

# 512K x 16 Static RAM

## Features

- **High Speed**
  - 55 ns and 70 ns availability
- **Low voltage range:**
  - CY62157CV18: 1.65V–1.95V
- **Ultra-low active power**
  - Typical Active Current: 0.5 mA @  $f = 1$  MHz
  - Typical Active Current: 4 mA @  $f = f_{max}$  (70 ns speed)
- **Low standby power**
- **Easy memory expansion with  $\overline{CE}_1$ ,  $\overline{CE}_2$  and  $\overline{OE}$  features**
- **Automatic power-down when deselected**
- **CMOS for optimum speed/power**

## Functional Description

The CY62157CV18 is a high-performance CMOS static RAM organized as 512K words by 16 bits. This device features advanced circuit design to provide ultra-low active current. This is ideal for providing More Battery Life™ (MoBL™) in portable applications such as cellular telephones. The device also has an automatic power-down feature that significantly reduces power consumption by 99% when addresses are not toggling.

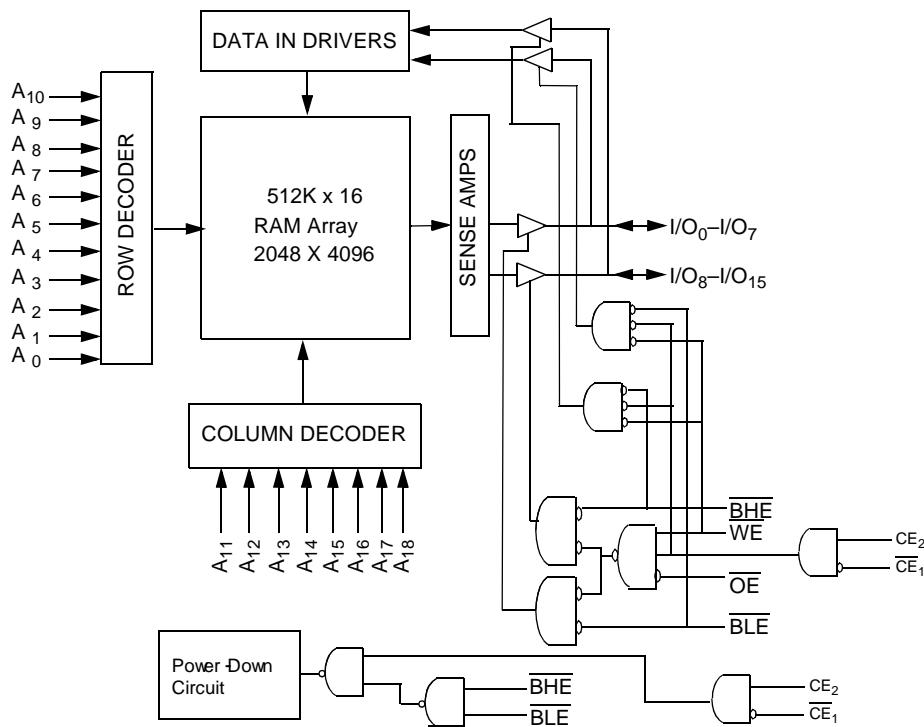
The device can also be put into standby mode when deselected ( $\overline{CE}_1$  HIGH or  $\overline{CE}_2$  LOW or both  $\overline{BHE}$  and  $\overline{BLE}$  are HIGH). The input/output pins ( $I/O_0$  through  $I/O_{15}$ ) are placed in a high-impedance state when: deselected ( $\overline{CE}_1$  HIGH or  $\overline{CE}_2$  LOW), outputs are disabled ( $\overline{OE}$  HIGH), both Byte High Enable and Byte Low Enable are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or during a write operation ( $\overline{CE}_1$  LOW,  $\overline{CE}_2$  HIGH and  $\overline{WE}$  LOW).

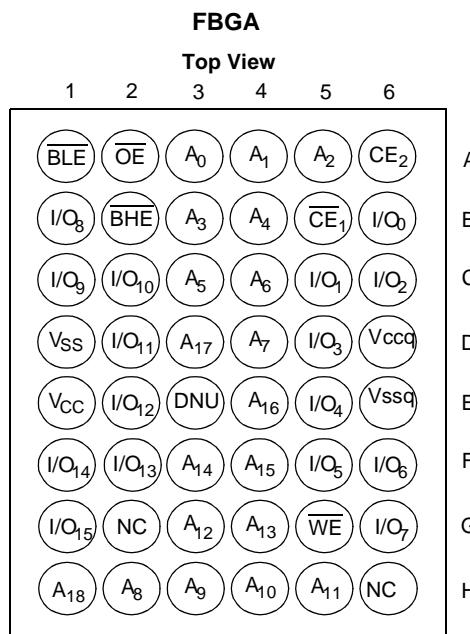
Writing to the device is accomplished by taking Chip Enables ( $\overline{CE}_1$  LOW and  $\overline{CE}_2$  HIGH) and Write Enable ( $\overline{WE}$ ) inputs LOW. If Byte Low Enable ( $\overline{BLE}$ ) is LOW, then data from  $I/O$  pins ( $I/O_0$  through  $I/O_7$ ), is written into the location specified on the address pins ( $A_0$  through  $A_{18}$ ). 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  $A_{18}$ ).

Reading from the device is accomplished by taking Chip Enable ( $\overline{CE}_1$  LOW and  $\overline{CE}_2$  HIGH) 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 datasheet for a complete description of read and write modes.

The CY62157CV18 is available in a 48-ball FBGA package.

## Logic Block Diagram



**Pin Configuration<sup>[1, 2]</sup>**

**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 to Ground Potential ..... -0.2V to +2.4V

DC Voltage Applied to Outputs  
in High Z State<sup>[3]</sup> ..... -0.2V to V<sub>CC</sub> + 0.2V

DC Input Voltage<sup>[3]</sup> ..... -0.2V to V<sub>CC</sub> + 0.2V

Output Current into Outputs (LOW) ..... 20 mA

Static Discharge Voltage ..... >2001V  
(per MIL-STD-883, Method 3015)

Latch-Up Current ..... >200 mA

**Operating Range**

Device	Range	Ambient Temperature	V <sub>CC</sub>
CY62157CV18	Industrial	-40°C to +85°C	1.65V to 1.95V

**Product Portfolio**

Product	V <sub>CC</sub> Range			Speed	Power Dissipation (Industrial)			
					Operating (I <sub>CC</sub> )		Standby (I <sub>SB2</sub> )	
					f = 1 MHz		Typ. <sup>[4]</sup>	Max.
	Min.	Typ. <sup>[4]</sup>	Max.		0.5 mA	3 mA		
CY62157CV18	1.65V	1.8V	1.95V	55 ns	0.5 mA	3 mA	5 mA	15 mA
				70 ns	0.5 mA	3 mA	4 mA	12 mA
							1.5 $\mu$ A	20 $\mu$ A

**Notes:**

1. NC pins are not connected to the die.
2. E3 (DNU) can be left as NC or V<sub>SS</sub> to ensure proper application.
3. V<sub>IIL(min.)</sub> = -2.0V for pulse durations less than 20 ns.
4. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = V<sub>CC(typ.)</sub>, T<sub>A</sub> = 25°C.

**Electrical Characteristics** Over the Operating Range

Parameter	Description	Test Conditions		CY62157CV18-55			CY62157CV18-70			Unit
				Min.	Typ. <sup>[4]</sup>	Max.	Min.	Typ. <sup>[4]</sup>	Max.	
$V_{OH}$	Output HIGH Voltage	$I_{OH} = -0.1$ mA	$V_{CC} = 1.65V$	1.4			1.4			V
$V_{OL}$	Output LOW Voltage	$I_{OL} = 0.1$ mA	$V_{CC} = 1.65V$			0.2			0.2	V
$V_{IH}$	Input HIGH Voltage			1.4		$V_{CC} +0.2V$	1.4		$V_{CC} +0.2V$	V
$V_{IL}$	Input LOW Voltage			-0.2		0.4	-0.2		0.4	V
$I_{IX}$	Input Leakage Current	$GND \leq V_I \leq V_{CC}$		-1		+1	-1		+1	$\mu A$
$I_{OZ}$	Output Leakage Current	$GND \leq V_O \leq V_{CC}$ , Output Disabled		-1		+1	-1		+1	$\mu A$
$I_{CC}$	$V_{CC}$ Operating Supply Current	$f = f_{MAX} = 1/t_{RC}$	$V_{CC} = 1.95V$		5	15		4	12	mA
		$f = 1$ MHz	$I_{OUT} = 0$ mA CMOS levels		0.5	3		0.5	3	mA
$I_{SB1}$	Automatic CE Power-Down Current—CMOS Inputs	$\overline{CE}_1 \geq V_{CC} - 0.2V$ , $CE_2 \leq 0.2V$ $V_{IN} \geq V_{CC} - 0.2V$ , $V_{IN} \leq 0.2V$ $f = f_{MAX}$ (Address and Data Only), $f = 0$ (OE, WE, BHE, and BLE)			1.5	20		1.5	20	$\mu A$
$I_{SB2}$	Automatic CE Power-Down Current—CMOS Inputs	$\overline{CE}_1 \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$ , $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$ , $f = 0$ , $V_{CC} = 1.95V$								

**Capacitance<sup>[5]</sup>**

Parameter	Description	Test Conditions	Max.	Unit
$C_{IN}$	Input Capacitance	$T_A = 25^\circ C$ , $f = 1$ MHz, $V_{CC} = V_{CC(\text{typ})}$	6	pF
$C_{OUT}$	Output Capacitance		8	pF

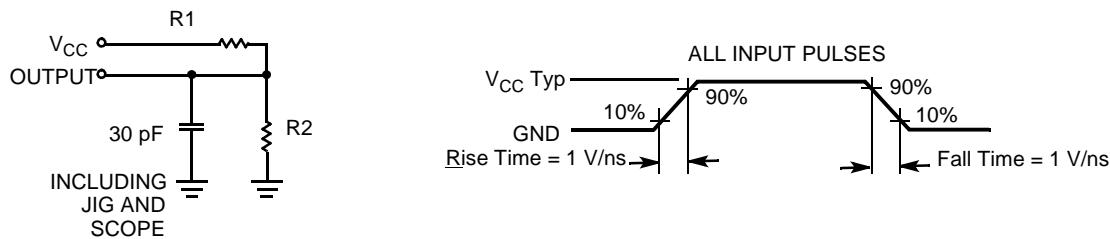
**Thermal Resistance**

Description	Test Conditions	Symbol	BGA	Unit
Thermal Resistance (Junction to Ambient) <sup>[5]</sup>	Still Air, soldered on a 4.25 x 1.125 inch, 4-layer printed circuit board	$\Theta_{JA}$	55	$^\circ C/W$
Thermal Resistance (Junction to Case) <sup>[5]</sup>		$\Theta_{JC}$	16	$^\circ C/W$

**Note:**

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

## AC Test Loads and Waveforms



Equivalent to: THÉVENIN EQUIVALENT

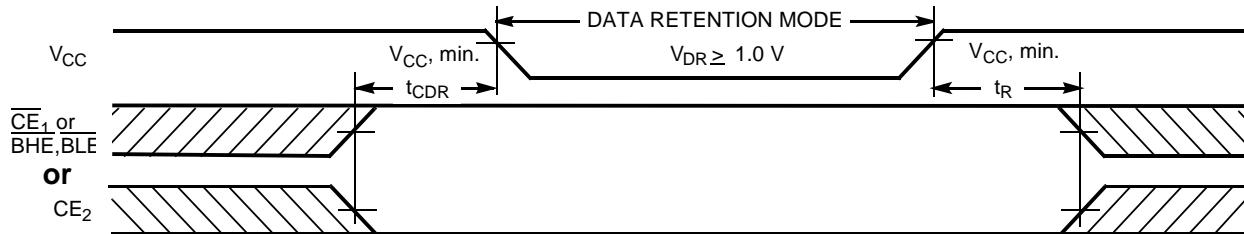


Parameters	1.8V	Unit
R1	13500	Ohms
R2	10800	Ohms
R <sub>TH</sub>	6000	Ohms
V <sub>TH</sub>	0.80	Volts

## Data Retention Characteristics (Over the Operating Range)

Parameter	Description	Conditions	Min.	Typ. <sup>[4]</sup>	Max.	Unit
$V_{DR}$	$V_{CC}$ for Data Retention		1.0		1.95	V
$I_{CCDR}$	Data Retention Current	$V_{CC} = 1.0V$ $CE_1 \geq V_{CC} - 0.2V, CE_2 \leq 0.2V,$ $V_{IN} \geq V_{CC} - 0.2V \text{ or } V_{IN} \leq 0.2V$		1	10	$\mu A$
$t_{CDR}$ <sup>[5]</sup>	Chip Deselect to Data Retention Time		0			ns
$t_R$ <sup>[6]</sup>	Operation Recovery Time			$t_{RC}$		ns

## Data Retention Waveform<sup>[7]</sup>



### Notes:

- Full Device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(\min.)} \geq 100 \mu s$  or stable at  $V_{CC(\min.)} \geq 100 \mu s$ .
- $BHE \cdot BLE$  is the AND of both  $BHE$  and  $BLE$ . Chip can be deselected by either disabling the chip enable signals or by disabling both  $BHE$  and  $BLE$ .

**Switching Characteristics** Over the Operating Range<sup>[8]</sup>

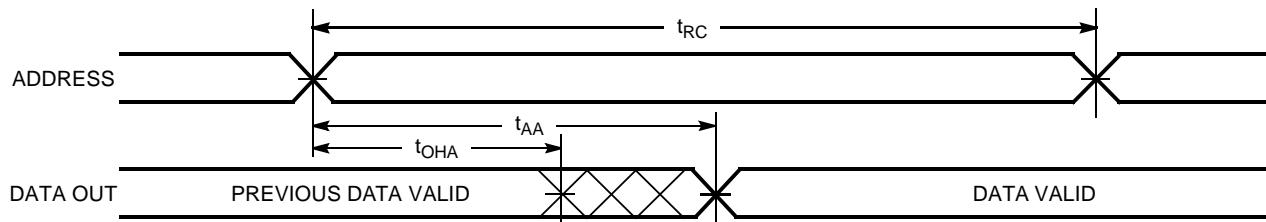
Parameter	Description	55 ns		70 ns		Unit
		Min.	Max.	Min.	Max.	
<b>READ CYCLE</b>						
$t_{RC}$	Read Cycle Time	55		70		ns
$t_{AA}$	Address to Data Valid		55		70	ns
$t_{OHA}$	Data Hold from Address Change	10		10		ns
$t_{ACE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Data Valid		55		70	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		25		35	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low Z <sup>[9]</sup>	5		5		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[9, 10]</sup>		20		25	ns
$t_{LZCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Low Z <sup>[9]</sup>	10		10		ns
$t_{HZCE}$	$\overline{CE}_1$ HIGH and $CE_2$ LOW to High Z <sup>[9, 10]</sup>		20		25	ns
$t_{PU}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Power-Up	0		0		ns
$t_{PD}$	$\overline{CE}_1$ HIGH and $CE_2$ LOW to Power-Down		55		70	ns
$t_{DBE}$	$\overline{BLE}$ / $\overline{BHE}$ LOW to Data Valid		55		70	ns
$t_{LZBE}$	$\overline{BLE}$ / $\overline{BHE}$ LOW to Low Z <sup>[9]</sup>	5		5		ns
$t_{HZBE}$	$\overline{BLE}$ / $\overline{BHE}$ HIGH to HIGH Z <sup>[9, 10]</sup>		20		25	ns
<b>WRITE CYCLE<sup>[11]</sup></b>						
$t_{WC}$	Write Cycle Time	55		70		ns
$t_{SCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Write End	45		60		ns
$t_{AW}$	Address Set-Up to Write End	45		60		ns
$t_{HA}$	Address Hold from Write End	0		0		ns
$t_{SA}$	Address Set-Up to Write Start	0		0		ns
$t_{PWE}$	$\overline{WE}$ Pulse Width	45		50		ns
$t_{BW}$	$\overline{BLE}$ / $\overline{BHE}$ LOW to Write End	45		60		ns
$t_{SD}$	Data Set-Up to Write End	25		30		ns
$t_{HD}$	Data Hold from Write End	0		0		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High Z <sup>[9, 10]</sup>		20		25	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[9]</sup>	5		10		ns

**Notes:**

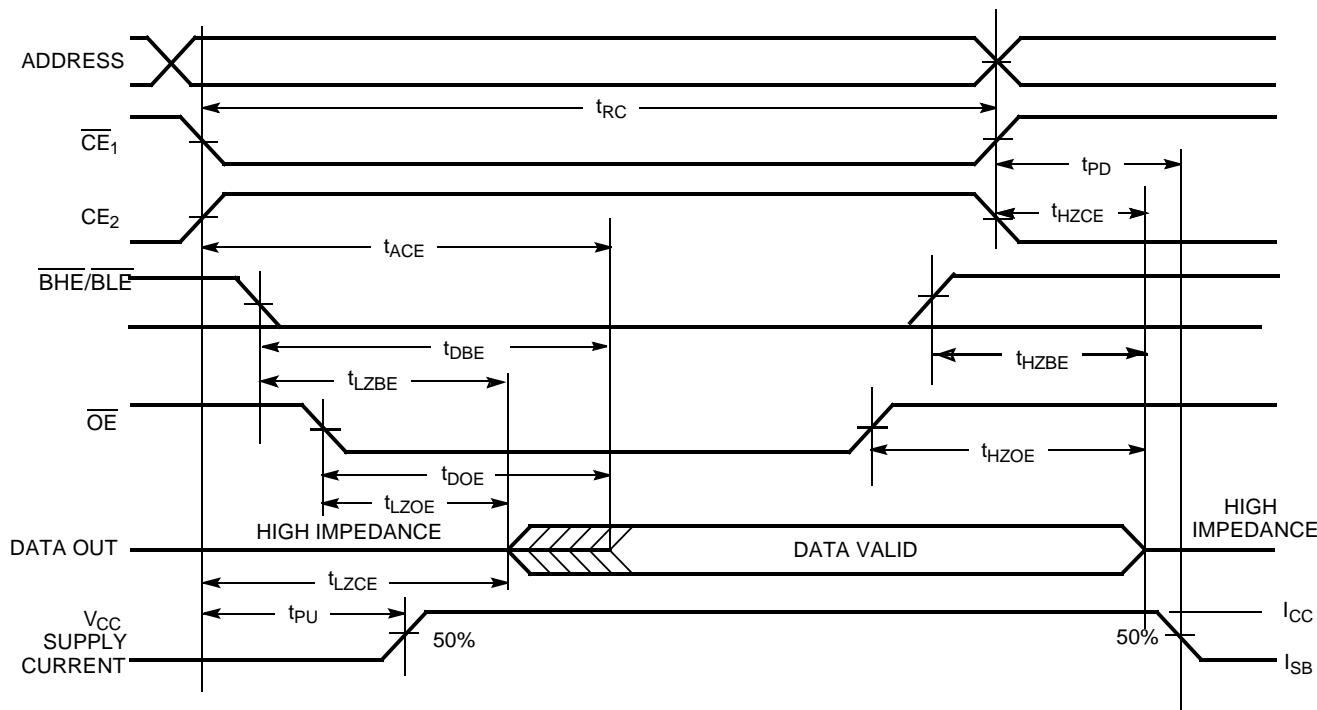
8. Test conditions assume signal transition time of 3 ns or less, timing reference levels of  $V_{CC(\text{typ})}/2$ , input pulse levels of 0 to  $V_{CC(\text{typ})}$ , and output loading of the specified  $I_{OL}/I_{OH}$  and 30-pF load capacitance.
9. At any given temperature and voltage condition,  $t_{HZCE}$  is less than  $t_{LZCE}$ ,  $t_{HZBE}$  is less than  $t_{LZBE}$ ,  $t_{HZOE}$  is less than  $t_{LZOE}$ , and  $t_{HZWE}$  is less than  $t_{LZWE}$  for any given device
10.  $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  transitions are measured when the outputs enter a high impedance state.
11. The internal write time of the memory is defined by the overlap of  $WE$ ,  $CE = V_{IL}$ ,  $BHE$  and/or  $BLE = V_{IL}$ ,  $CE_2 = V_{IH}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input set-up and hold timing should be referenced to the edge of the signal that terminates the write.

## Switching Waveforms

### Read Cycle No. 1 (Address Transition controlled)<sup>[12, 13]</sup>



### Read Cycle No. 2 (OE controlled)<sup>[13, 14]</sup>



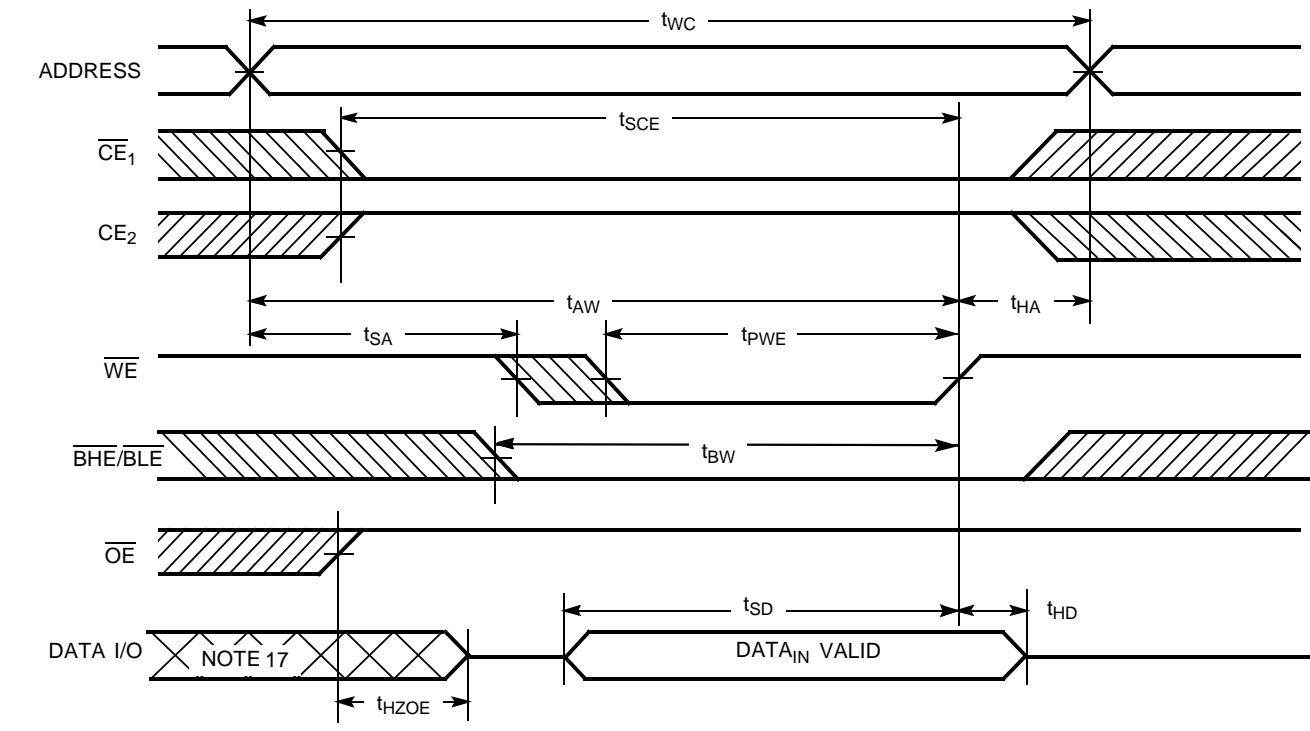
#### Notes:

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

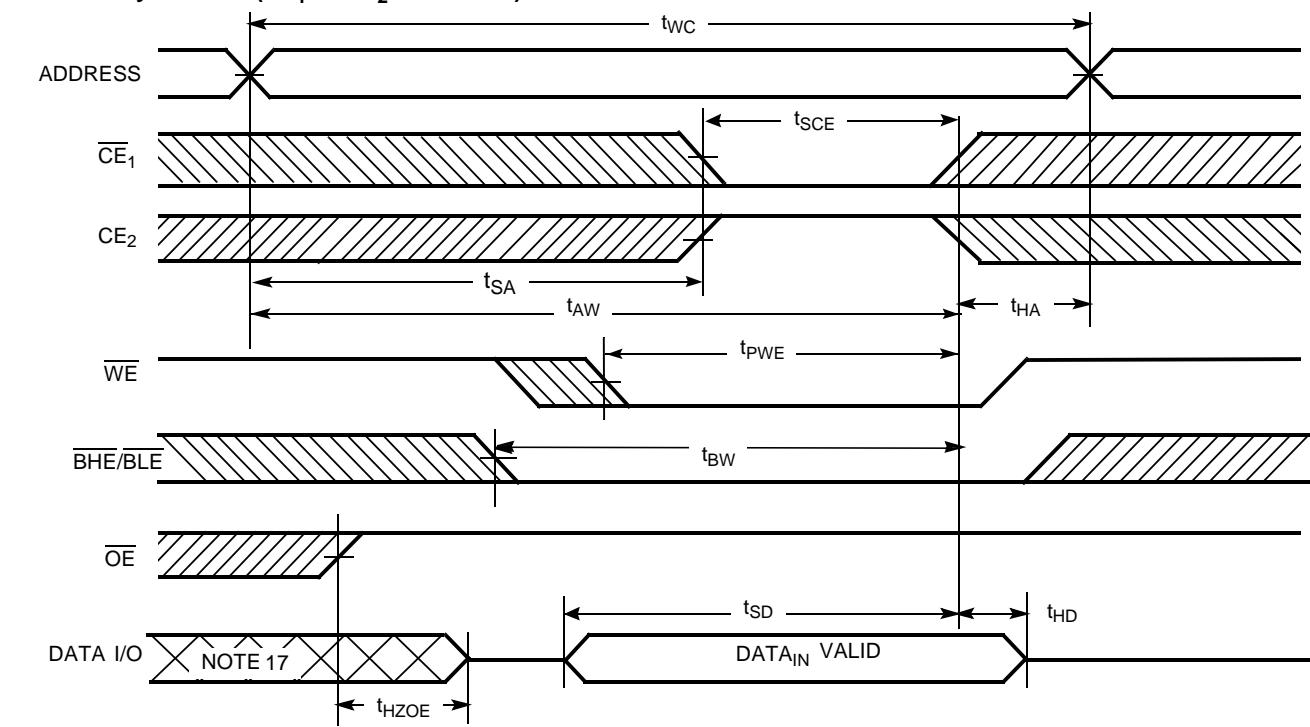


## Switching Waveforms (continued)

## Write Cycle No. 1 (WE Controlled) [11, 15, 16]



## Write Cycle No. 2 (CE1 or CE2 Controlled) [11, 15, 16]

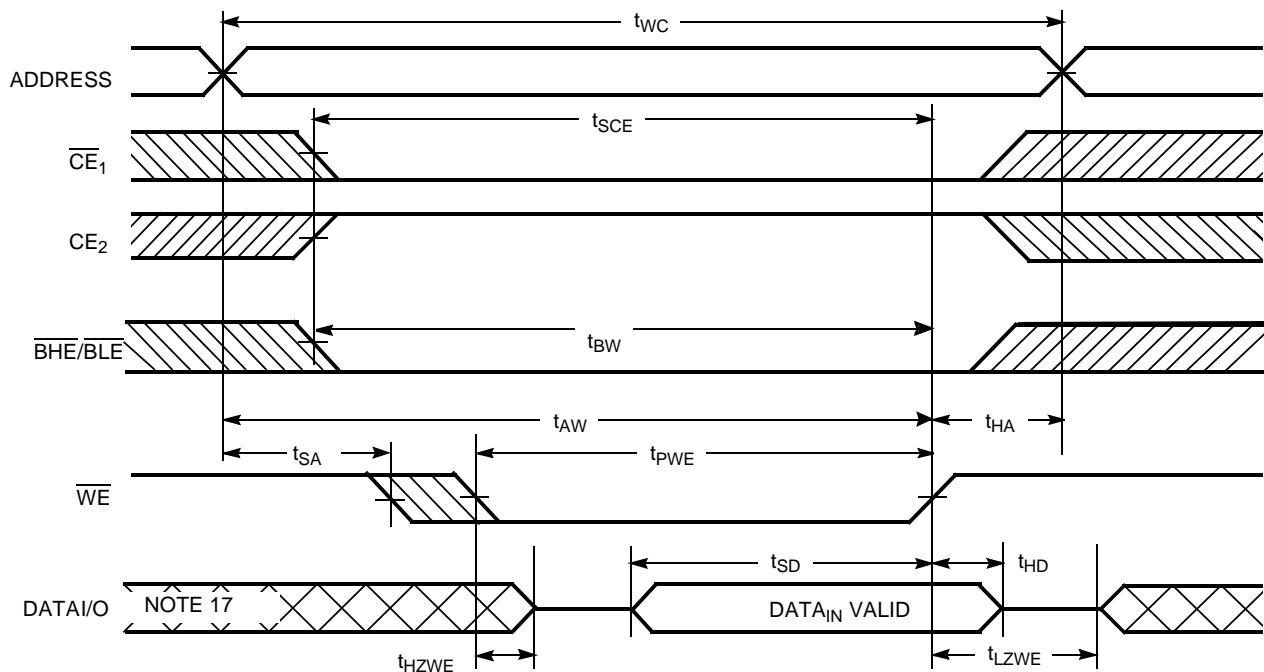


## Notes:

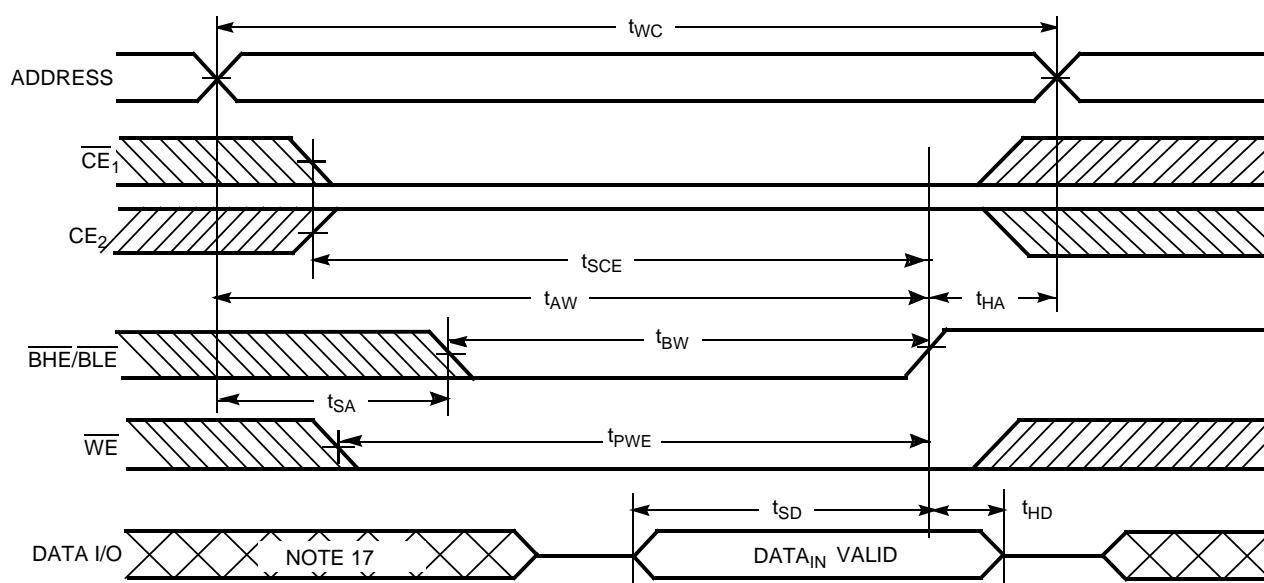
15. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
16. If  $\overline{CE}_1$  goes HIGH and  $\overline{CE}_2$  goes LOW simultaneously with  $\overline{WE} = V_{IH}$ , the output remains in a high-impedance state.
17. During this period, the I/Os are in output state and input signals should not be applied.

## Switching Waveforms (continued)

### Write Cycle No. 3 (WE Controlled, OE LOW)<sup>[16]</sup>

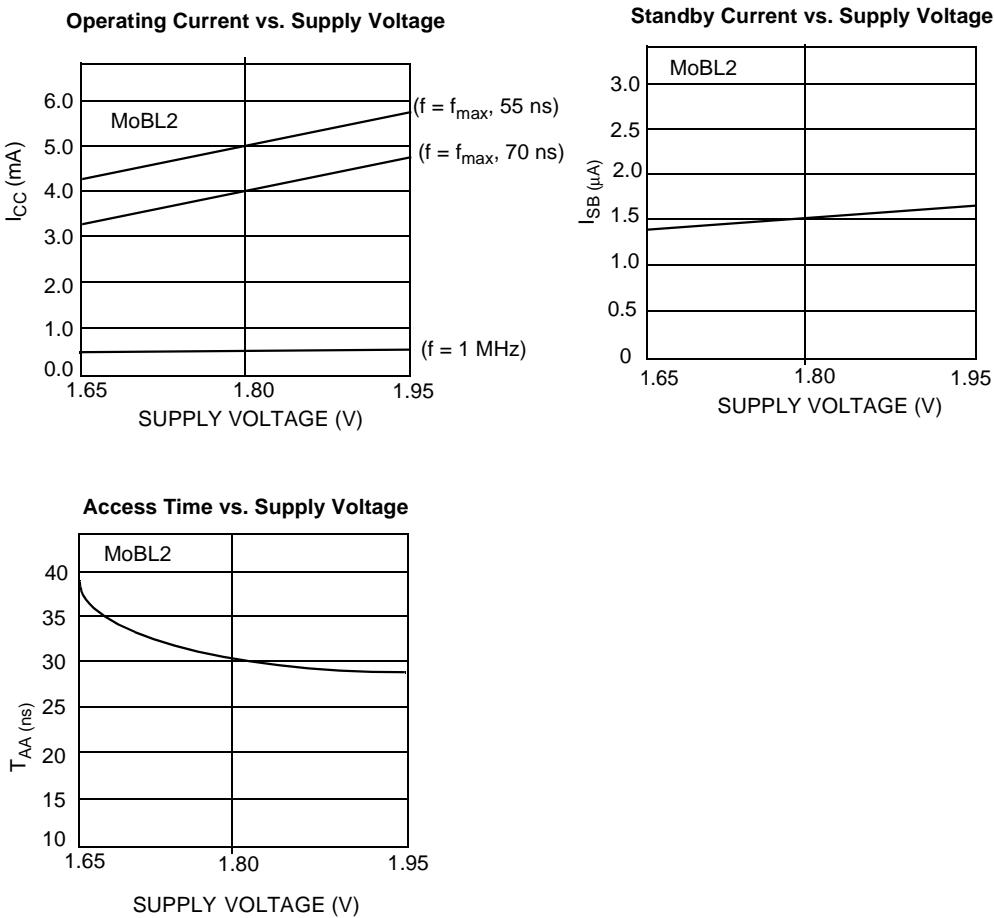


### Write Cycle No. 4 (BHE/BLE Controlled, OE LOW) [16]



## Typical DC and AC Characteristics

(Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at  $V_{CC} = V_{CC(\text{typ.})}$ ,  $T_A = 25^\circ\text{C}$ )

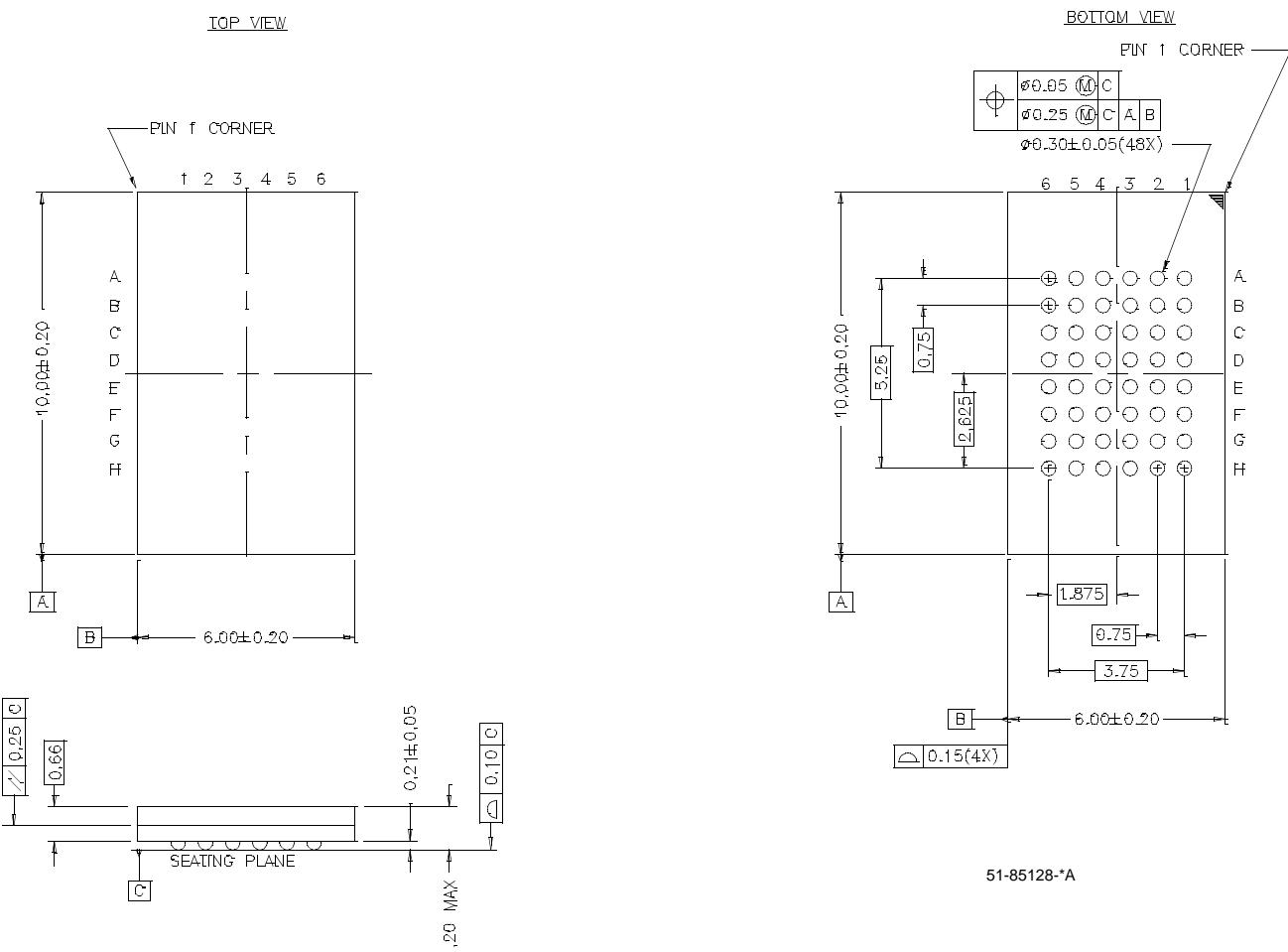


## Truth Table

CE <sub>1</sub>	CE <sub>2</sub>	WE	OE	BHE	BLE	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect/Power-Down	Standby ( $I_{SB}$ )
X	L	X	X	X	X	High Z	Deselect/Power-Down	Standby ( $I_{SB}$ )
X	X	X	X	H	H	High Z	Deselect/Power-Down	Standby ( $I_{SB}$ )
L	H	H	L	L	L	Data Out (I/O0–I/O15)	Read	Active ( $I_{CC}$ )
L	H	H	L	H	L	Data Out (I/O0–I/O7); High Z (I/O8–I/O15)	Read	Active ( $I_{CC}$ )
L	H	H	L	L	H	High Z (I/O0–I/O7); Data Out (I/O8–I/O15)	Read	Active ( $I_{CC}$ )
L	H	H	H	L	H	High Z	Output Disabled	Active ( $I_{CC}$ )
L	H	H	H	H	L	High Z	Output Disabled	Active ( $I_{CC}$ )
L	H	H	H	L	L	High Z	Output Disabled	Active ( $I_{CC}$ )
L	H	L	X	L	L	Data In (I/O0–I/O15)	Write	Active ( $I_{CC}$ )
L	H	L	X	H	L	Data In (I/O0–I/O7); High Z (I/O8–I/O15)	Write	Active ( $I_{CC}$ )
L	H	L	X	L	H	High Z (I/O0–I/O7); Data In (I/O8–I/O15)	Write	Active ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
55	CY62157CV18LL-55BAI	BA48F	48-Ball Fine Pitch BGA	Industrial
70	CY62157CV18LL-70BAI			

**Package Diagram**
**48-Ball (6 mm x 10 mm x 1.2 mm) Fine Pitch BGA BA48F**


Document Title: CY62157CV18 MoBL2™ 512K x 16 Static RAM				
Document Number: 38-05012				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	106158	04/06/01	MGN	New Data Sheet, replaces CY62157BV18.
*A	107242	07/31/01	MGN	Changing from Preliminary to Final.
*B	109231	08/31/01	MGN	Add comment on front page about Active Current at different frequencies.
*C	110574	11/02/01	MGN	Improved $t_{DOE}$ from 35 ns to 25 ns (@55 ns). Added Typical DC & AC Characteristics. Format standardization