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CY62177ESL MoBL®

32-Mbit (2M × 16/4M × 8) Static RAM

Features

- Thin small outline package I (TSOP I) configurable as 2M × 16 or as 4M × 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 µA
  - Maximum standby current: 25 µA
- 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

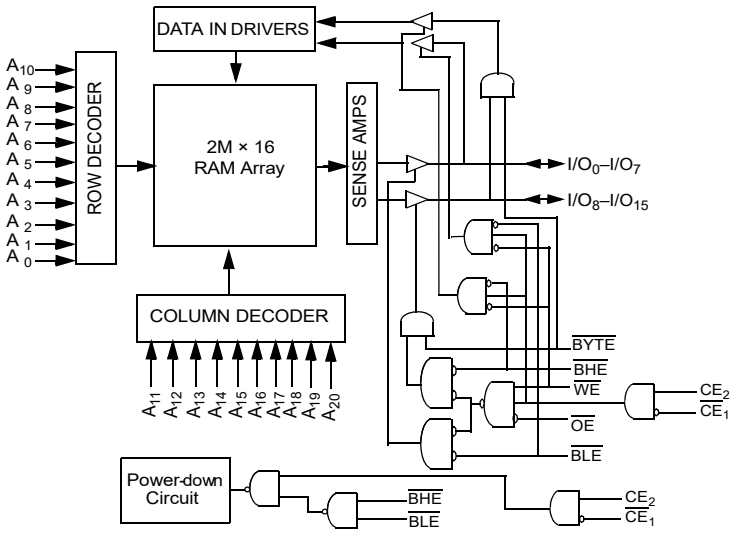
Functional Description

The CY62177ESL is a high performance CMOS static RAM organized as 2M words by 16 bits and 4M 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 ($\overline{CE}_1$ HIGH or CE_2 LOW or both $\overline{BHE}$ and $\overline{BLE}$ are HIGH). The input and output pins (I/O_0 through I/O_{15}) are placed in a high impedance state when: deselected ($\overline{CE}_1$ HIGH or 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, CE_2 HIGH and $\overline{WE}$ LOW).

To write to the device, take Chip Enables ($\overline{CE}_1$ LOW and CE_2 HIGH) and Write Enable ($\overline{WE}$) input 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_{20}). If Byte High Enable ($\overline{BHE}$) is LOW, then data from I/O pins (I/O_8 through I/O_{15}) is written to the location specified on the address pins (A_0 through A_{20}). To read from the device, take Chip Enables ($\overline{CE}_1$ LOW and 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 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.

For a complete list of related documentation, click here.

Logic Block Diagram



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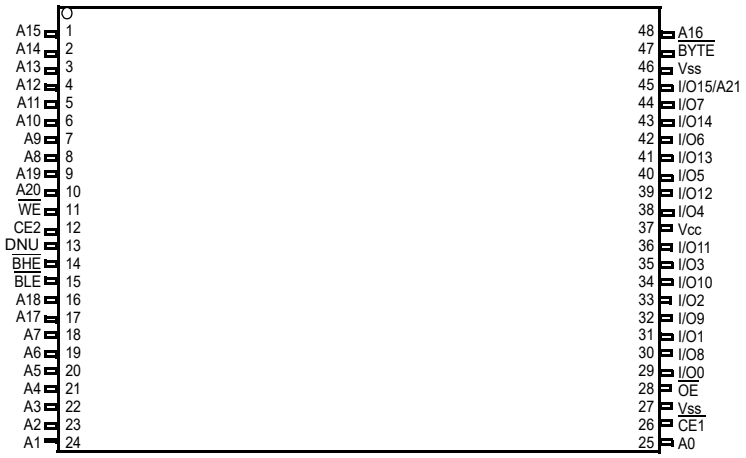
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Pin Configuration

Figure 1. 48-pin TSOP I pinout (Front View) [1, 2]



Product Portfolio

Product	V_{CC} Range (V)[3]	Speed (ns)	Power Dissipation					
			Operating I_{CC} (mA)				Standby I_{SB2} (µA)	
			f = 1 MHz		f = f_{Max}			
			Typ[4]	Max	Typ[4]	Max	Typ[4]	Max
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-pin TSOP-I package has to be tied to V_{CC} to use the device as a 2M × 16 SRAM. The 48-pin TSOP I package can also be used as a 4M × 8 SRAM by tying the BYTE signal to V_{SS}. In the 4M × 8 configuration, Pin 45 is A21, while BHE, BLE, and I/O_8 to I/O_{14} 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_{CC} = 3 V, and V_{CC} = 5 V, T_A = 25 °C.

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Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. 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 ..... –0.3 V to $V_{CC(max)}$ + 0.3 V

DC voltage applied to outputs in high Z state [5, 6] ..... –0.3 V to $V_{CC(max)}$ + 0.3 V

DC input voltage [5, 6] ..... –0.3 V to $V_{CC(max)}$ + 0.3 V

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

Static discharge voltage (per MIL-STD-883, method 3015) ..... ≥ 2001 V

Latch-up current ..... ≥ 200 mA

Operating Range

Device	Range	Ambient Temperature	V_{CC}[7]
CY62177ESL	Industrial	–40 °C to +85 °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 [8]	Max	
V_{OH}	Output HIGH voltage	2.2 V ≤ V_{CC} ≤ 2.7 V	I_{OH} = –0.1 mA	2.0	–	–	V
		2.7 V ≤ V_{CC} ≤ 3.6 V	I_{OH} = –1.0 mA	2.4	–	–	V
		4.5 V ≤ V_{CC} ≤ 5.5 V	I_{OH} = –1.0 mA	2.4	–	–	V
V_{OL}	Output LOW voltage	2.2 V ≤ V_{CC} ≤ 2.7 V	I_{OL} = 0.1 mA	–	–	0.4	V
		2.7 V ≤ V_{CC} ≤ 3.6 V	I_{OL} = 2.1 mA	–	–	0.4	V
		4.5 V ≤ V_{CC} ≤ 5.5 V	I_{OL} = 2.1 mA	–	–	0.4	V
V_{IH}	Input HIGH voltage	2.2 V ≤ V_{CC} ≤ 2.7 V		1.8	–	V_{CC} + 0.3 V	V
		2.7 V ≤ V_{CC} ≤ 3.6 V		2.2	–	V_{CC} + 0.3 V	V
		4.5 V ≤ V_{CC} ≤ 5.5 V		2.2	–	V_{CC} + 0.3 V	V
V_{IL}	Input LOW voltage	2.2 V ≤ V_{CC} ≤ 2.7 V		–0.3	–	0.6	V
		2.7 V ≤ V_{CC} ≤ 3.6 V		–0.3	–	0.7[9]	V
		4.5 V ≤ V_{CC} ≤ 5.5 V		–0.3	–	0.7[9]	V
I_{IX}	Input leakage current	GND ≤ V_I ≤ V_{CC}		–1	–	+1	µA
I_{OZ}	Output leakage current	GND ≤ V_O ≤ V_{CC}, Output disabled		–1	–	+1	µA
I_{CC}	V_{CC} operating supply current	f = f_{Max} = 1/t_{RC}	V_{CC} = $V_{CC(max)}$, I_{OUT} = 0 mA CMOS levels	–	35	45	mA
		f = 1 MHz		–	4.5	5.5	mA
I_{SB2} [10]	Automatic power-down current — CMOS inputs	$\overline{CE}_1$ ≥ V_{CC} – 0.2 V or CE_2 ≤ 0.2 V or ($\overline{BHE}$ and $\overline{BLE}$) ≥ V_{CC} – 0.2 V, V_{IN} ≥ V_{CC} – 0.2 V or V_{IN} ≤ 0.2 V, f = 0, V_{CC} = 3.6 V		–	3	25	µA

Notes

5. $V_{IL(min)}$ = –2.0 V for pulse durations less than 20 ns.
6. $V_{IH(max)}$ = V_{CC} + 0.75 V for pulse durations less than 20 ns.
7. Full Device AC operation assumes a 100 µs ramp time from 0 to V_{CC} (min) and 200 µs wait time after V_{CC} stabilization.
8. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V_{CC} = 3 V, and V_{CC} = 5 V, T_A = 25 °C
9. Under DC conditions the device meets a V_{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 ($\overline{CE}_1$ and CE_2), byte enables ($\overline{BHE}$ and $\overline{BLE}$) and $\overline{BYTE}$ must be tied to CMOS levels to meet the I_{SB2}/I_{CCDR} spec. Other inputs can be left floating.

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Capacitance

Parameter [11]	Description	Test Conditions	Max	Unit
C_{IN}	Input capacitance	T_A = 25 °C, f = 1 MHz, V_{CC} = $V_{CC(typ)}$	15	pF
C_{OUT}	Output capacitance		15	pF

Thermal Resistance

Parameter [11]	Description	Test Conditions	TSOP I	Unit
Θ_{JA}	Thermal resistance (junction to ambient)	Still air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	55.91	°C/W
Θ_{JC}	Thermal resistance (junction to case)		9.39	°C/W

AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms

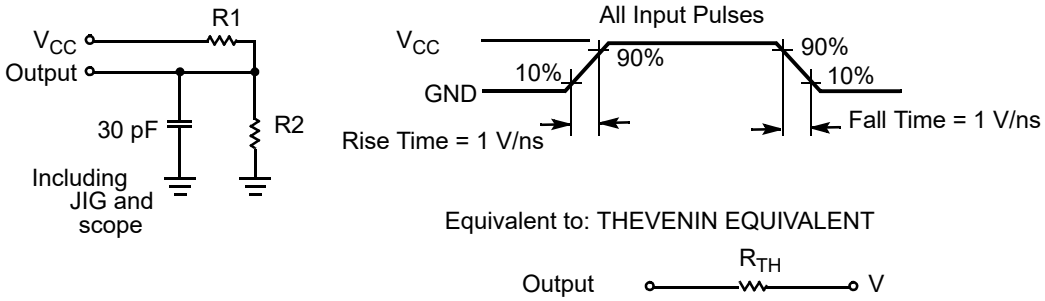


Table 1. AC Test Loads

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

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

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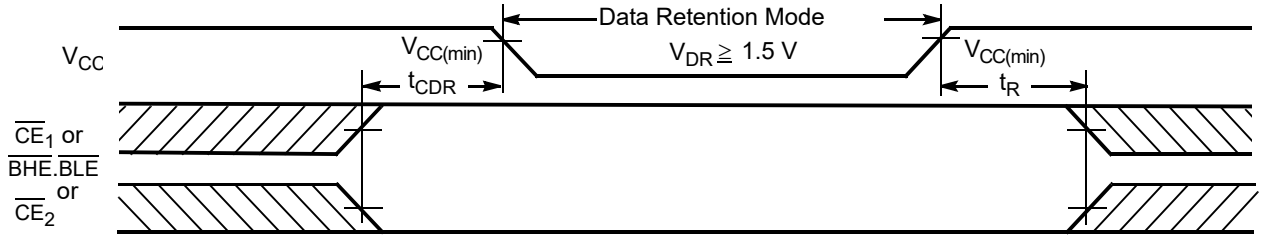
Data Retention Characteristics

Over the operating range

Parameter	Description	Conditions	Min	Typ [12]	Max	Unit
V_{DR}	V_{CC} for data retention		1.5	–	–	V
I_{CCDR} [13]	Data retention current	V_{CC} = 1.5 V, $\overline{CE}_1 \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V or ($\overline{BHE}$ and $\overline{BLE}$) $\geq V_{CC} - 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V	–	–	17	µA
t_{CDR}[14]	Chip deselect to data retention time	–	0	–	–	ns
t_R[15]	Operation recovery time	–	55	–	–	ns

Data Retention Waveform

Figure 3. Data Retention Waveform [16]



Notes

12. Typical values are included only for reference and are not guaranteed or tested. Typical values are measured at V_{CC} = 3 V, and V_{CC} = 5 V, T_A = 25 °C.
13. Chip enables ($\overline{CE}$1 and CE2), byte enables ($\overline{BHE}$ and $\overline{BLE}$) and $\overline{BYTE}$ must be tied to CMOS levels to meet the I_{SB2}/I_{CCDR} spec. Other inputs can be left floating.
14. Tested initially and after any design or process changes that may affect these parameters.
15. Full device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min)} \geq 100$ µs or stable at $V_{CC(min)} \geq 100$ µs.
16. $\overline{BHE}.\overline{BLE}$ is the AND of both $\overline{BHE}$ and $\overline{BLE}$. Chip is deselected by either disabling the chip enable signals or by disabling both $\overline{BHE}$ and $\overline{BLE}$.

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Switching Characteristics

Over the operating range

Parameter [17, 18]	Description	55 ns		Unit
		Min	Max	
Read Cycle				
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[19]	5	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to high Z[19, 20]	–	18	ns
t_{LZCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to low Z[19]	10	–	ns
t_{HZCE}	$\overline{CE}_1$ HIGH and CE_2 LOW to high Z[19, 20]	–	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}	BLE/BHE LOW to data valid	–	55	ns
t_{LZBE}	$\overline{BLE}/\overline{BHE}$ LOW to low Z [19]	10	–	ns
t_{HZBE}	$\overline{BLE}/\overline{BHE}$ HIGH to high Z [19, 20]	–	18	ns
Write Cycle[21]				
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[19, 20]	–	20	ns
t_{LZWE}	$\overline{WE}$ HIGH to low Z[19]	10	–	ns

Notes

17. In an earlier revision of this device, under a specific application condition, READ and WRITE operations were limited to switching of the byte enable and/or chip enable signals as described in the Application Note AN66311. However, the issue has been fixed and in production now, and hence, this Application Note is no longer applicable. It is available for download on our website as it contains information on the date code of the parts, beyond which the fix has been in production.
18. Test conditions for all parameters other than tristate parameters assume signal transition time of 1 V/ns, timing reference levels of $V_{CC(typ)}/2$, input pulse levels of 0 to $V_{CC(typ)}$, and output loading of the specified I_{OL}/I_{OH} as shown in Figure 2 on page 5.
19. 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.
20. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the outputs enter a high impedence state.
21. The internal Write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE}_1 = V_{IL}$, $\overline{BHE}$ 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.

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Switching Waveforms

Figure 4. Read Cycle No. 1 (Address Transition Controlled) [22, 23]

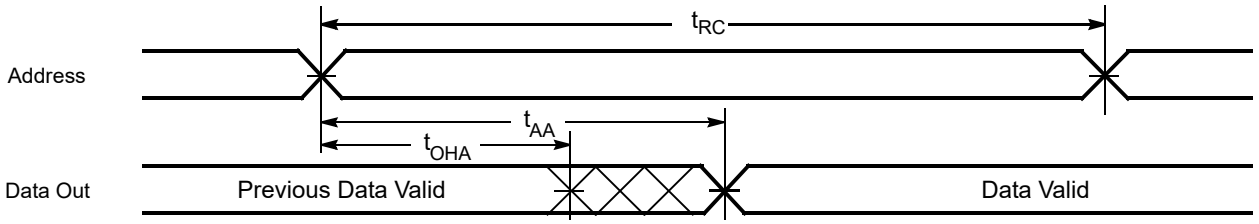
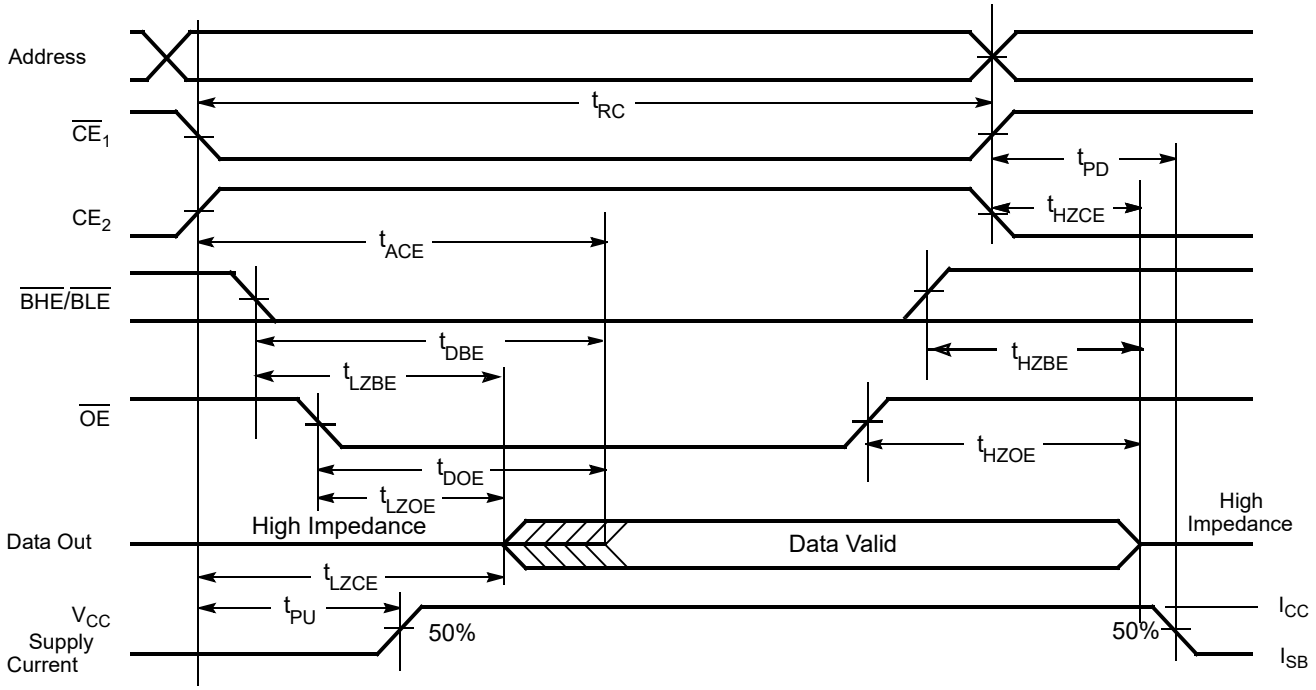


Figure 5. Read Cycle No. 2 ($\overline{OE}$ Controlled) [23, 24]



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

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Switching Waveforms (continued)

Figure 6. Write Cycle No. 1 ($\overline{WE}$ Controlled) [25, 26, 27]

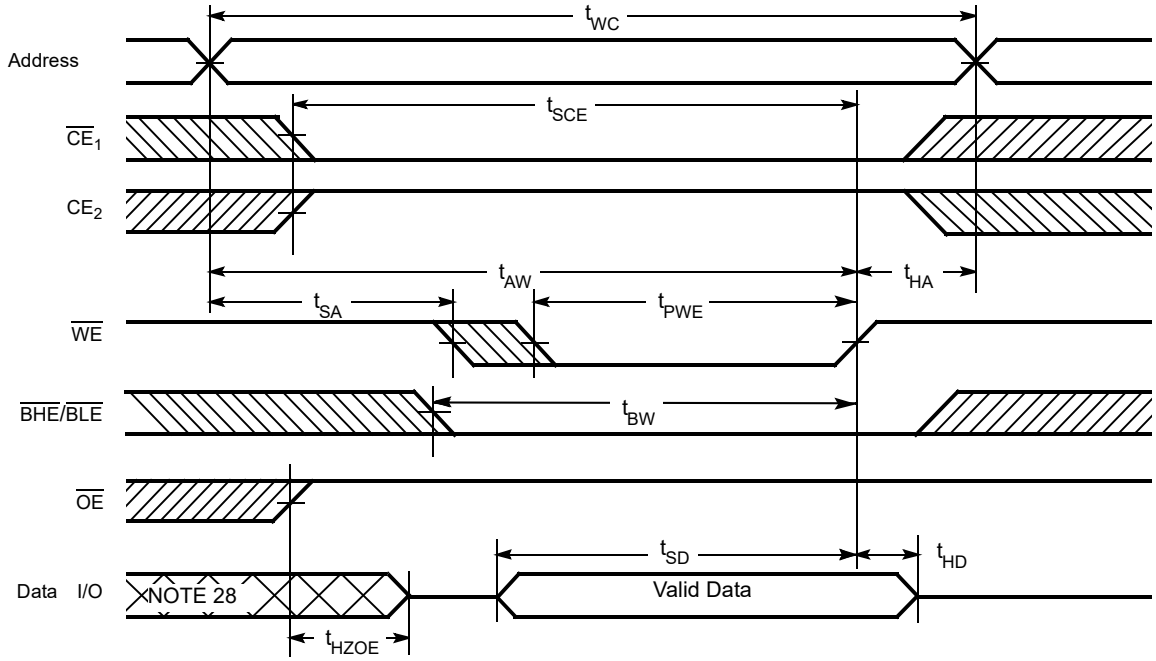
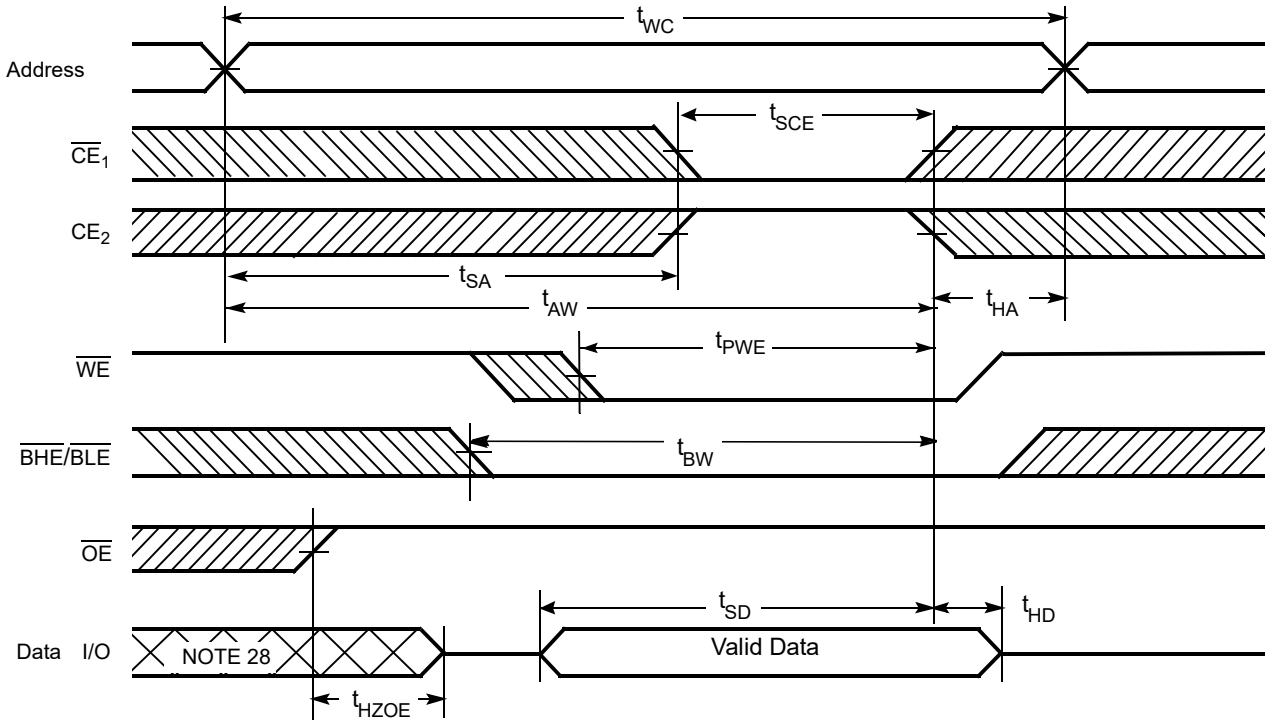


Figure 7. Write Cycle No. 2 ($\overline{CE_1}$ or CE_2 Controlled) [25, 26, 27]



Notes

25. The internal Write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE_1}$ = 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.
26. Data I/O is high impedance if $\overline{OE}$ = V_{IH}.
27. If $\overline{CE_1}$ goes HIGH and CE_2 goes LOW simultaneously with $\overline{WE}$ = V_{IH}, the output remains in a high impedance state.
28. During this period the I/Os are in output state and input signals should not be applied.

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Switching Waveforms (continued)

Figure 8. Write Cycle No. 3 (WE Controlled, OE LOW) [29]

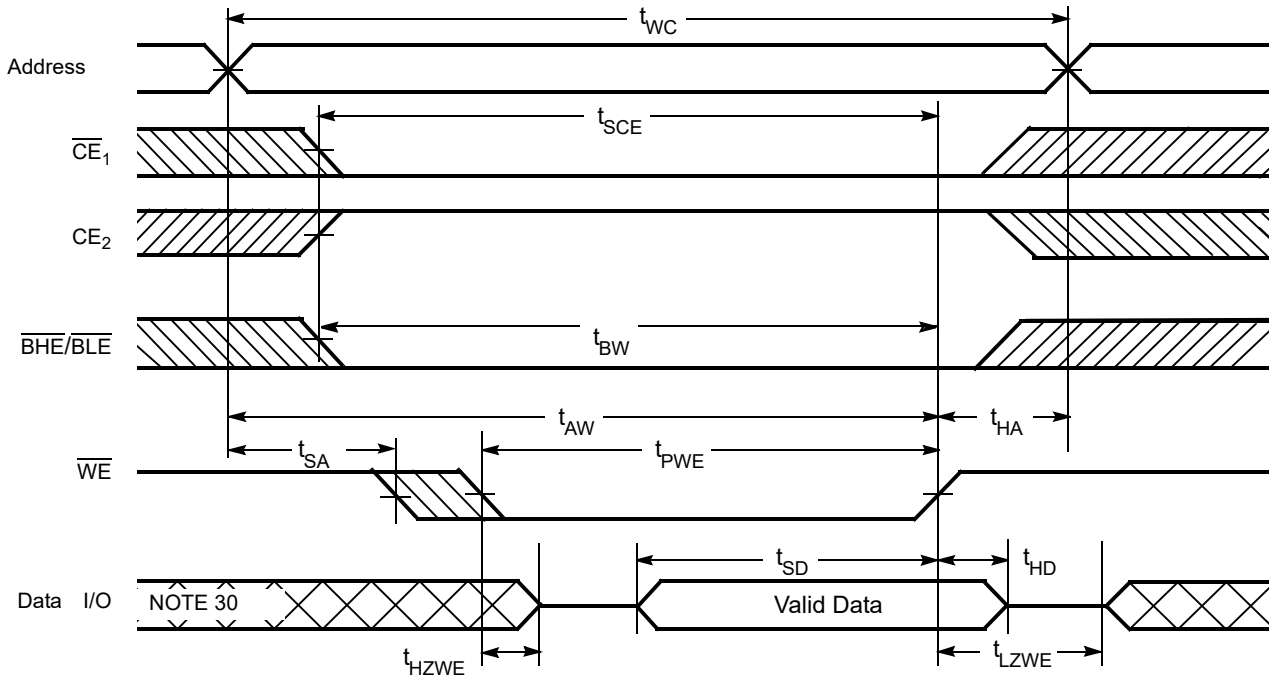
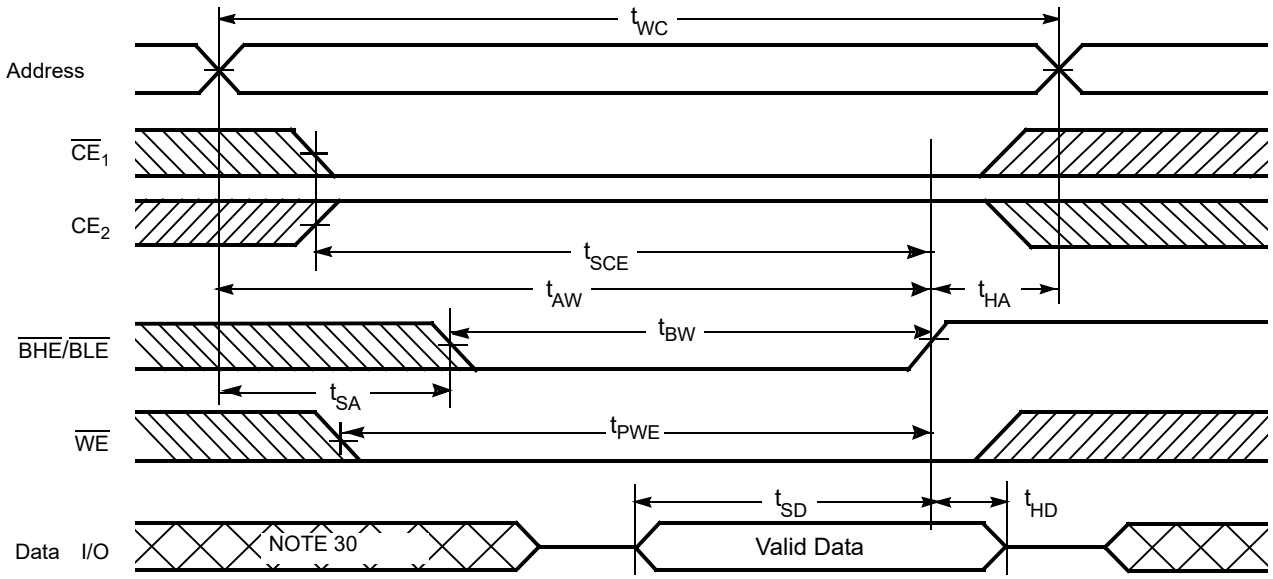


Figure 9. Write Cycle No. 4 (BHE/BLE Controlled, OE LOW) [29]



Notes
29. If $\overline{CE}_1$ goes HIGH and CE_2 goes LOW simultaneously with $\overline{WE}$ = V_{IH}, the output remains in a high impedance state.
30. During this period the I/Os are in output state and input signals should not be applied.

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Truth Table

$\overline{CE_1}$	CE_2	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs Outputs	Mode	Power
H	X[31]	X	X	X[31]	X[31]	High Z	Deselect/Power-down	Standby (I_{SB})
X[31]	L	X	X	X[31]	X[31]	High Z	Deselect/Power-down	Standby (I_{SB})
X[31]	X[31]	X	X	H	H	High Z	Deselect/Power-down	Standby (I_{SB})
L	H	H	L	L	L	Data out (I/O_0–I/O_{15})	Read	Active (I_{CC})
L	H	H	L	H	L	High Z (I/O_8–I/O_{15}); Data out (I/O_0–I/O_7)	Read	Active (I_{CC})
L	H	H	L	L	H	Data out (I/O_8–I/O_{15}); High Z (I/O_0–I/O_7)	Read	Active (I_{CC})
L	H	L	X	L	L	Data in (I/O_0–I/O_{15})	Write	Active (I_{CC})
L	H	L	X	H	L	High Z (I/O_8–I/O_{15}); Data in (I/O_0–I/O_7)	Write	Active (I_{CC})
L	H	L	X	L	H	Data in (I/O_8–I/O_{15}); High Z (I/O_0–I/O_7)	Write	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})

Note
31. 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.

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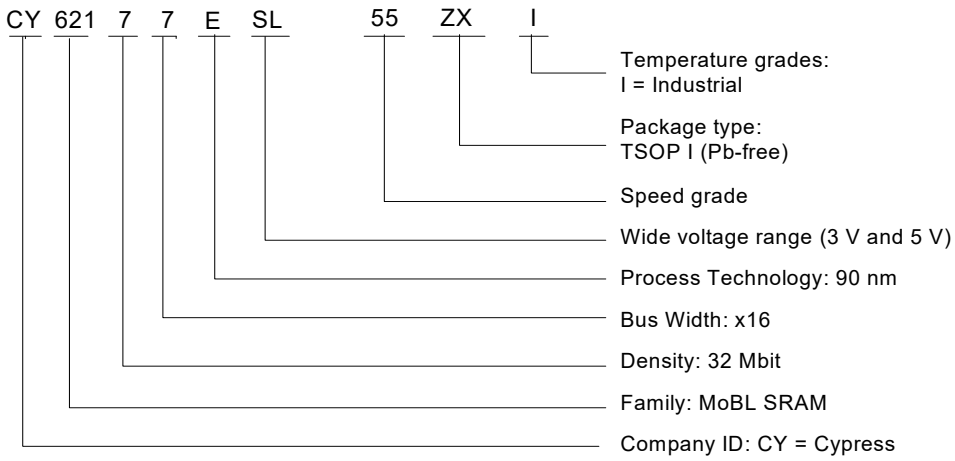
Ordering Information

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 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 × 18.4 × 1 mm) Pb-free	Industrial

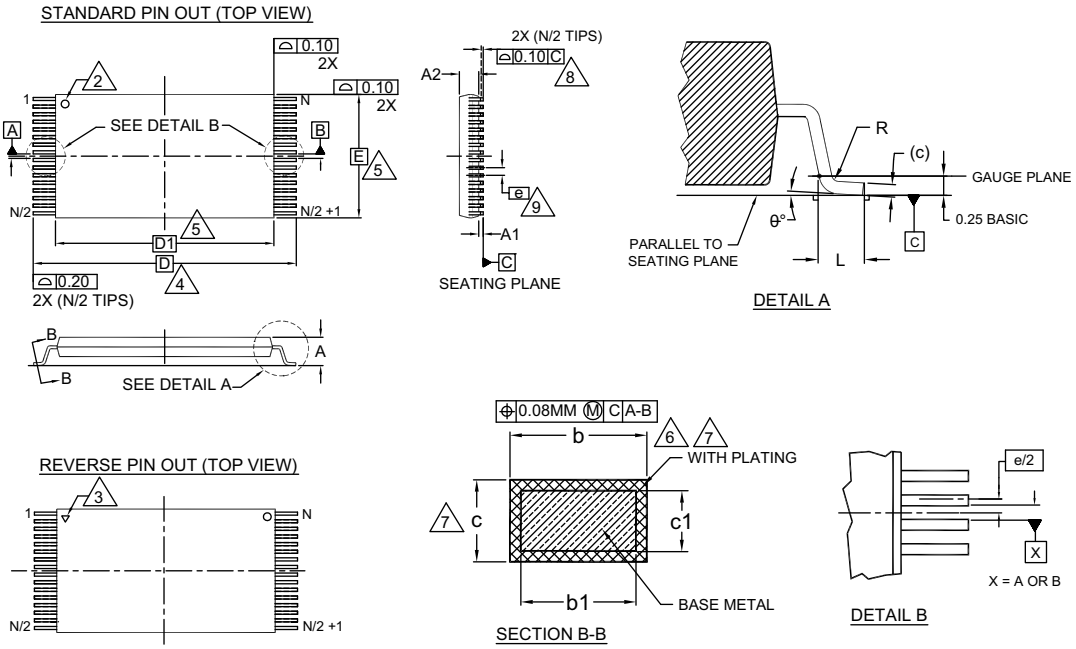
Ordering Code Definitions



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Package Diagrams

Figure 10. 48-pin TSOP I (12 × 18.4 × 1 mm) Z48A Package Outline, 51-85183



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	—	—	1.20
A1	0.05	—	0.15
A2	0.95	1.00	1.05
b1	0.17	0.20	0.23
b	0.17	0.22	0.27
c1	0.10	—	0.16
c	0.10	—	0.21
D	20.00 BASIC		
D1	18.40 BASIC		
E	12.00 BASIC		
e	0.50 BASIC		
L	0.50	0.60	0.70
θ	0°	—	8
R	0.08	—	0.20
N	48		

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS (mm).
2. PIN 1 IDENTIFIER FOR STANDARD PIN OUT (DIE UP).
3. PIN 1 IDENTIFIER FOR REVERSE PIN OUT (DIE DOWN): INK OR LASER MARK.
4. TO BE DETERMINED AT THE SEATING PLANE -C- . THE SEATING PLANE IS DEFINED AS THE PLANE OF CONTACT THAT IS MADE WHEN THE PACKAGE LEADS ARE ALLOWED TO REST FREELY ON A FLAT HORIZONTAL SURFACE.
5. DIMENSIONS D1 AND E DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION ON E IS 0.15mm PER SIDE AND ON D1 IS 0.25mm PER SIDE.
6. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF b DIMENSION AT MAX. MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD TO BE 0.07mm .
7. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
8. LEAD COPLANARITY SHALL BE WITHIN 0.10mm AS MEASURED FROM THE SEATING PLANE.
9. DIMENSION "e" IS MEASURED AT THE CENTERLINE OF THE LEADS.
10. JEDEC SPECIFICATION NO. REF: MO-142(D)DD.

51-85183 *F

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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	degree Celsius
MHz	megahertz
µA	microampere
mA	milliampere
ns	nanosecond
Ω	ohm
pF	picofarad
V	volt
W	watt

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Document History Page

Document Title: CY62177ESL MoBL®, 32-Mbit (2M × 16/4M × 8) Static RAM Document Number: 001-64709				
Revision	**ECN**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	3077028	RAME	11/02/2010	New data sheet.
*A	3103863	RAME	12/07/2010	Updated Ordering Information: No change in part numbers. The MPN CY62177ESL-55ZXI is moved to production.
*B	3433813	TAVA	11/16/2011	Updated Functional Description: Removed Note “For best practice recommendations, refer to the Cypress application note System Design Guidelines.” and its reference. Updated Pin Configuration: Updated Figure 1 (Changed pin 13 from NC to DNU). Completing Sunset Review.
*C	4101093	VINI	08/21/2013	Updated Switching Characteristics: Added Note 17 and referred the same note in “Parameter” column. Updated to new template.
*D	4573215	VINI	11/18/2014	Updated Functional Description: Added “For a complete list of related documentation, click here.” at the end. Completing Sunset Review.
*E	5016184	NILE	11/17/2015	Updated Thermal Resistance: Replaced “two-layer” with “four-layer” in “Test Conditions” column. Changed value of Θ_{JA} parameter corresponding to TSOP I package from 44.66 °C/W to 55.91 °C/W. Changed value of Θ_{JC} parameter corresponding to TSOP I package from 12.12 °C/W to 9.39 °C/W. Updated Package Diagrams: spec 51-85183 – Changed revision from *C to *D. Updated to new template. Completing Sunset Review.
*F	6383009	NILE	11/13/2018	Updated Package Diagrams: spec 51-85183 – Changed revision from *D to *F. Updated to new template. Completing Sunset Review.

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