

## Features

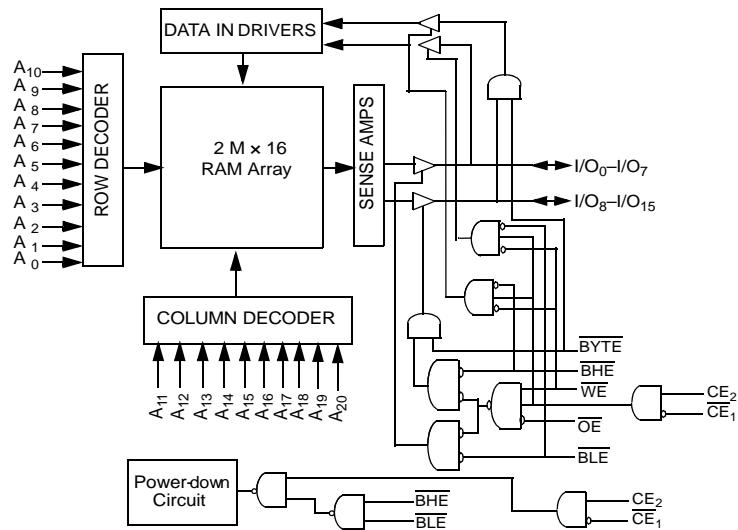
- Thin small outline package-I (TSOP-I) configurable as 2 M × 16 or as 4 M × 8 static RAM (SRAM)
- High-speed up to 55 ns
- Wide voltage range: 2.2 V to 3.6 V and 4.5 V to 5.5 V
- Ultra low standby power
  - Typical standby current: 3  $\mu$ A
  - Maximum standby current: 25  $\mu$ A
- Ultra low active power
  - Typical active current: 4.5 mA at  $f = 1$  MHz
- Easy memory expansion with  $\overline{CE}_1$ ,  $CE_2$ , and  $\overline{OE}$  Features
- Automatic power-down when deselected
- Complementary metal oxide semiconductor (CMOS) for optimum speed and power
- Available in Pb-free 48-ball TSOP-I package

## Functional Description

The CY62177ESL is a high performance CMOS static RAM organized as 2 M words by 16 bits and 4 M words by 8 bits. This device features advanced circuit design to provide ultra low active current. It 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 percent when addresses are not toggling. The device can also be put into standby mode when deselected ( $CE_1$  HIGH or  $CE_2$  LOW or both BHE and BLE are HIGH). The input and output pins (I/O<sub>0</sub> through I/O<sub>15</sub>) are placed in a high impedance state when: deselected ( $CE_1$  HIGH or  $CE_2$  LOW), outputs are disabled ( $OE$  HIGH), both Byte High Enable and Byte Low Enable are disabled (BHE, BLE HIGH), or during a write operation ( $CE_1$  LOW,  $CE_2$  HIGH and WE LOW).

To write to the device, take Chip Enables ( $CE_1$  LOW and  $CE_2$  HIGH) and Write Enable (WE) input LOW. If Byte Low Enable (BLE) is LOW, then data from I/O pins (I/O<sub>0</sub> through I/O<sub>7</sub>), is written into the location specified on the address pins (A<sub>0</sub> through A<sub>20</sub>). If Byte High Enable (BHE) is LOW, then data from I/O pins (I/O<sub>8</sub> through I/O<sub>15</sub>) is written to the location specified on the address pins (A<sub>0</sub> through A<sub>20</sub>). To read from the device, take Chip Enables ( $CE_1$  LOW and  $CE_2$  HIGH) and Output Enable (OE) LOW while forcing the Write Enable (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by the address pins appear on I/O<sub>0</sub> to I/O<sub>7</sub>. If Byte High Enable (BHE) is LOW, then data from memory appears on I/O<sub>8</sub> to I/O<sub>15</sub>. See the [Truth Table](#) on page 10 for a complete description of read and write modes.

## Logic Block Diagram

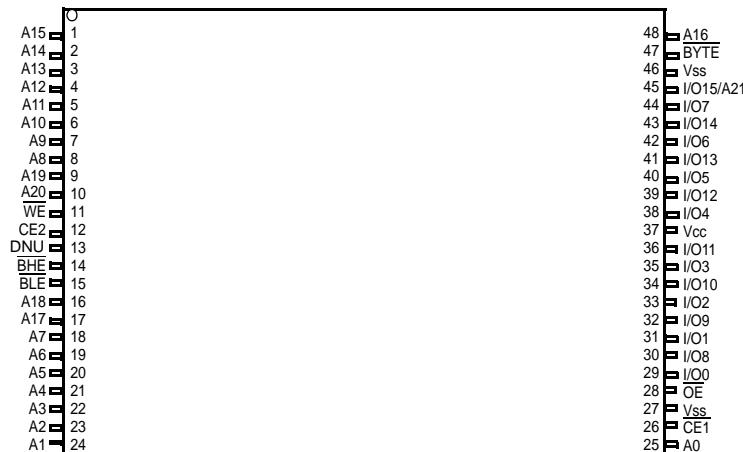


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## Pin Configuration

Figure 1. 48-Pin TSOPI (Forward) (2 M × 16/4 M × 8)<sup>[2, 3]</sup>



## Product Portfolio

Product	V <sub>CC</sub> Range (V) <sup>[4]</sup>	Speed (ns)	Power Dissipation					
			Operating I <sub>CC</sub> (mA)				Standby I <sub>SB2</sub> (µA)	
			f = 1 MHz		f = f <sub>Max</sub>			
CY62177ESL	2.2 V to 3.6 V and 4.5 V to 5.5 V	55	4.5	5.5	35	45	3	25

### Notes

1. NC pins are not connected on the die.
2. The BYTE pin in the 48-TSOP-I package has to be tied to V<sub>CC</sub> to use the device as a 2 M × 16 SRAM. The 48-TSOP-I package can also be used as a 4 M × 8 SRAM by tying the BYTE signal to V<sub>SS</sub>. In the 4 M × 8 configuration, Pin 45 is A21, while BHE, BLE, and I/O<sub>8</sub> to I/O<sub>14</sub> pins are not used.
3. Datasheet Specifications are not guaranteed in the range of 3.6 V to 4.5 V.
4. 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 maximum ratings may shorten the useful life of the device. User guidelines are not tested.

Storage temperature .....  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$

Ambient temperature with power applied .....  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Supply voltage to ground potential .....  $-0.3\text{ V}$  to  $V_{\text{CC(max)}} + 0.3\text{ V}$

DC voltage applied to outputs in high Z state<sup>[5, 6]</sup> .....  $-0.3\text{ V}$  to  $V_{\text{CC(max)}} + 0.3\text{ V}$

DC input voltage<sup>[5, 6]</sup> .....  $-0.3\text{ V}$  to  $V_{\text{CC(max)}} + 0.3\text{ V}$

Output current into outputs (LOW) ..... 20 mA

Static discharge voltage .....  $\geq 2001\text{ V}$  (per MIL-STD-883, method 3015)

Latch-up current .....  $\geq 200\text{ mA}$

## Operating Range

Device	Range	Ambient Temperature	$V_{\text{CC}}^{[7]}$
CY62177ESL	Industrial	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$	2.2 V to 3.6 V and 4.5 V to 5.5 V

## Electrical Characteristics

Over the operating range

Parameter	Description	Test Conditions		55 ns			Unit
		Min	Typ <sup>[8]</sup>	Max			
$V_{\text{OH}}$	Output HIGH voltage	$2.2\text{ V} \leq V_{\text{CC}} \leq 2.7\text{ V}$	$I_{\text{OH}} = -0.1\text{ mA}$	2.0	—	—	V
		$2.7\text{ V} \leq V_{\text{CC}} \leq 3.6\text{ V}$	$I_{\text{OH}} = -1.0\text{ mA}$	2.4	—	—	V
		$4.5\text{ V} \leq V_{\text{CC}} \leq 5.5\text{ V}$	$I_{\text{OH}} = -1.0\text{ mA}$	2.4	—	—	V
$V_{\text{OL}}$	Output LOW voltage	$2.2\text{ V} \leq V_{\text{CC}} \leq 2.7\text{ V}$	$I_{\text{OL}} = 0.1\text{ mA}$	—	—	0.4	V
		$2.7\text{ V} \leq V_{\text{CC}} \leq 3.6\text{ V}$	$I_{\text{OL}} = 2.1\text{ mA}$	—	—	0.4	V
		$4.5\text{ V} \leq V_{\text{CC}} \leq 5.5\text{ V}$	$I_{\text{OL}} = 2.1\text{ mA}$	—	—	0.4	V
$V_{\text{IH}}$	Input HIGH voltage	$2.2\text{ V} \leq V_{\text{CC}} \leq 2.7\text{ V}$		1.8	—	$V_{\text{CC}} + 0.3\text{ V}$	V
		$2.7\text{ V} \leq V_{\text{CC}} \leq 3.6\text{ V}$		2.2	—	$V_{\text{CC}} + 0.3\text{ V}$	V
		$4.5\text{ V} \leq V_{\text{CC}} \leq 5.5\text{ V}$		2.2	—	$V_{\text{CC}} + 0.3\text{ V}$	V
$V_{\text{IL}}$	Input LOW voltage	$2.2\text{ V} \leq V_{\text{CC}} \leq 2.7\text{ V}$		-0.3	—	0.6	V
		$2.7\text{ V} \leq V_{\text{CC}} \leq 3.6\text{ V}$		-0.3	—	0.7 <sup>[9]</sup>	V
		$4.5\text{ V} \leq V_{\text{CC}} \leq 5.5\text{ V}$		-0.3	—	0.7 <sup>[9]</sup>	V
$I_{\text{IX}}$	Input leakage current	$\text{GND} \leq V_{\text{I}} \leq V_{\text{CC}}$		-1	—	+1	$\mu\text{A}$
$I_{\text{OZ}}$	Output leakage current	$\text{GND} \leq V_{\text{O}} \leq V_{\text{CC}}$ , Output disabled		-1	—	+1	$\mu\text{A}$
$I_{\text{CC}}$	$V_{\text{CC}}$ operating supply current	$f = f_{\text{Max}} = 1/t_{\text{RC}}$	$V_{\text{CC}} = V_{\text{CC(max)}}$	—	35	45	mA
		$f = 1\text{ MHz}$	$I_{\text{OUT}} = 0\text{ mA}$ CMOS levels	—	4.5	5.5	mA
$I_{\text{SB2}}^{[10]}$	Automatic power-down current—CMOS inputs	$\text{CE}_1 \geq V_{\text{CC}} - 0.2\text{ V}$ or $\text{CE}_2 \leq 0.2\text{ V}$ or (BHE and BLE) $\geq V_{\text{CC}} - 0.2\text{ V}$ , $V_{\text{IN}} \geq V_{\text{CC}} - 0.2\text{ V}$ or $V_{\text{IN}} \leq 0.2\text{ V}$ , $f = 0$ , $V_{\text{CC}} = 3.6\text{ V}$		—	3	25	$\mu\text{A}$

## Capacitance

Parameter <sup>[11]</sup>	Description	Test Conditions	Max	Unit
$C_{\text{IN}}$	Input capacitance	$T_A = 25^{\circ}\text{C}$ , $f = 1\text{ MHz}$ , $V_{\text{CC}} = V_{\text{CC(typ)}}$	15	pF
$C_{\text{OUT}}$	Output capacitance		15	pF

### Notes

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

6.  $V_{\text{IH(max)}} = V_{\text{CC}} + 0.75\text{ V}$  for pulse durations less than 20 ns.

7. Full Device AC operation assumes a 100  $\mu\text{s}$  ramp time from 0 to  $V_{\text{CC}}$  (min) and 200  $\mu\text{s}$  wait time after  $V_{\text{CC}}$  stabilization.

8. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at  $V_{\text{CC}} = 3\text{ V}$ , and  $V_{\text{CC}} = 5\text{ V}$ ,  $T_A = 25^{\circ}\text{C}$

9. Under DC conditions the device meets a  $V_{\text{IL}}$  of 0.8 V. However, in dynamic conditions Input LOW voltage applied to the device must not be higher than 0.7 V.

10. Chip enables (CE1 and CE2), byte enables (BHE and BLE) and BYTE must be tied to CMOS levels to meet the  $I_{\text{SB2}}$  /  $I_{\text{CCDR}}$  spec. Other inputs can be left floating.

11. Tested initially and after any design or process changes that may effect these parameters.

## Thermal Resistance

Parameter <sup>[12]</sup>	Description	Test Conditions	TSOPI	Unit
$\Theta_{JA}$	Thermal resistance (junction to ambient)	Still air, soldered on a 3 x 4.5 inch, two-layer printed circuit board	44.66	°C / W
$\Theta_{JC}$	Thermal resistance (junction to case)		12.12	°C / W

Figure 2. AC Test Loads and Waveforms

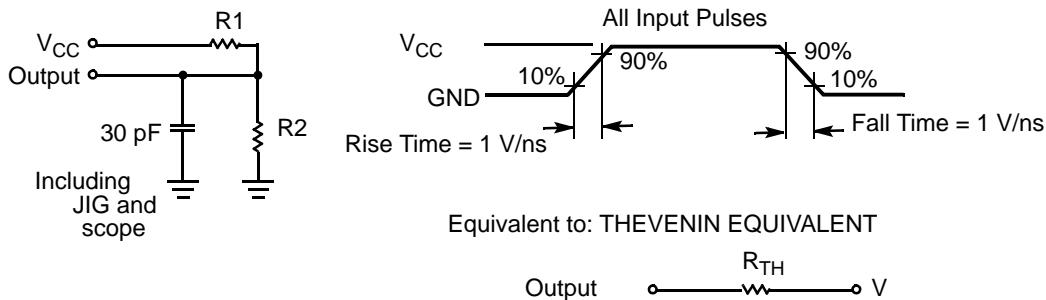


Table 1. AC Test Loads

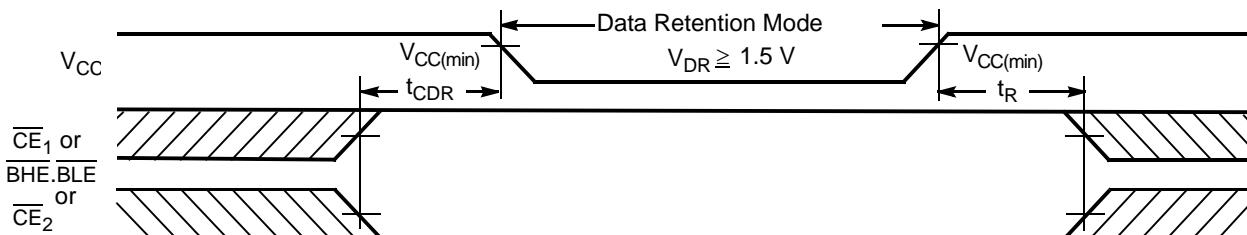
Parameter	2.5 V	3.0 V	5.0 V	Unit
R1	16667	1103	1800	Ω
R2	15385	1554	990	Ω
$R_{TH}$	8000	645	639	Ω
$V_{TH}$	1.20	1.75	1.77	V

## Data Retention Characteristics

Over the operating range

Parameter	Description	Conditions	Min	Typ <sup>[13]</sup>	Max	Unit
$V_{DR}$	$V_{CC}$ for data retention		1.5	—	—	V
$I_{CCDR}$ <sup>[14]</sup>	Data retention current	$V_{CC} = 1.5 \text{ V}$ , $CE_1 \geq V_{CC} - 0.2 \text{ V}$ or $CE_2 \leq 0.2 \text{ V}$ or (BHE and BLE) $\geq V_{CC} - 0.2 \text{ V}$ , $V_{IN} \geq V_{CC} - 0.2 \text{ V}$ or $V_{IN} \leq 0.2 \text{ V}$	—	—	17	μA
$t_{CDR}$ <sup>[12]</sup>	Chip deselect to data retention time	—	0	—	—	ns
$t_R$ <sup>[15]</sup>	Operation recovery time	—	55	—	—	ns

Figure 3. Data Retention Waveform<sup>[16]</sup>



### Notes

12. Tested initially and after any design or process changes that may affect these parameters.
13. Typical values are included only for reference and are not guaranteed or tested. Typical values are measured at  $V_{CC} = 3 \text{ V}$ , and  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25 \text{ }^\circ\text{C}$ .
14. Chip enables ( $\overline{CE}_1$  and  $\overline{CE}_2$ ), byte enables (BHE and BLE) and BYTE must be tied to CMOS levels to meet the  $I_{SB2}$  /  $I_{CCDR}$  spec. Other inputs can be left floating.
15. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(\min)}$   $\geq 100 \mu\text{s}$  or stable at  $V_{CC(\min)} \geq 100 \mu\text{s}$ .
16. BHE.BLE is the AND of both BHE and BLE. Chip is deselected by either disabling the chip enable signals or by disabling both  $\overline{BHE}$  and  $\overline{BLE}$ .

## Switching Characteristics

Over the operating range

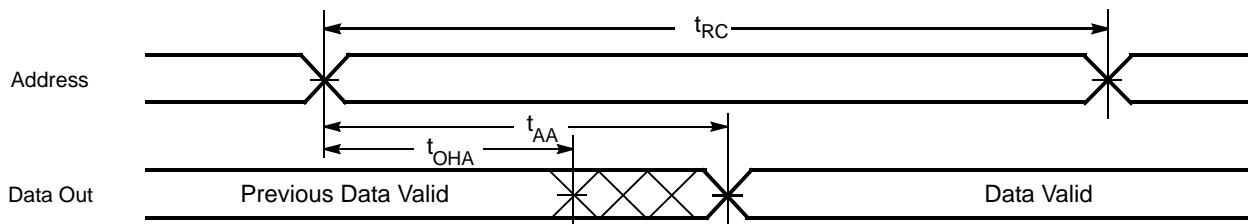
Parameter <sup>[17]</sup>	Description	55 ns		Unit
		Min	Max	
<b>Read Cycle</b>				
$t_{RC}$	Read cycle time	55	–	ns
$t_{AA}$	Address to data valid	–	55	ns
$t_{OHA}$	Data hold from address change	6	–	ns
$t_{ACE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to data valid	–	55	ns
$t_{DOE}$	$\overline{OE}$ LOW to data valid	–	25	ns
$t_{LZOE}$	$\overline{OE}$ LOW to low Z <sup>[18]</sup>	5	–	ns
$t_{HZOE}$	$\overline{OE}$ HIGH to high Z <sup>[18, 19]</sup>	–	18	ns
$t_{LZCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to low Z <sup>[18]</sup>	10	–	ns
$t_{HZCE}$	$\overline{CE}_1$ HIGH and $CE_2$ LOW to high Z <sup>[18, 19]</sup>	–	18	ns
$t_{PU}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to power-up	0	–	ns
$t_{PD}$	$\overline{CE}_1$ HIGH and $CE_2$ LOW to power-down	–	55	ns
$t_{DBE}$	$\overline{BLE}/\overline{BHE}$ LOW to data valid	–	55	ns
$t_{LZBE}$	$\overline{BLE}/\overline{BHE}$ LOW to low Z <sup>[18]</sup>	10	–	ns
$t_{HZBE}$	$\overline{BLE}/\overline{BHE}$ HIGH to high Z <sup>[18, 19]</sup>	–	18	ns
<b>Write Cycle<sup>[20]</sup></b>				
$t_{WC}$	Write cycle time	55	–	ns
$t_{SCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to write end	40	–	ns
$t_{AW}$	Address setup to write end	40	–	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	40	–	ns
$t_{BW}$	$\overline{BLE}/\overline{BHE}$ LOW to write end	40	–	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>[18, 19]</sup>	–	20	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to low Z <sup>[18]</sup>	10	–	ns

### Notes

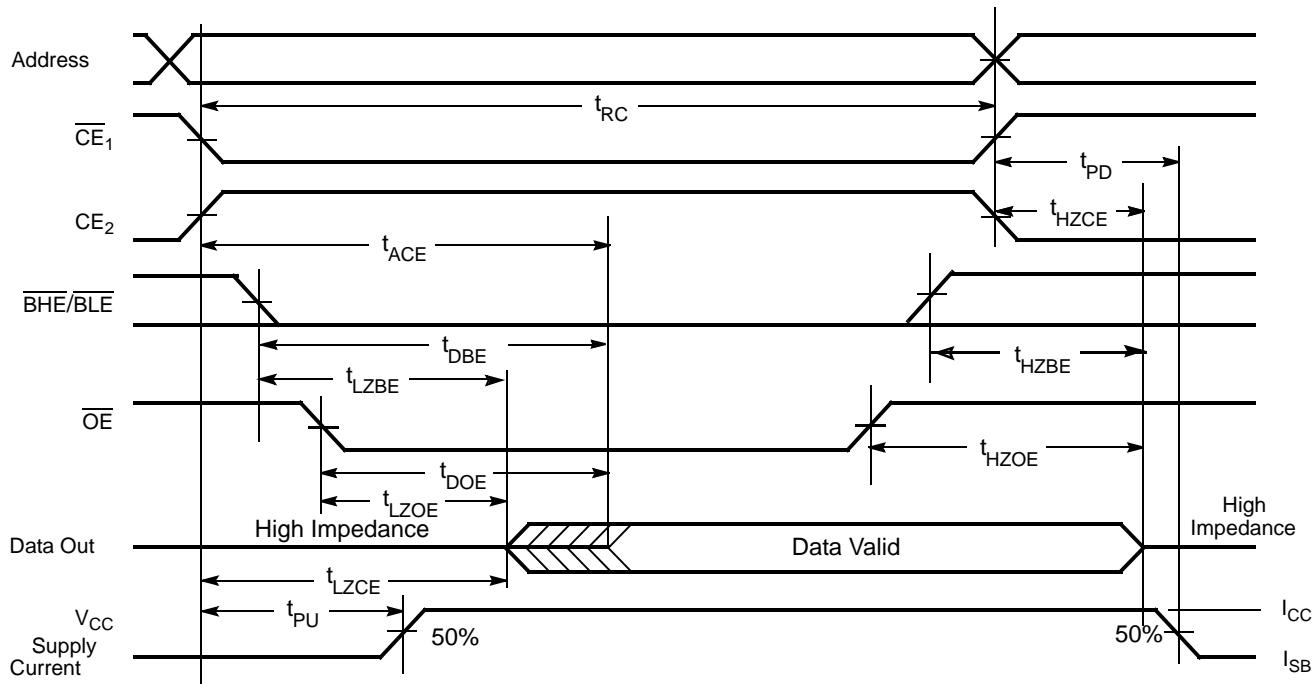
17. Test conditions for all parameters other than tristate parameters assume signal transition time of 1 V/ns, timing reference levels of  $V_{CC(\text{typ})}/2$ , input pulse levels of 0 to  $V_{CC(\text{typ})}$ , and output loading of the specified  $I_{OL}/I_{OH}$  as shown in [AC Test Loads](#) on page 5.
18. 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.
19.  $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  transitions are measured when the outputs enter a high impedance state.
20. The internal Write time of the memory is defined by the overlap of  $WE$ ,  $\overline{CE}_1 = V_{IL}$ ,  $\overline{BHE}$  and/or  $\overline{BLE} = V_{IL}$ , and  $CE_2 = V_{IH}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing should be referenced to the edge of the signal that terminates the write.

## Switching Waveforms

**Figure 4. Read Cycle 1 (Address Transition Controlled)<sup>[21, 22]</sup>**

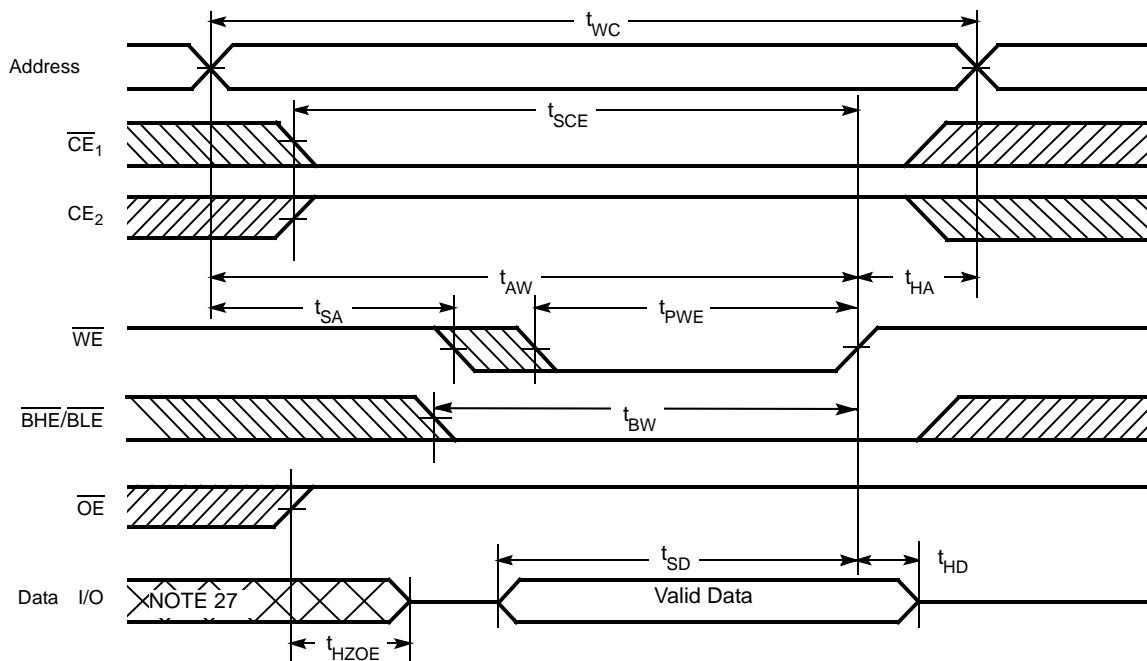
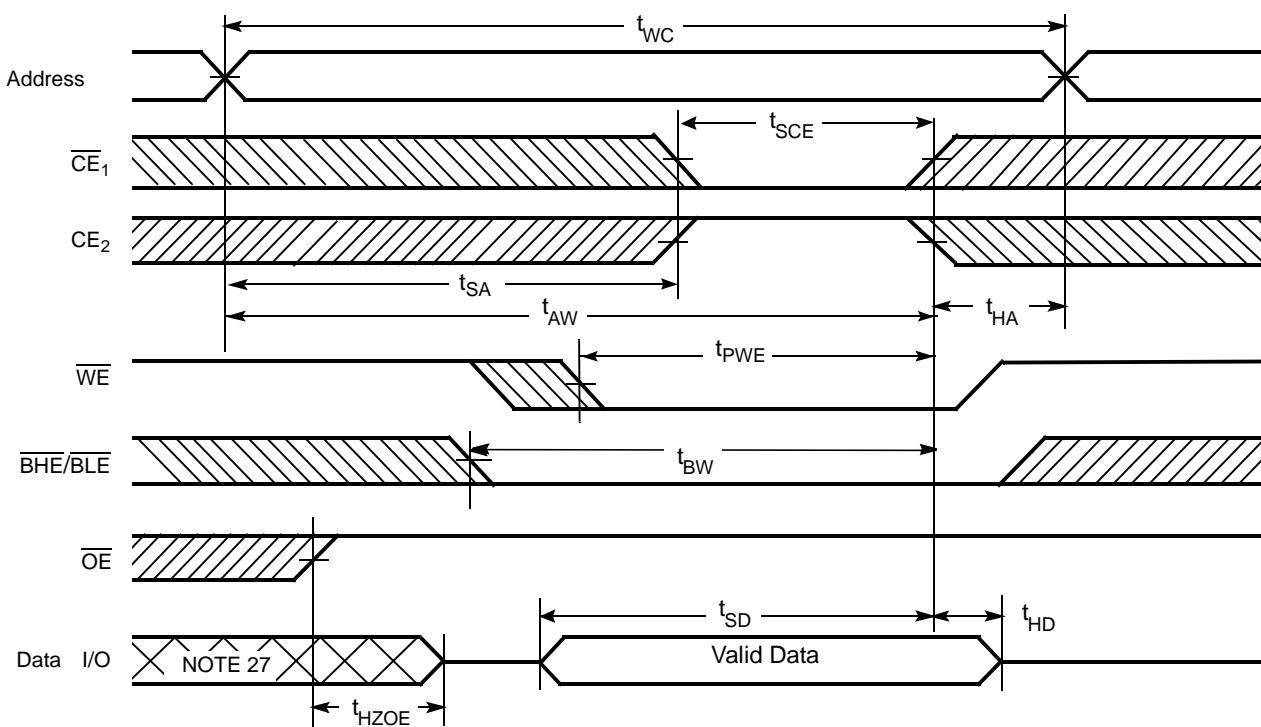


**Figure 5. Read Cycle 2 ( $\overline{OE}$  Controlled)<sup>[22, 23]</sup>**

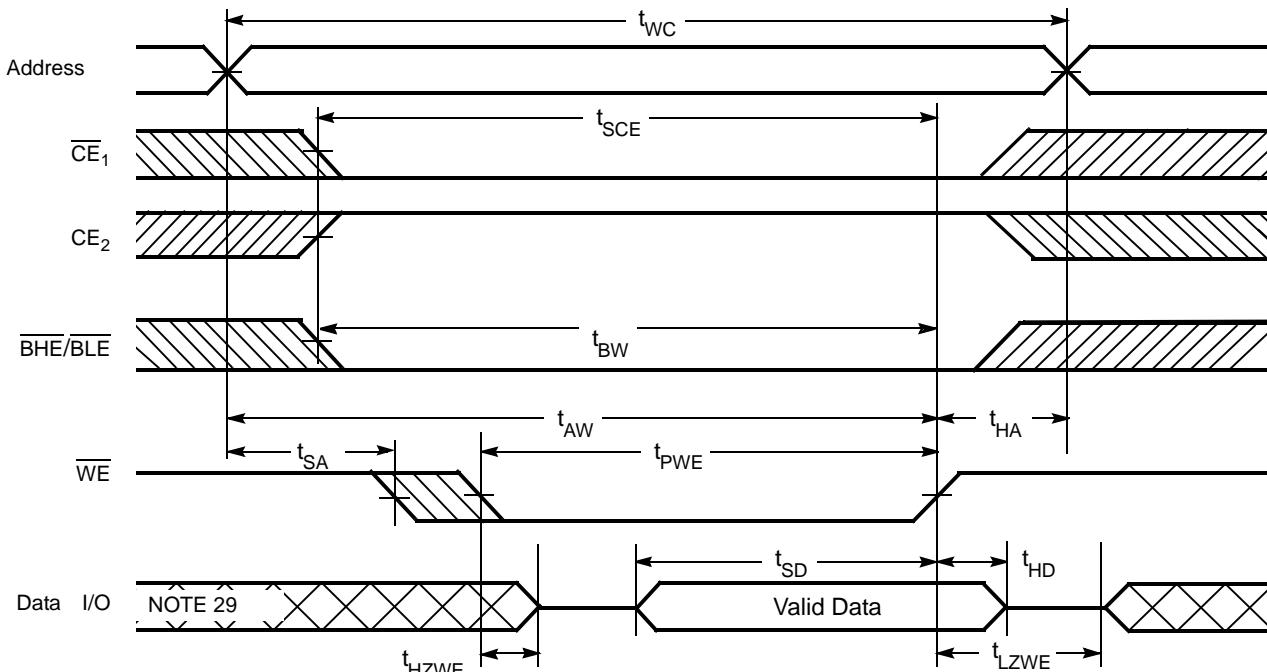
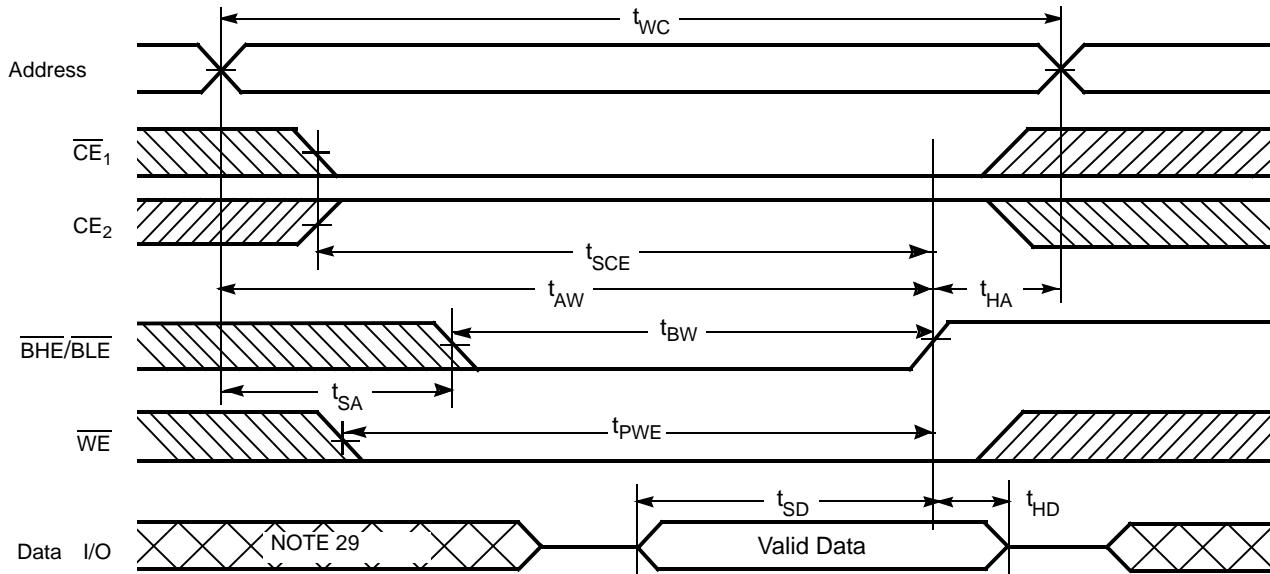


### Notes

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

**Switching Waveforms (continued)**
**Figure 6. Write Cycle 1 (WE Controlled) [24, 25, 26]**

**Figure 7. Write Cycle 2 (CE<sub>1</sub> or CE<sub>2</sub> Controlled) [24, 25, 26]**

**Notes**

24. The internal Write time of the memory is defined by the overlap of WE, CE<sub>1</sub> = V<sub>IL</sub>, BHE and/or BLE = V<sub>IL</sub>, and CE<sub>2</sub> = V<sub>IH</sub>. 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 should be referenced to the edge of the signal that terminates the write.
25. Data I/O is high impedance if OE = V<sub>IH</sub>.
26. If CE<sub>1</sub> goes HIGH and CE<sub>2</sub> goes LOW simultaneously with WE = V<sub>IH</sub>, the output remains in a high impedance state.
27. During this period the I/Os are in output state and input signals should not be applied.

**Switching Waveforms (continued)**
**Figure 8. Write Cycle 3 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[28]</sup>**

**Figure 9. Write Cycle 4 ( $\overline{\text{BHE/BLE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[28]</sup>**

**Notes**

28. If  $\overline{\text{CE}}_1$  goes HIGH and  $\text{CE}_2$  goes LOW simultaneously with  $\overline{\text{WE}} = V_{IH}$ , the output remains in a high impedance state.

29. During this period the I/Os are in output state and input signals should not be applied.

## Truth Table

<b>CE<sub>1</sub></b>	<b>CE<sub>2</sub></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 <sup>[30]</sup>	X	X	X <sup>[30]</sup>	X <sup>[30]</sup>	High Z	Deselect/Power-down	Standby (I <sub>SB</sub> )
X <sup>[30]</sup>	L	X	X	X <sup>[30]</sup>	X <sup>[30]</sup>	High Z	Deselect/Power-down	Standby (I <sub>SB</sub> )
X <sup>[30]</sup>	X <sup>[30]</sup>	X	X	H	H	High Z	Deselect/Power-down	Standby (I <sub>SB</sub> )
L	H	H	L	L	L	Data out (I/O <sub>0</sub> –I/O <sub>15</sub> )	Read	Active (I <sub>CC</sub> )
L	H	H	L	H	L	High Z (I/O <sub>8</sub> –I/O <sub>15</sub> ); Data out (I/O <sub>0</sub> –I/O <sub>7</sub> )	Read	Active (I <sub>CC</sub> )
L	H	H	L	L	H	Data out (I/O <sub>8</sub> –I/O <sub>15</sub> ); High Z (I/O <sub>0</sub> –I/O <sub>7</sub> )	Read	Active (I <sub>CC</sub> )
L	H	L	X	L	L	Data in (I/O <sub>0</sub> –I/O <sub>15</sub> )	Write	Active (I <sub>CC</sub> )
L	H	L	X	H	L	High Z (I/O <sub>8</sub> –I/O <sub>15</sub> ); Data in (I/O <sub>0</sub> –I/O <sub>7</sub> )	Write	Active (I <sub>CC</sub> )
L	H	L	X	L	H	Data in (I/O <sub>8</sub> –I/O <sub>15</sub> ); High Z (I/O <sub>0</sub> –I/O <sub>7</sub> )	Write	Active (I <sub>CC</sub> )
L	H	H	H	L	H	High Z	Output disabled	Active (I <sub>CC</sub> )
L	H	H	H	H	L	High Z	Output disabled	Active (I <sub>CC</sub> )
L	H	H	H	L	L	High Z	Output disabled	Active (I <sub>CC</sub> )

**Note**

30. The 'X' (Don't care) state for the chip enables and byte enables in the truth table refer to the logic state (either HIGH or LOW). Intermediate voltage levels on these pins is not permitted.

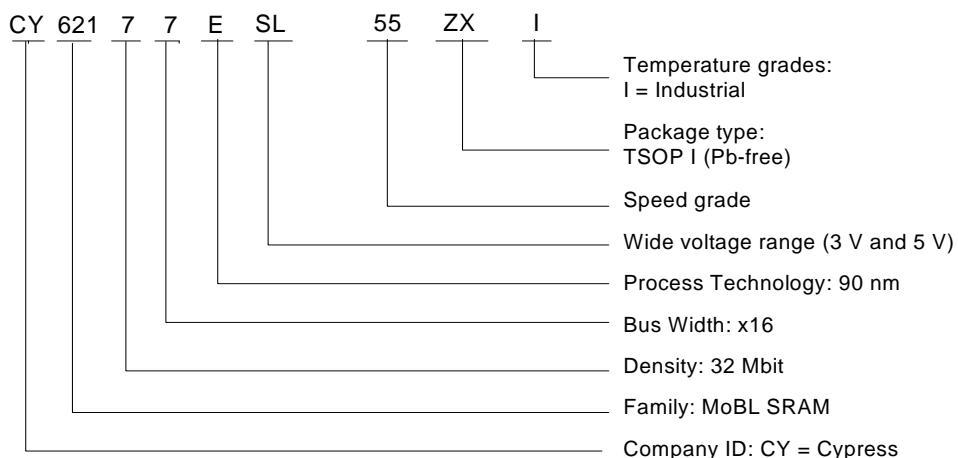
## Ordering Information

**Table 2** lists the CY62177ESL MoBL® key package features and ordering codes. The table contains only the parts that are currently available. If you do not see what you are looking for, contact your local sales representative. For more information, visit the Cypress website at [www.cypress.com](http://www.cypress.com) and refer to the product summary page at <http://www.cypress.com/products>.

**Table 2. Key Features and Ordering Information**

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
55	CY62177ESL-55ZXI	51-85183	48-pin TSOP-I (12 x 18.4 x 1 mm) Pb-free	Industrial

### Ordering Code Definitions

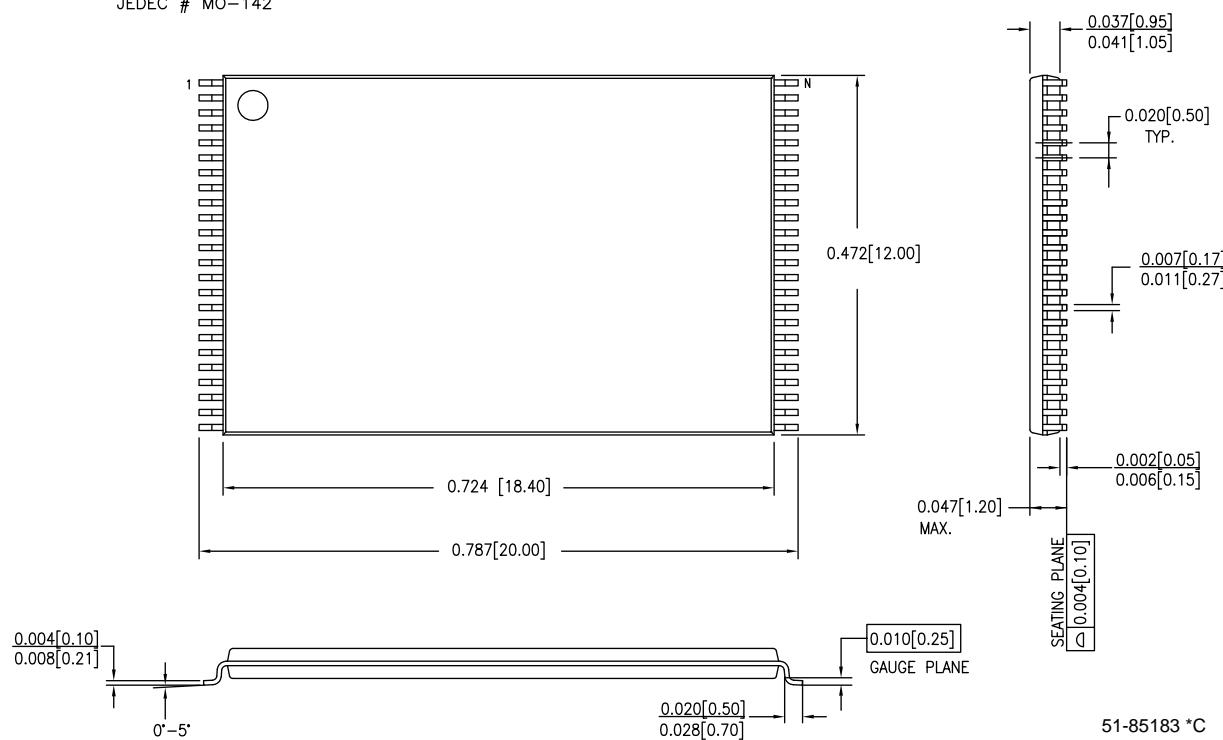


## Package Diagrams

Figure 10. 48-Pin TSOP I (12 x 18.4 x 1 mm), 51-85183

DIMENSIONS IN INCHES[MM] MIN.  
MAX.

JEDEC # MO-142



## Acronyms

Acronym	Description
CMOS	complementary metal oxide semiconductor
I/O	input/output
SRAM	static random access memory
TSOP	thin small outline package

## Document Conventions

### Units of Measure

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

## Document History Page

**Document Title:** CY62177ESL MoBL® 32-Mbit (2 M × 16/4 M × 8) Static RAM  
**Document Number:** 001-64709

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	3077028	RAME	11/02/10	New Datasheet
*A	3103863	RAME	12/07/2010	The specified part in the ordering information table is moved to production. No change in the datasheet.
*B	3433813	TAVA	11/16/2011	Removed footnote #1. Pin #13 of <a href="#">Figure 1</a> under Pin Configuration section changed from NC to DNU.

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