit (1M x 16) Static RAM				
Document Number: 38-05256				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	113725	03/28/02	NSL	New Data Sheet
*A	117058	07/31/02	DFP	Removed 15-ns bin
*B	117989	08/30/02	DFP	Added 8-ns bin Changed I <sub>cc</sub> for 8, 10, 12 bins t <sub>power</sub> changed from 1 μs to 1 ms. Load Cap Comment changed (for Tx line load) t <sub>SD</sub> changed to 5.5 ns for the 10-ns bin Changed some 8-ns bin numbers (t <sub>HZ</sub> , t <sub>DOE</sub> , t <sub>DBE</sub> ) Removed hz<lz comments from data sheet
*C	120383	11/06/02	DFP	Final data sheet Added note 3 to "AC Test Loads and Waveforms" and note 7 to t <sub>pu</sub> and t <sub>pd</sub> Updated Input/Output Caps (for 48BGA only) to 8 pF/10 pF and for the 54-pin TSOP to 6/8 pF
*D	124439	2/25/03	MEG	Changed ISB1 from 100 mA to 70 mA Shaded fBGA production ordering information
*E	492137	See ECN	NXR	Corrected Block Diagram on page #1 Removed 8 ns speed bin Changed 48-Ball FBGA to 60-Ball FBGA in Pin Configuration Included Note #1 and 2 on page #2 Changed the description of I <sub>I<sub>X</sub></sub> from Input Load Current to Input Leakage Current in DC Electrical Characteristics table Updated the Ordering Information Table
*F	508117	See ECN	NXR	Updated FBGA Pin Configuration Updated Ordering Information table
*G	877322	See ECN	VKN	Updated Ordering Information table