

# 8-Mbit (512 K × 16) Static RAM

## Features

- Very high speed: 45 ns
- Wide voltage range: 2.2 V to 3.6 V and 4.5 V to 5.5 V
- Ultra low standby power
  - Typical Standby current: 2 μA
  - Maximum Standby current: 8 μA
- Ultra low active power
  - Typical active current: 1.8 mA at f = 1 MHz
- Easy memory expansion with  $\overline{CE}$  and  $\overline{OE}$  features
- Automatic power down when deselected
- Complementary metal oxide semiconductor (CMOS) for optimum speed and power
- Available in Pb-free 44-pin thin small outline package (TSOP) II package

## Functional Description

The CY62157ESL 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. The device also has an automatic power down feature that significantly reduces power consumption when

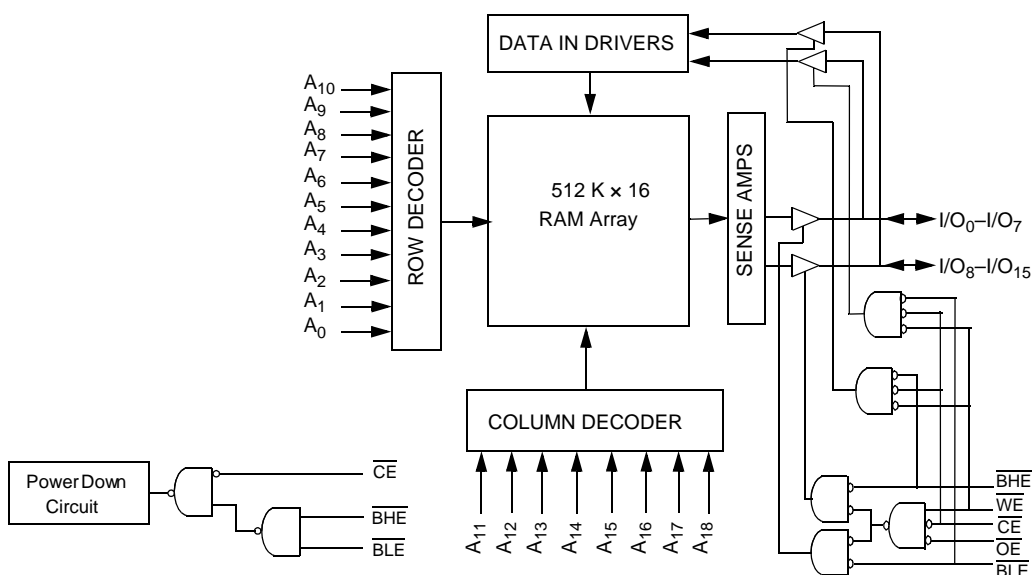
addresses are not toggling. Place the device into standby mode when deselected ( $\overline{CE}$  HIGH or both  $\overline{BHE}$  and  $\overline{BLE}$  are HIGH). The input or output pins ( $I/O_0$  through  $I/O_{15}$ ) are placed in a high impedance state when the device is deselected ( $\overline{CE}$  HIGH), the outputs are disabled ( $\overline{OE}$  HIGH), both the Byte High Enable and the Byte Low Enable are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or during an active write operation ( $\overline{CE}$  LOW and  $\overline{WE}$  LOW).

To write to the device, take 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  $A_{18}$ ). 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  $A_{18}$ ).

To read from the device, take 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 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  $I/O_{15}$ . See the Truth Table on page 11 for a complete description of read and write modes.

The CY62157ESL device is suitable for interfacing with processors that have TTL I/P levels. It is not suitable for processors that require CMOS I/P levels. Please see Electrical Characteristics on page 4 for more details and suggested alternatives.

## Logic Block Diagram

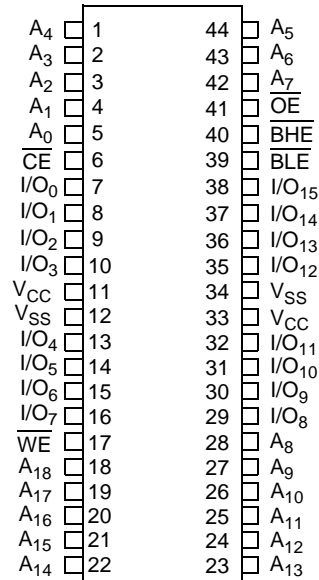


## Contents

<b>Pin Configurations</b> .....	<b>3</b>	<b>Truth Table</b> .....	<b>11</b>
<b>Product Portfolio</b> .....	<b>3</b>	<b>Ordering Information</b> .....	<b>12</b>
<b>Maximum Ratings</b> .....	<b>4</b>	Ordering Code Definitions .....	12
<b>Operating Range</b> .....	<b>4</b>	<b>Package Diagram</b> .....	<b>13</b>
<b>Electrical Characteristics</b> .....	<b>4</b>	<b>Acronyms</b> .....	<b>14</b>
<b>Capacitance</b> .....	<b>5</b>	<b>Document Conventions</b> .....	<b>14</b>
<b>Thermal Resistance</b> .....	<b>5</b>	Units of Measure .....	14
<b>AC Test Loads and Waveforms</b> .....	<b>5</b>	<b>Document History Page</b> .....	<b>15</b>
<b>Data Retention Characteristics</b> .....	<b>6</b>	<b>Sales, Solutions, and Legal Information</b> .....	<b>17</b>
<b>Data Retention Waveform</b> .....	<b>6</b>	Worldwide Sales and Design Support .....	17
<b>Switching Characteristics</b> .....	<b>7</b>	Products .....	17
<b>Switching Waveforms</b> .....	<b>8</b>	PSoC Solutions .....	17

## Pin Configurations

Figure 1. 44-pin TSOP II pinout (Top View)



## Product Portfolio

Product	Range	V <sub>CC</sub> Range (V) <sup>[1]</sup>	Speed (ns)	Power Dissipation					
				Operating I <sub>CC</sub> (mA)				Standby, I <sub>SB2</sub> (μA)	
				f = 1MHz		f = f <sub>max</sub>			
				Typ <sup>[2]</sup>	Max	Typ <sup>[2]</sup>	Max	Typ <sup>[2]</sup>	Max
CY62157ESL	Industrial	2.2 V–3.6 V and 4.5 V–5.5 V	45	1.8	3	18	25	2	8

### Notes

1. Datasheet specifications are not guaranteed for V<sub>CC</sub> in the range of 3.6 V to 4.5 V.
2. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = 3 V, and V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25 °C.

## Maximum Ratings

Exceeding the maximum ratings may impair 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 to Ground Potential .....	-0.5 V to 6.0 V
DC Voltage Applied to Outputs in High Z State <sup>[3, 4]</sup> .....	-0.5 V to 6.0 V
DC Input Voltage <sup>[3, 4]</sup> .....	-0.5 V to 6.0 V

Output Current into Outputs (LOW) .....	20 mA
Static Discharge Voltage (MIL-STD-883, Method 3015) .....	>2001 V
Latch up Current .....	>200 mA

## Operating Range

Device	Range	Ambient Temperature	V <sub>CC</sub> <sup>[5]</sup>
CY62157ESL	Industrial	-40 °C to +85 °C	2.2 V–3.6 V, and 4.5 V–5.5 V

## Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	45 ns			Unit	
			Min	Typ <sup>[6]</sup>	Max		
V <sub>OH</sub>	Output high voltage	2.2 ≤ V <sub>CC</sub> ≤ 2.7	I <sub>OH</sub> = -0.1 mA	2.0	-	-	V
		2.7 ≤ V <sub>CC</sub> ≤ 3.6	I <sub>OH</sub> = -1.0 mA	2.4	-	-	
		4.5 ≤ V <sub>CC</sub> ≤ 5.5	I <sub>OH</sub> = -1.0 mA	2.4	-	-	
		4.5 ≤ V <sub>CC</sub> ≤ 5.5	I <sub>OH</sub> = -0.1 mA	-	-	3.4 <sup>[7]</sup>	
V <sub>OL</sub>	Output low voltage	2.2 ≤ V <sub>CC</sub> ≤ 2.7	I <sub>OL</sub> = 0.1 mA	-	-	0.4	V
		2.7 ≤ V <sub>CC</sub> ≤ 3.6	I <sub>OL</sub> = 2.1 mA	-	-	0.4	
		4.5 ≤ V <sub>CC</sub> ≤ 5.5	I <sub>OL</sub> = 2.1 mA	-	-	0.4	
V <sub>IH</sub>	Input high voltage	2.2 ≤ V <sub>CC</sub> ≤ 2.7		1.8	-	V <sub>CC</sub> + 0.3	V
		2.7 ≤ V <sub>CC</sub> ≤ 3.6		2.2	-	V <sub>CC</sub> + 0.3	
		4.5 ≤ V <sub>CC</sub> ≤ 5.5		2.2	-	V <sub>CC</sub> + 0.5	
V <sub>IL</sub>	Input low voltage	2.2 ≤ V <sub>CC</sub> ≤ 2.7		-0.3	-	0.6	V
		2.7 ≤ V <sub>CC</sub> ≤ 3.6		-0.3	-	0.8	
		4.5 ≤ V <sub>CC</sub> ≤ 5.5		-0.5	-	0.8	
I <sub>IX</sub>	Input leakage current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>		-1	-	+1	μA
I <sub>OZ</sub>	Output leakage current	GND ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , Output Disabled		-1	-	+1	μA
I <sub>CC</sub>	V <sub>CC</sub> operating supply current	f = f <sub>max</sub> = 1/t <sub>RC</sub>	V <sub>CC</sub> = V <sub>CCmax</sub>	-	18	25	mA
		f = 1 MHz	I <sub>OUT</sub> = 0 mA, CMOS levels	-	1.8	3	
I <sub>SB1</sub> <sup>[8]</sup>	Automatic CE power down current – CMOS inputs	$\overline{CE} \geq V_{CC} - 0.2 \text{ V}$ , $V_{IN} \geq V_{CC} - 0.2 \text{ V}$ or $V_{IN} \leq 0.2 \text{ V}$ , $f = f_{max}$ (address and data only), $f = 0$ ( $\overline{OE}$ , $\overline{BHE}$ , $\overline{BLE}$ and $\overline{WE}$ ), $V_{CC} = V_{CC(max)}$		-	2	8	μA
I <sub>SB2</sub> <sup>[8]</sup>	Automatic CE power down current – CMOS inputs	$\overline{CE} \geq V_{CC} - 0.2 \text{ V}$ , $V_{IN} \geq V_{CC} - 0.2 \text{ V}$ or $V_{IN} \leq 0.2 \text{ V}$ , $f = 0$ , $V_{CC} = V_{CC(max)}$		-	2	8	μA

### Notes

- V<sub>IL</sub> (min) = -2.0 V for pulse durations less than 20 ns.
- V<sub>IH</sub> (max) = V<sub>CC</sub> + 0.75 V for pulse durations less than 20 ns.
- Full device AC operation assumes a 100 μs ramp time from 0 to V<sub>CC</sub> (min) and 200 μs wait time after V<sub>CC</sub> stabilization.
- Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = 3 V, and V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25 °C.
- Please note that the maximum V<sub>OH</sub> limit does not exceed minimum CMOS V<sub>IH</sub> of 3.5 V. If you are interfacing this SRAM with 5 V legacy processors that require a minimum V<sub>IH</sub> of 3.5 V, please refer to Application Note AN6081 for technical details and options you may consider.
- Chip enable (CE) needs to be tied to CMOS levels to meet the I<sub>SB1</sub>/I<sub>SB2</sub> / I<sub>CCDR</sub> spec. Other inputs can be left floating.

### Capacitance

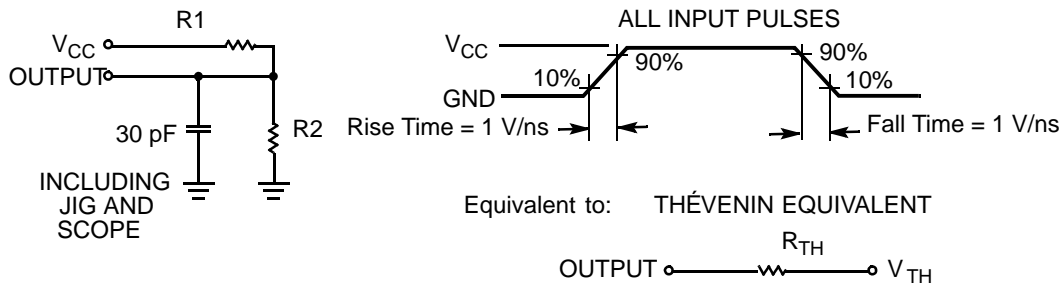
Parameter <sup>[9]</sup>	Description	Test Conditions	Max	Unit
C <sub>IN</sub>	Input capacitance	T <sub>A</sub> = 25 °C, f = 1 MHz, V <sub>CC</sub> = V <sub>CC(typ)</sub>	10	pF
C <sub>OUT</sub>	Output capacitance		10	pF

### Thermal Resistance

Parameter <sup>[9]</sup>	Description	Test Conditions	TSOP II	Unit
Θ <sub>JA</sub>	Thermal resistance (junction to ambient)	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	77	°C/W
Θ <sub>JC</sub>	Thermal resistance (junction to case)		13	°C/W

### AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms



Parameters	2.5 V	3.0 V	5.0 V	Unit
R1	16667	1103	1800	Ω
R2	15385	1554	990	Ω
R <sub>TH</sub>	8000	645	639	Ω
V <sub>TH</sub>	1.20	1.75	1.77	V

**Note**

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

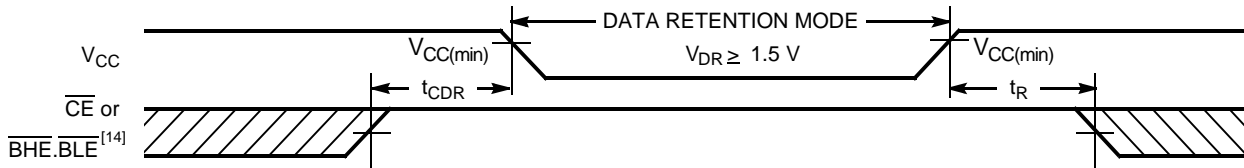
### Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ <sup>[10]</sup>	Max	Unit
V <sub>DR</sub>	V <sub>CC</sub> for data retention		1.5	–	–	V
I <sub>CCDR</sub> <sup>[10]</sup>	Data retention current	$\overline{CE} \geq V_{CC} - 0.2 \text{ V}$ , $V_{IN} \geq V_{CC} - 0.2 \text{ V}$ or $V_{IN} \leq 0.2 \text{ V}$				μA
		V <sub>CC</sub> = 1.5 V	–	2	5	
		V <sub>CC</sub> = 2.0 V	–	2	8	
t <sub>CDR</sub> <sup>[12]</sup>	Chip deselect to data retention time		0	–	–	ns
t <sub>R</sub> <sup>[13]</sup>	Operation recovery time		45	–	–	ns

### Data Retention Waveform

Figure 3. Data Retention Waveform



**Notes**

- 10. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V<sub>CC</sub> = 3 V, and V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25 °C.
- 11. Chip enable (CE) needs to be tied to CMOS levels to meet the I<sub>SB1</sub>/I<sub>SB2</sub> / I<sub>CCDR</sub> spec. Other inputs can be left floating.
- 12. Tested initially and after any design or process changes that may affect these parameters.
- 13. Full device operation requires linear V<sub>CC</sub> ramp from V<sub>DR</sub> to V<sub>CC(min)</sub> ≥ 100 μs or stable at V<sub>CC(min)</sub> ≥ 100 μs.
- 14. BHE.BLE is the AND of both BHE and BLE. Deselect the chip by either disabling chip enable signals or by disabling both BHE and BLE.

## Switching Characteristics

Over the Operating Range

Parameter <sup>[15]</sup>	Description	45 ns		Unit
		Min	Max	
<b>Read Cycle</b>				
t <sub>RC</sub>	Read cycle time	45	–	ns
t <sub>AA</sub>	Address to data valid	–	45	ns
t <sub>OHA</sub>	Data hold from address change	10	–	ns
t <sub>ACE</sub>	$\overline{CE}$ LOW to data valid	–	45	ns
t <sub>DOE</sub>	$\overline{OE}$ LOW to data valid	–	22	ns
t <sub>LZOE</sub>	$\overline{OE}$ LOW to Low Z <sup>[16]</sup>	5	–	ns
t <sub>HZOE</sub>	$\overline{OE}$ HIGH to High Z <sup>[16, 17]</sup>	–	18	ns
t <sub>LZCE</sub>	$\overline{CE}$ LOW to Low Z <sup>[16]</sup>	10	–	ns
t <sub>HZCE</sub>	$\overline{CE}$ HIGH to High Z <sup>[16, 17]</sup>	–	18	ns
t <sub>PU</sub>	$\overline{CE}$ LOW to power up	0	–	ns
t <sub>PD</sub>	$\overline{CE}$ HIGH to power down	–	45	ns
t <sub>DBE</sub>	$\overline{BLE}/\overline{BHE}$ LOW to data valid	–	45	ns
t <sub>LZBE</sub>	$\overline{BLE}/\overline{BHE}$ LOW to Low Z <sup>[16, 18]</sup>	5	–	ns
t <sub>HZBE</sub>	$\overline{BLE}/\overline{BHE}$ HIGH to High Z <sup>[16, 17]</sup>	–	18	ns
<b>Write Cycle <sup>[19]</sup></b>				
t <sub>WC</sub>	Write cycle time	45	–	ns
t <sub>SCE</sub>	$\overline{CE}$ LOW to write end	35	–	ns
t <sub>AW</sub>	Address setup to write end	35	–	ns
t <sub>HA</sub>	Address hold from write end	0	–	ns
t <sub>SA</sub>	Address setup to write start	0	–	ns
t <sub>PWE</sub>	$\overline{WE}$ pulse width	35	–	ns
t <sub>BW</sub>	$\overline{BLE}/\overline{BHE}$ LOW to write end	35	–	ns
t <sub>SD</sub>	Data setup to write end	25	–	ns
t <sub>HD</sub>	Data hold from write end	0	–	ns
t <sub>HZWE</sub>	$\overline{WE}$ LOW to High Z <sup>[16, 17]</sup>	–	18	ns
t <sub>LZWE</sub>	$\overline{WE}$ HIGH to Low Z <sup>[16]</sup>	10	–	ns

### Notes

15. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3 V, and output loading of the specified IOL/IOH as shown in the Figure 2 on page 5.
16. At any temperature and voltage condition, t<sub>HZCE</sub> is less than t<sub>LZCE</sub>, t<sub>HZBE</sub> is less than t<sub>LZBE</sub>, t<sub>HZOE</sub> is less than t<sub>LZOE</sub>, and t<sub>HZWE</sub> is less than t<sub>LZWE</sub> for any device.
17. t<sub>HZOE</sub>, t<sub>HZCE</sub>, t<sub>HZBE</sub>, and t<sub>HZWE</sub> transitions are measured when the outputs enter a high-impedance state.
18. If both byte enables are toggled together, this value is 10 ns.
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.

### Switching Waveforms

Figure 4. Read Cycle No.1: Address Transition Controlled. [20, 21]

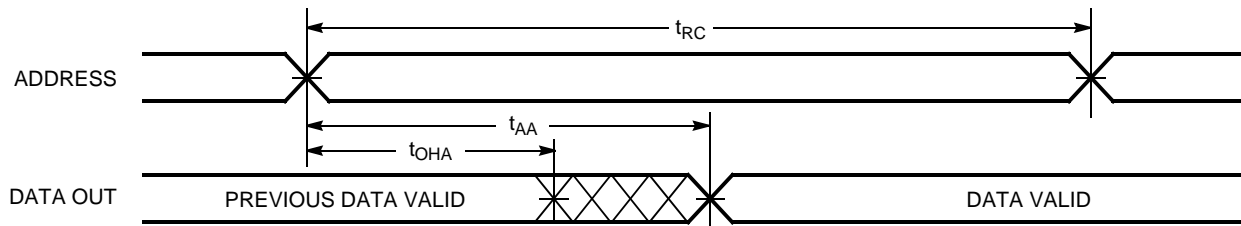
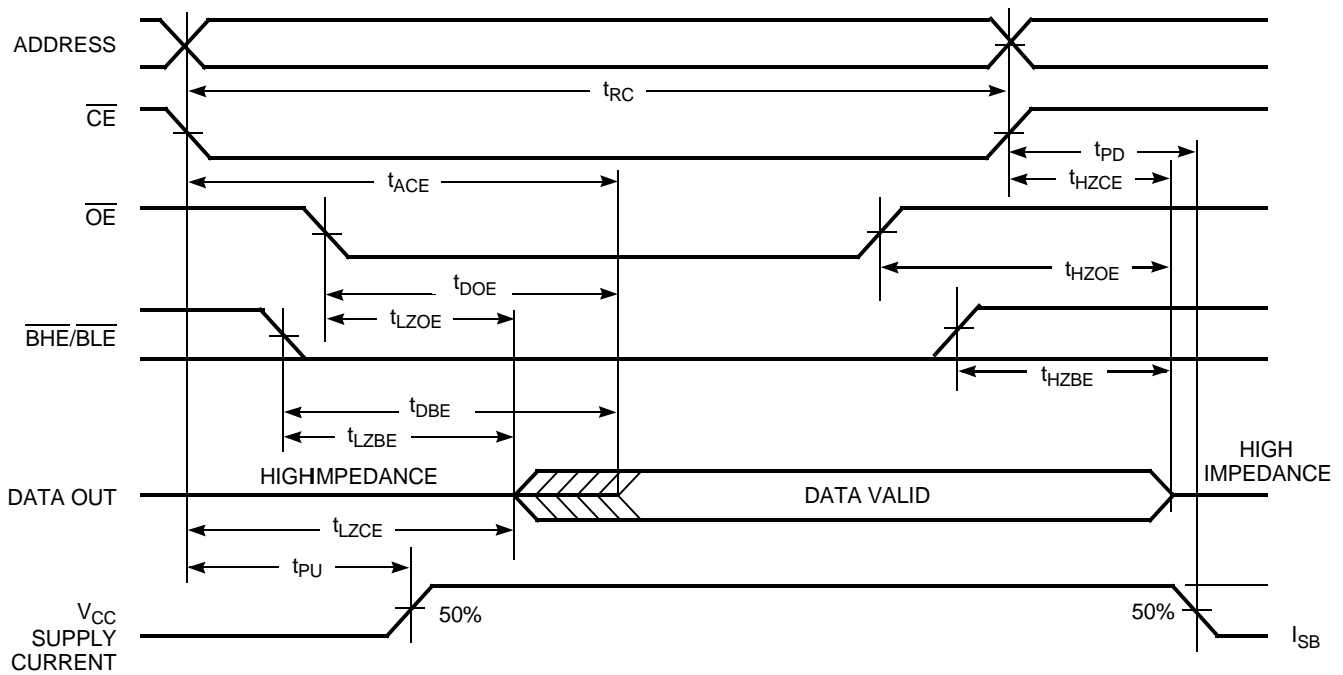


Figure 5. Read Cycle No. 2:  $\overline{OE}$  Controlled [21, 22]



**Notes**

- 20. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$  =  $V_{IL}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$ , or both =  $V_{IL}$ .
- 21.  $\overline{WE}$  is HIGH for read cycle.
- 22. Address valid before or similar to  $\overline{CE}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$  transition LOW.



Switching Waveforms (continued)

Figure 6. Write Cycle No 1:  $\overline{WE}$  Controlled [23, 24]

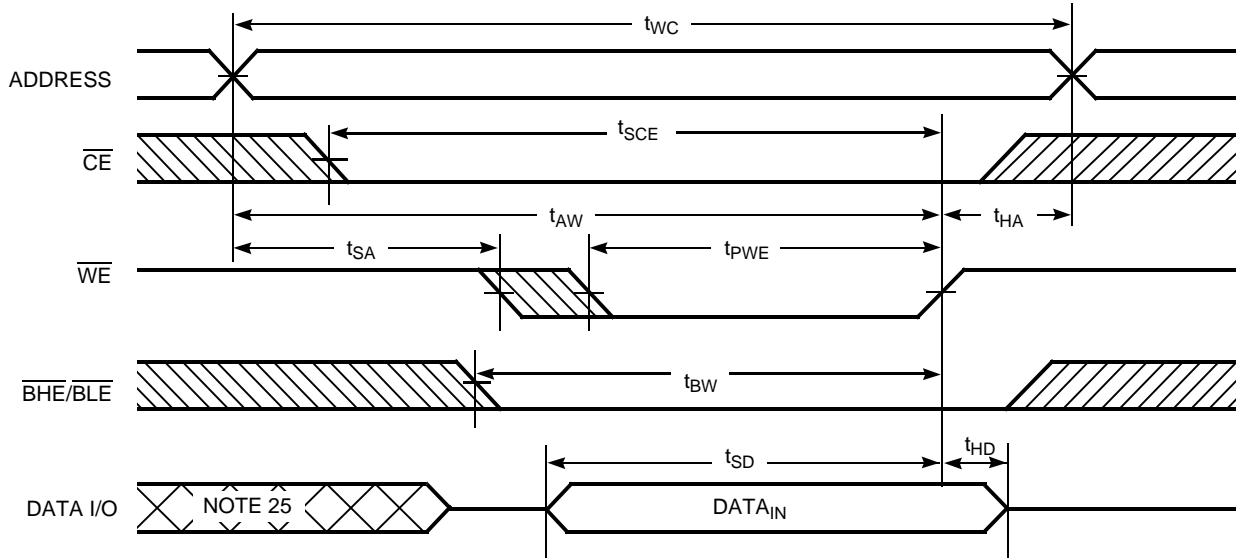
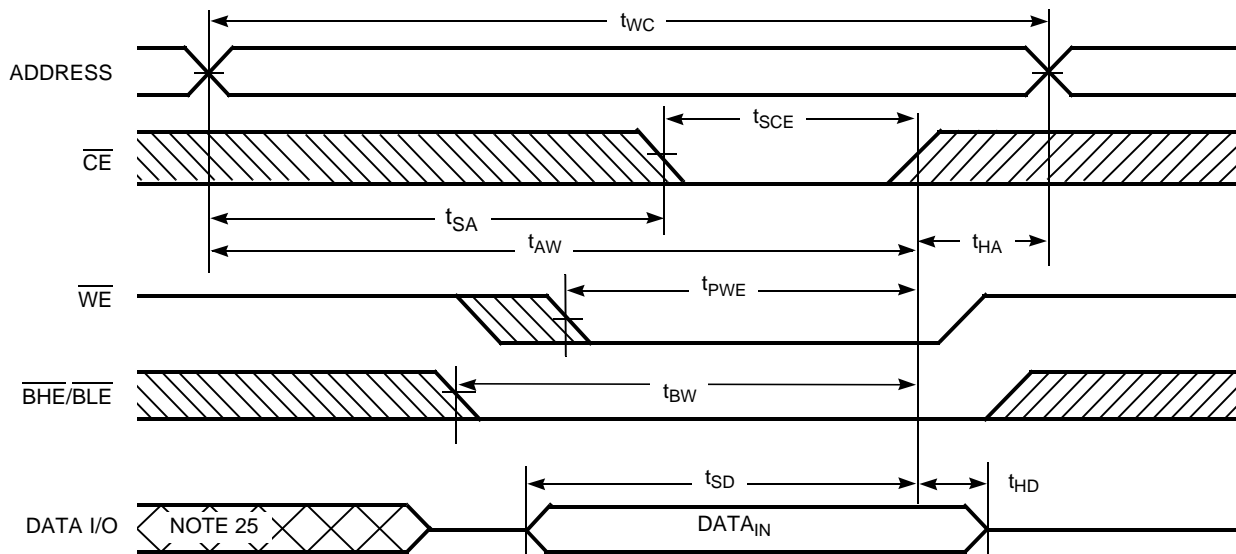


Figure 7. Write Cycle 2:  $\overline{CE}$  Controlled [23, 24]

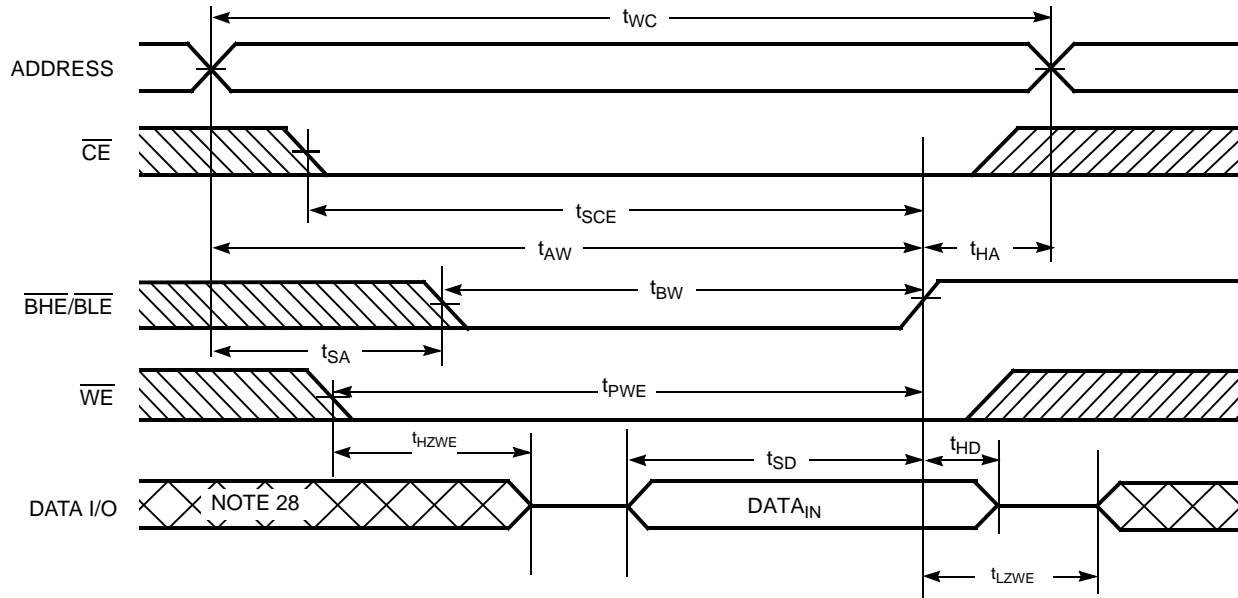


Notes

- 23. 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.
- 24. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE} = V_{IH}$ , the output remains in a high impedance state.
- 25. During this period, the I/Os are in output state. Do not apply input signals.

Switching Waveforms (continued)

Figure 8. Write Cycle 3:  $\overline{\text{BHE}}/\overline{\text{BLE}}$  Controlled [26, 27]



Notes

- 26. The internal write time of the memory is defined by the overlap of  $\overline{\text{WE}}$ ,  $\overline{\text{CE}} = V_{\text{IL}}$ ,  $\overline{\text{BHE}}$ ,  $\overline{\text{BLE}}$  or both =  $V_{\text{IL}}$ . 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.
- 27. If  $\overline{\text{CE}}$  goes HIGH simultaneously with  $\overline{\text{WE}} = V_{\text{IH}}$ , the output remains in a high impedance state.
- 28. During this period, the I/Os are in output state. Do not apply input signals.

**Truth Table**

CE	WE	OE	BHE	BLE	Inputs/Outputs	Mode	Power
H	X	X	X	X	High Z	Deselect/power down	Standby (I <sub>SB</sub> )
X <sup>[29]</sup>	X	X	H	H	High Z	Deselect/power down	Standby (I <sub>SB</sub> )
L	H	L	L	L	Data Out (I/O <sub>0</sub> –I/O <sub>15</sub> )	Read	Active (I <sub>CC</sub> )
L	H	L	H	L	Data Out (I/O <sub>0</sub> –I/O <sub>7</sub> ); I/O <sub>8</sub> –I/O <sub>15</sub> in High Z	Read	Active (I <sub>CC</sub> )
L	H	L	L	H	Data Out (I/O <sub>8</sub> –I/O <sub>15</sub> ); I/O <sub>0</sub> –I/O <sub>7</sub> in High Z	Read	Active (I <sub>CC</sub> )
L	H	H	L	L	High-Z	Output disabled	Active (I <sub>CC</sub> )
L	H	H	H	L	High-Z	Output disabled	Active (I <sub>CC</sub> )
L	H	H	L	H	High-Z	Output disabled	Active (I <sub>CC</sub> )
L	L	X	L	L	Data In (I/O <sub>0</sub> –I/O <sub>15</sub> )	Write	Active (I <sub>CC</sub> )
L	L	X	H	L	Data In (I/O <sub>0</sub> –I/O <sub>7</sub> ); I/O <sub>8</sub> –I/O <sub>15</sub> in High Z	Write	Active (I <sub>CC</sub> )
L	L	X	L	H	Data In (I/O <sub>8</sub> –I/O <sub>15</sub> ); I/O <sub>0</sub> –I/O <sub>7</sub> in High Z	Write	Active (I <sub>CC</sub> )

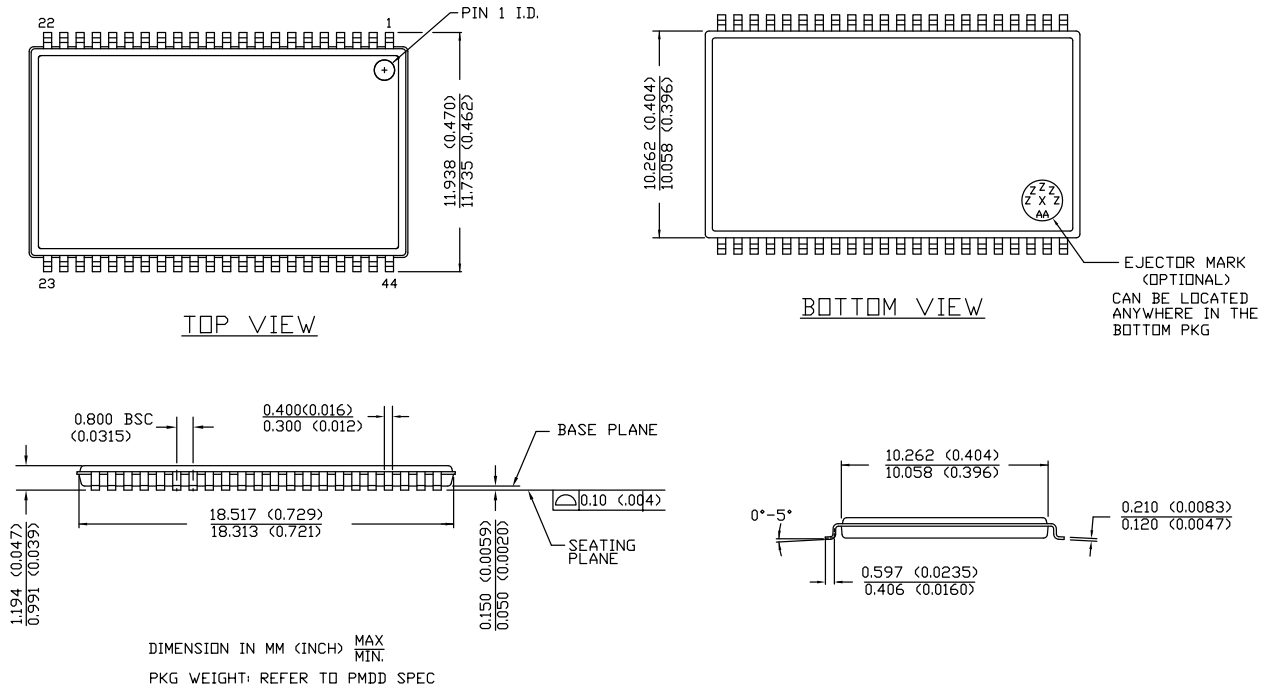
**Note**

29. The 'X' (Don't care) state for the Chip enable in the truth table refers to the logic state (either HIGH or LOW). Intermediate voltage levels on this pin is not permitted.



Package Diagram

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



51-85087 \*E

### Acronyms

Acronym	Description
BHE	Byte High Enable
BLE	Byte Low Enable
CE	Chip Enable
CMOS	Complementary Metal Oxide Semiconductor
I/O	Input/Output
OE	Output Enable
SRAM	Static Random Access Memory
TSOP	Thin Small Outline Package
WE	Write Enable

### Document Conventions

#### Units of Measure

Symbol	Unit of Measure
°C	degrees Celsius
MHz	megahertz
μA	microampere
mA	milliampere
ns	nanosecond
Ω	ohm
pF	picofarad
V	volt
W	watt

## Document History Page

Document Title: CY62157ESL MoBL <sup>®</sup> , 8-Mbit (512 K × 16) Static RAM Document Number: 001-43141				
Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
**	1875228	See ECN	VKN / AESA	New data sheet.
*A	2943752	06/03/2010	VKN	<p>Added <a href="#">Contents</a>.</p> <p>Updated <a href="#">Electrical Characteristics</a>: Added Note 8 and referred the same note in I<sub>SB2</sub> parameter.</p> <p>Updated <a href="#">Truth Table</a>: Added Note 29 and referred the same note in <math>\overline{CE}</math> column.</p> <p>Updated <a href="#">Package Diagram</a>.</p> <p>Added <a href="#">Sales, Solutions, and Legal Information</a>.</p>
*B	3109266	12/13/2010	PRAS	<p>Changed Table Footnotes to Footnotes.</p> <p>Added <a href="#">Ordering Code Definitions</a>.</p>
*C	3295175	06/29/2011	RAME	<p>Updated <a href="#">Functional Description</a>: Remove reference to AN1064 SRAM system guidelines.</p> <p>Updated <a href="#">Electrical Characteristics</a>: Updated Note 8 (Added I<sub>SB1</sub>) and referred the same note in I<sub>SB1</sub> parameter.</p> <p>Updated <a href="#">Capacitance</a>: Added Note 9 and referred the same note in parameter column.</p> <p>Updated <a href="#">Thermal Resistance</a>: Added Note 9 and referred the same note in parameter column.</p> <p>Updated <a href="#">Data Retention Characteristics</a>: Added Note 11 and referred the same note in I<sub>CCDR</sub> parameter.</p> <p>Updated <a href="#">Ordering Code Definitions</a>.</p> <p>Added <a href="#">Units of Measure</a>.</p>
*D	3904207	02/14/2013	MEMJ	<p>Updated <a href="#">Switching Waveforms</a>: Updated <a href="#">Figure 6</a> (Removed <math>\overline{OE}</math> signal). Updated <a href="#">Figure 7</a> (Removed <math>\overline{OE}</math> signal). Removed the Note "Data I/O is high impedance if <math>\overline{OE} = V_{IH}</math>." and its reference in <a href="#">Figure 6</a>, <a href="#">Figure 7</a>. Removed the figure "Write Cycle 3: <math>\overline{WE}</math> controlled, <math>\overline{OE}</math> LOW". Updated <a href="#">Figure 8</a> (Removed "OE LOW" in caption only). Removed the Note "Data I/O is high impedance if <math>\overline{OE} = V_{IH}</math>." and its reference in <a href="#">Figure 8</a>.</p> <p>Updated <a href="#">Package Diagram</a>: spec 51-85087 – Changed revision from *C to *E.</p>

**Document History Page** (continued)

Document Title: CY62157ESL MoBL <sup>®</sup> , 8-Mbit (512 K × 16) Static RAM Document Number: 001-43141				
Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
*E	4019657	06/04/2013	MEMJ	<p>Updated <a href="#">Functional Description</a>.</p> <p>Updated <a href="#">Electrical Characteristics</a>:            Added one more Test Condition "<math>4.5 \leq V_{CC} \leq 5.5</math>, <math>I_{OH} = -0.1</math> mA" for <math>V_{OH}</math> parameter and added maximum value corresponding to that Test Condition.            Added Note 7 and referred the same note in maximum value for <math>V_{OH}</math> parameter corresponding to Test Condition "<math>4.5 \leq V_{CC} \leq 5.5</math>, <math>I_{OH} = -0.1</math> mA".</p>



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