

# 8-Mbit (512K x 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

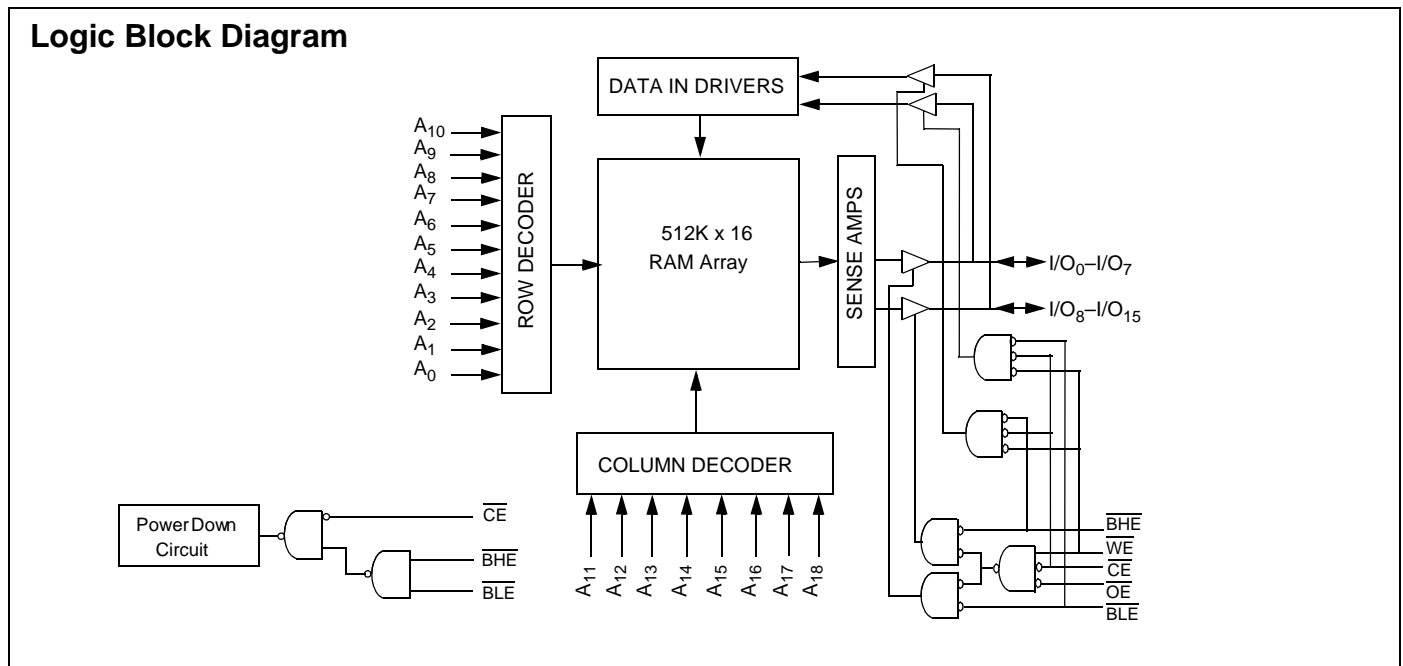
## Functional Description

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 such as cellular telephones. 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.

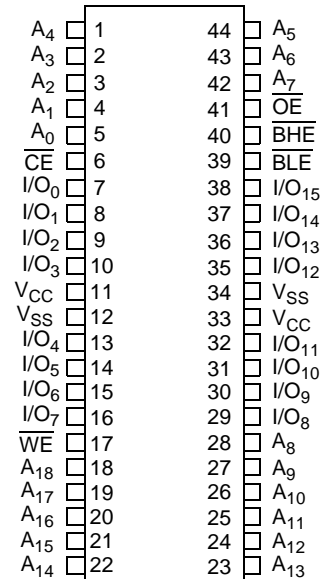


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## Pin Configuration

Figure 1. 44-Pin TSOP II (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

- Datasheet specifications are not guaranteed for V<sub>CC</sub> in the range of 3.6 V to 4.5 V.
- 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 .....	>2001 V (MIL-STD-883, Method 3015)
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	–	–	
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>[7]</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>[7]</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.
- 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.

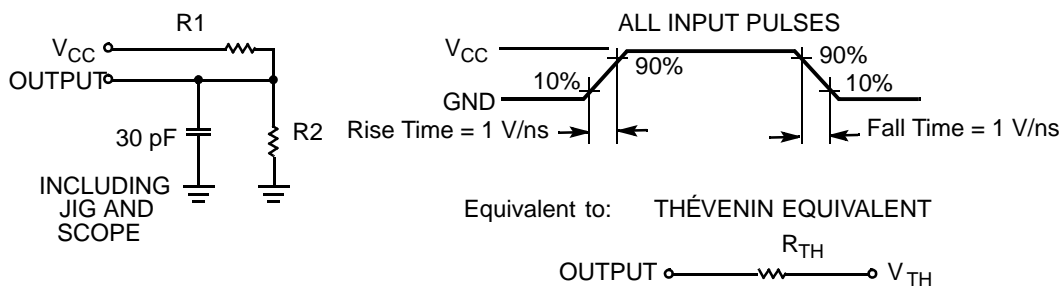
### Capacitance

Parameter <sup>[8]</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>[8]</sup>	Description	Test Conditions	TSOP II	Unit
Θ <sub>JA</sub>	Thermal resistance (Junction to ambient)	Still Air, soldered on a 3 x 4.5 inch, two-layer printed circuit board	77	°C/W
Θ <sub>JC</sub>	Thermal resistance (Junction to case)		13	°C/W

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**

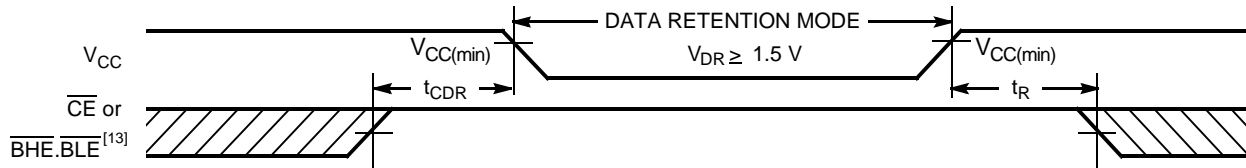
8. Tested initially and after any design or process changes that may affect these parameters.

### Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ <sup>[9]</sup>	Max	Unit
$V_{DR}$	$V_{CC}$ for data retention		1.5	–	–	V
$I_{CCDR}$ <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 $V_{IN} \leq 0.2\text{ V}$				$\mu\text{A}$
		$V_{CC} = 1.5\text{ V}$	–	2	5	
		$V_{CC} = 2.0\text{ V}$	–	2	8	
$t_{CDR}$ <sup>[11]</sup>	Chip deselect to data retention time		0	–	–	ns
$t_R$ <sup>[12]</sup>	Operation recovery time		45	–	–	ns

Figure 3. Data Retention Waveform



**Notes**

- 9. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at  $V_{CC} = 3\text{ V}$ , and  $V_{CC} = 5\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$ .
- 10. 10Chip enable ( $\overline{CE}$ ) needs to be tied to CMOS levels to meet the  $I_{SB1}/I_{SB2} / I_{CCDR}$  spec. Other inputs can be left floating.
- 11. Tested initially and after any design or process changes that may affect these parameters.
- 12. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(min)}$   $\geq 100\text{ }\mu\text{s}$  or stable at  $V_{CC(min)}$   $\geq 100\text{ }\mu\text{s}$ .
- 13.  $\overline{BHE.BLE}$  is the AND of both  $\overline{BHE}$  and  $\overline{BLE}$ . Deselect the chip by either disabling chip enable signals or by disabling both  $\overline{BHE}$  and  $\overline{BLE}$ .

## Switching Characteristics

Over the Operating Range

Parameter <sup>[14]</sup>	Description	45 ns		Unit
		Min	Max	
<b>Read Cycle</b>				
$t_{RC}$	Read cycle time	45	–	ns
$t_{AA}$	Address to data valid	–	45	ns
$t_{OHA}$	Data hold from address change	10	–	ns
$t_{ACE}$	$\overline{CE}$ LOW to data valid	–	45	ns
$t_{DOE}$	$\overline{OE}$ LOW to data valid	–	22	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z <sup>[15]</sup>	5	–	ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[15, 16]</sup>	–	18	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low-Z <sup>[15]</sup>	10	–	ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High-Z <sup>[15, 16]</sup>	–	18	ns
$t_{PU}$	$\overline{CE}$ LOW to power up	0	–	ns
$t_{PD}$	$\overline{CE}$ HIGH to power down	–	45	ns
$t_{DBE}$	$\overline{BLE}/\overline{BHE}$ LOW to data valid	–	45	ns
$t_{LZBE}$	$\overline{BLE}/\overline{BHE}$ LOW to Low-Z <sup>[15, 17]</sup>	5	–	ns
$t_{HZBE}$	$\overline{BLE}/\overline{BHE}$ HIGH to High-Z <sup>[15, 16]</sup>	–	18	ns
<b>Write Cycle<sup>[18]</sup></b>				
$t_{WC}$	Write cycle time	45	–	ns
$t_{SCE}$	$\overline{CE}$ LOW to write end	35	–	ns
$t_{AW}$	Address setup to write end	35	–	ns
$t_{HA}$	Address hold from write end	0	–	ns
$t_{SA}$	Address setup to write start	0	–	ns
$t_{PWE}$	$\overline{WE}$ pulse width	35	–	ns
$t_{BW}$	$\overline{BLE}/\overline{BHE}$ LOW to write end	35	–	ns
$t_{SD}$	Data setup to write end	25	–	ns
$t_{HD}$	Data hold from write end	0	–	ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[15, 16]</sup>	–	18	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[15]</sup>	10	–	ns

### Notes

14. 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 [AC Test Loads and Waveforms](#) on page 5.
15. At any 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 device.
16.  $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  transitions are measured when the outputs enter a high-impedance state.
17. If both byte enables are toggled together, this value is 10 ns.
18. 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. [19, 20]

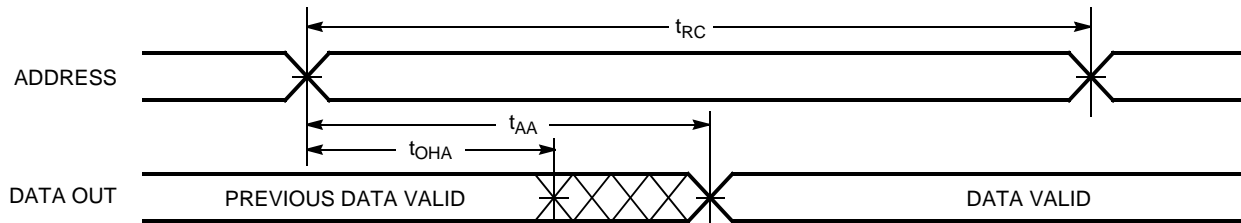
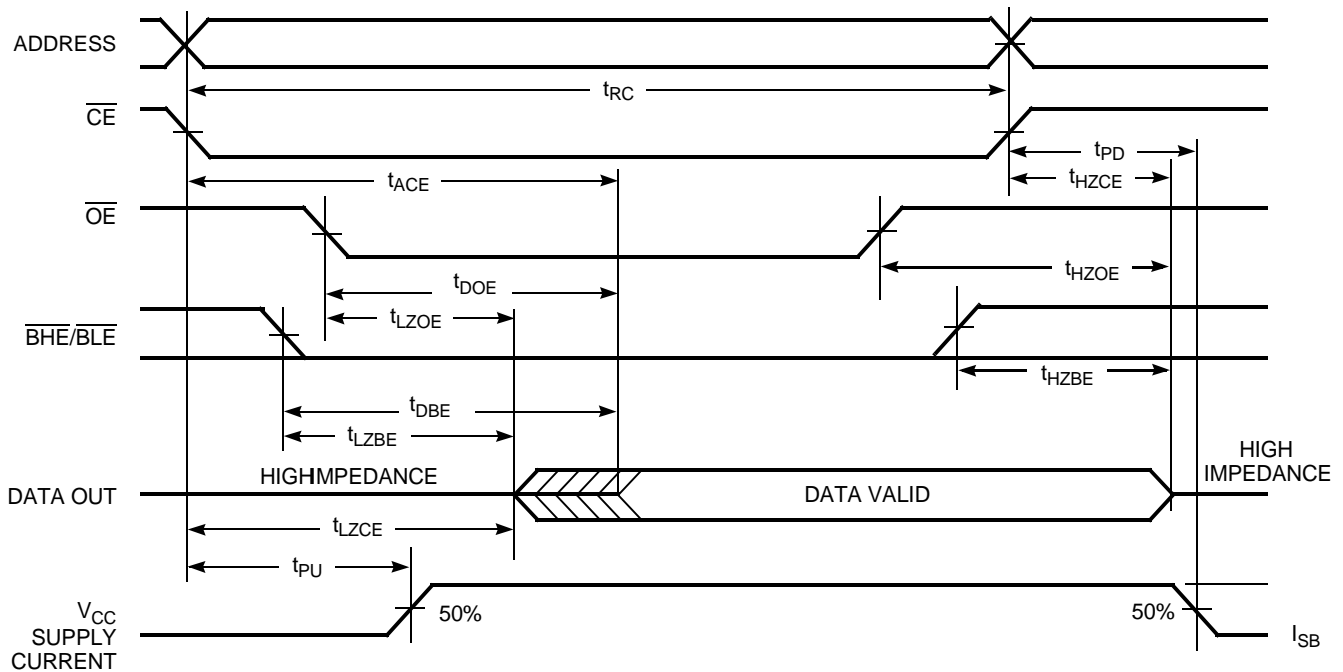


Figure 5. Read Cycle No. 2:  $\overline{OE}$  Controlled [20, 21]



### Notes

19. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE} = V_{IL}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$ , or both =  $V_{IL}$ .
20. WE is HIGH for read cycle.
21. 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 [22, 23, 24]

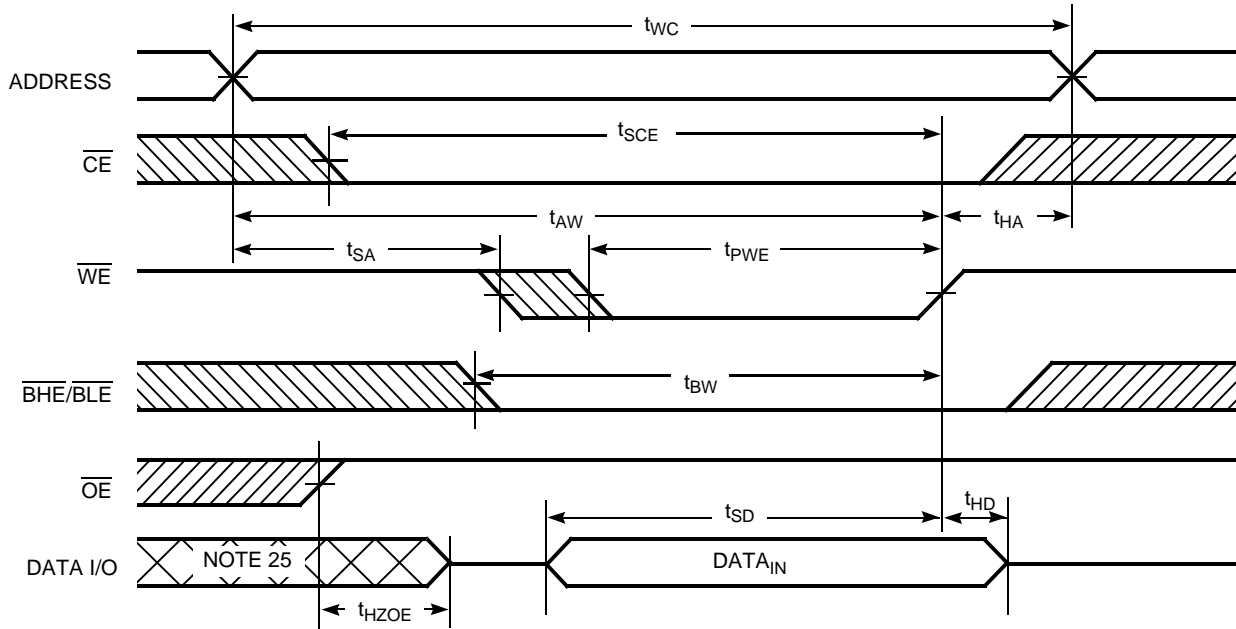
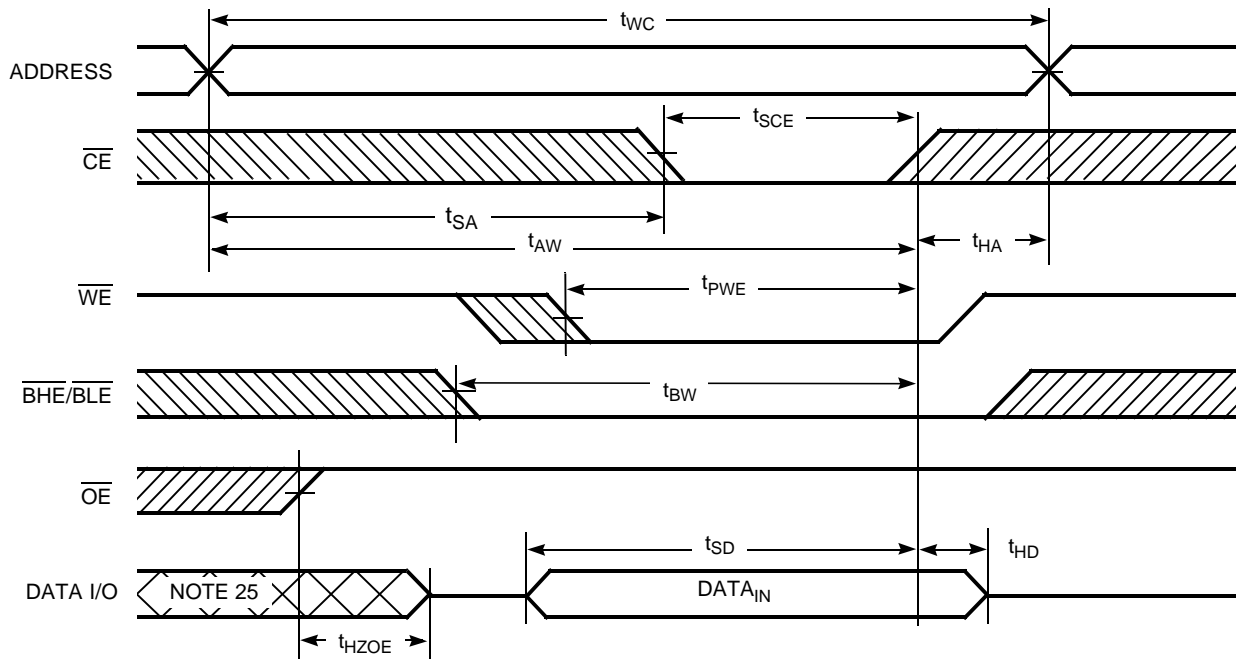


Figure 7. Write Cycle 2:  $\overline{CE}$  Controlled [22, 23, 24]



Notes

- 22. 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.
- 23. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
- 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:  $\overline{WE}$  controlled,  $\overline{OE}$  LOW [26, 27, 28]

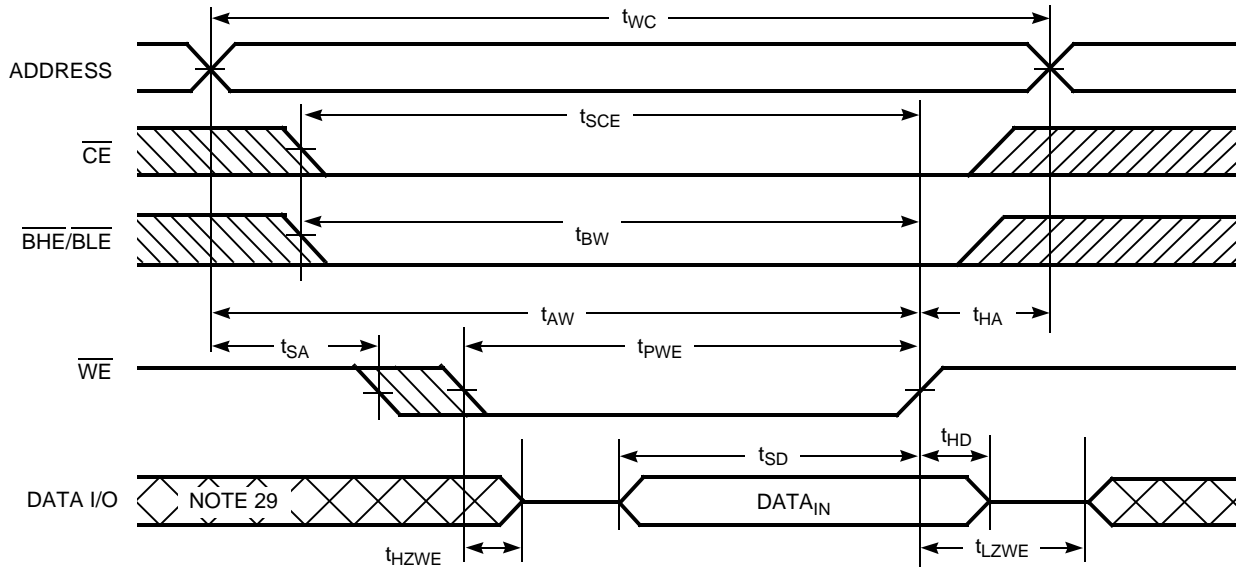
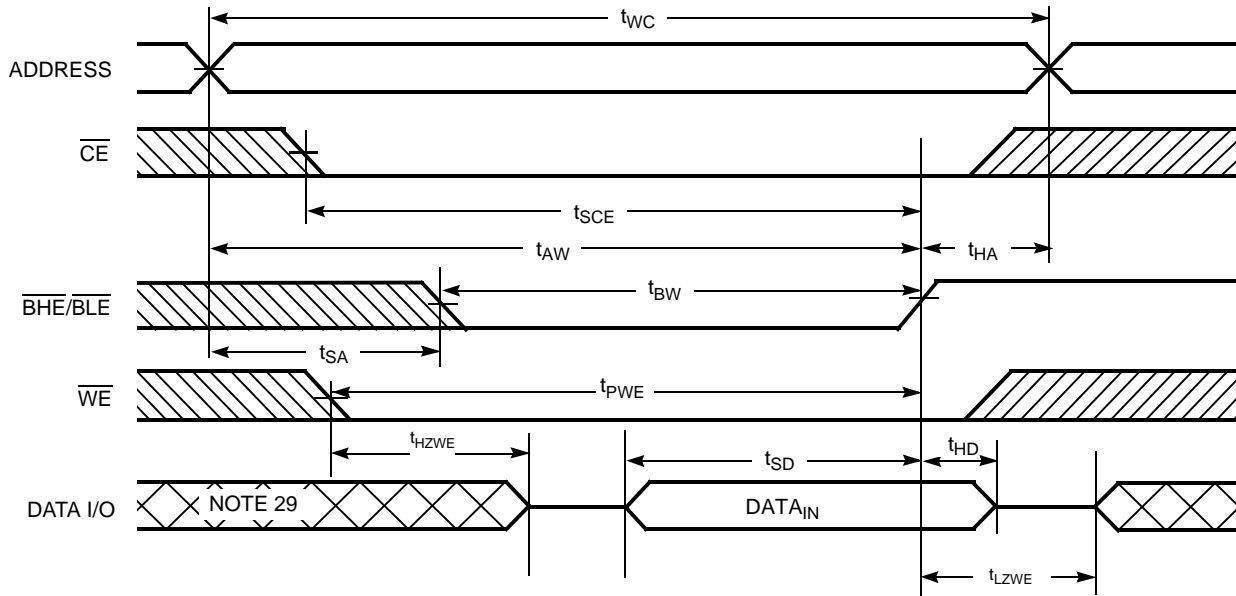


Figure 9. Write Cycle 4:  $\overline{BHE}/\overline{BLE}$  Controlled,  $\overline{OE}$  LOW [26, 27, 28]



Notes

- 26. 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.
- 27. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
- 28. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE} = V_{IH}$ , the output remains in a high impedance state.
- 29. During this period, the I/Os are in output state. Do not apply input signals.

**Truth Table**

<b>CE</b>	<b>WE</b>	<b>OE</b>	<b>BHE</b>	<b>BLE</b>	<b>Inputs/Outputs</b>	<b>Mode</b>	<b>Power</b>
H	X	X	X	X	High-Z	Deselect/power down	Standby ( $I_{SB}$ )
X <sup>[30]</sup>	X	X	H	H	High-Z	Deselect/power down	Standby ( $I_{SB}$ )
L	H	L	L	L	Data Out (I/O <sub>0</sub> –I/O <sub>15</sub> )	Read	Active ( $I_{CC}$ )
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 ( $I_{CC}$ )
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 ( $I_{CC}$ )
L	H	H	L	L	High-Z	Output disabled	Active ( $I_{CC}$ )
L	H	H	H	L	High-Z	Output disabled	Active ( $I_{CC}$ )
L	H	H	L	H	High-Z	Output disabled	Active ( $I_{CC}$ )
L	L	X	L	L	Data In (I/O <sub>0</sub> –I/O <sub>15</sub> )	Write	Active ( $I_{CC}$ )
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 ( $I_{CC}$ )
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 ( $I_{CC}$ )

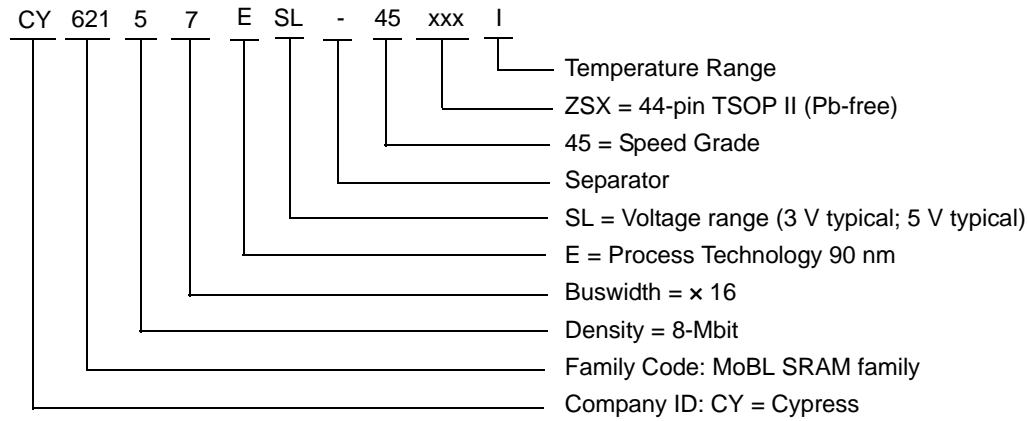
**Note**

30. 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.

### Ordering Information

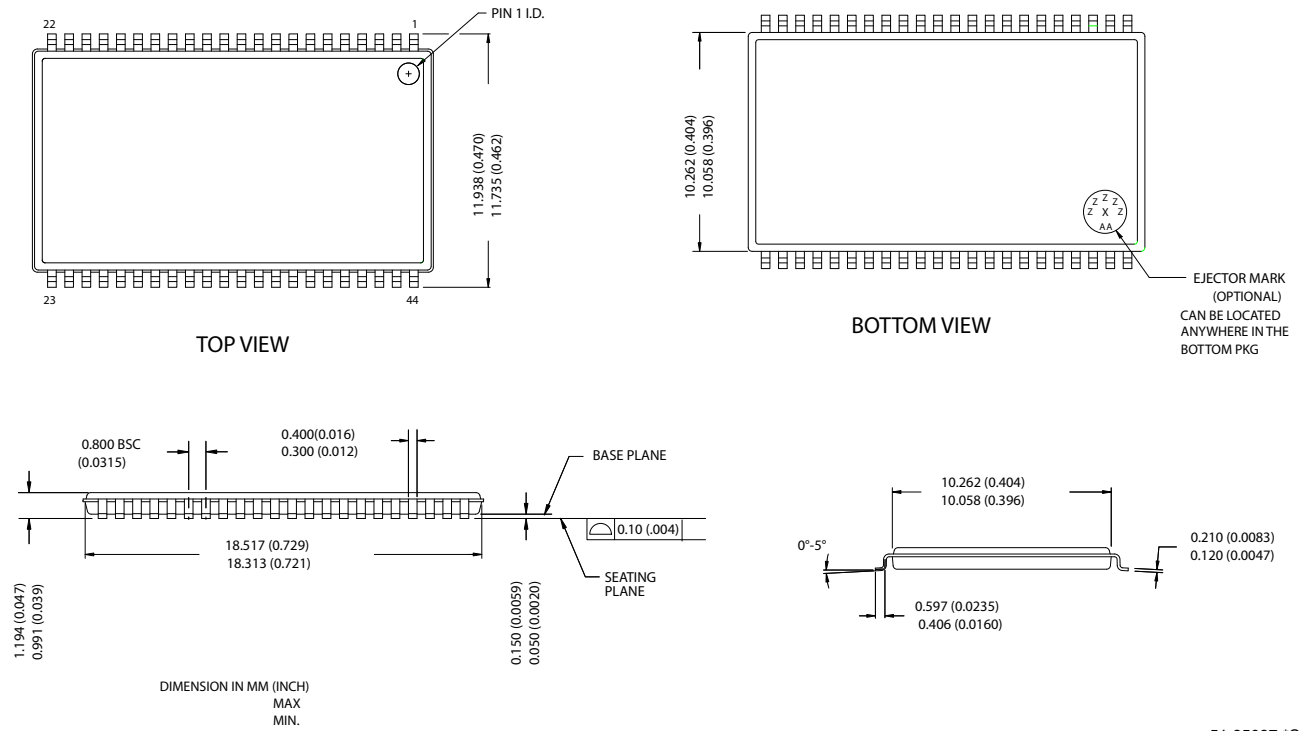
Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62157ESL-45ZSXI	51-85087	44-pin thin small outline package type II (Pb-free)	Industrial

### Ordering Code Definitions



Package Diagram

Figure 10. 44-Pin TSOP II, 51-85087



51-85087-\*C

## 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
μA	microamperes
mA	milliamperes
MHz	megahertz
ns	nanoseconds
pF	picofarads
V	volts
Ω	ohms
W	watts

**Document History Page**

Document Title: CY62157ESL MoBL <sup>®</sup> 8-Mbit (512K x 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	Added <a href="#">Contents</a> Added footnote for the ISB2 parameter in <a href="#">Electrical Characteristics</a> Added footnote related to chip enable in <a href="#">Truth Table</a> Updated <a href="#">Package Diagram</a> Added <a href="#">Sales, Solutions, and Legal Information</a>
*B	3109266	12/13/2010	PRAS	Changed Table Footnotes to Footnotes. Added Ordering Code Definitions.
*C	3295175	06/29/2011	RAME	Remove reference to AN1064 SRAM system guidelines. Added I <sub>SB1</sub> and I <sub>CCDR</sub> to footnotes 7 and 10. Added footnote 8 for <a href="#">Capacitance</a> and <a href="#">Thermal Resistance</a> section. Updated <a href="#">Ordering Code Definitions</a> . Added <a href="#">Document Conventions</a> . Updated Table of Contents.

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