CY62146ESL MoBL®

4-Mbit (256K x 16) Static RAM

Features

- Very high speed: 45 ns
- Wide voltage range: 2.2V–3.6V and 4.5V–5.5V
- Ultra low standby power
  - Typical Standby current: 1 µA
  - Maximum Standby current: 7 µA
- Ultra low active power
  - Typical active current: 2 mA at f = 1 MHz
- Easy memory expansion with $\overline{CE}$ and $\overline{OE}$ features
- Automatic power down when deselected
- CMOS for optimum speed and power
- Available in Pb-free 44-pin TSOP II package

Functional Description

The CY62146ESL is a high performance CMOS static RAM organized as 256K 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 reduces power consumption when addresses are not toggling. Placing the device into standby mode reduces power consumption by more than 99% when deselected ($\overline{CE}$ HIGH). The input and output pins (IO_0 through IO_{15}) are placed in a high impedance state when:

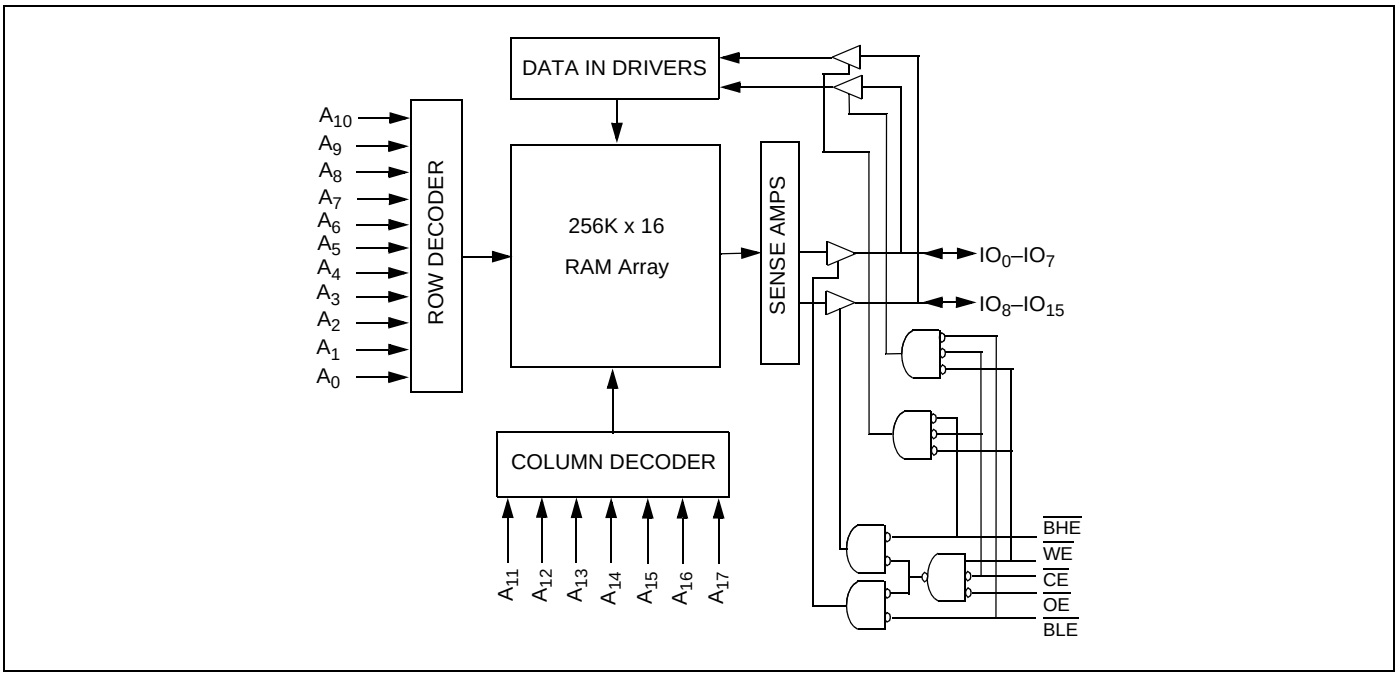
- Deselected ($\overline{CE}$ HIGH)
- Outputs are disabled ($\overline{OE}$ HIGH)
- Both Byte High Enable and Byte Low Enable are disabled ($\overline{BHE}$, $\overline{BLE}$ HIGH)
- Write operation is active ($\overline{CE}$ LOW and $\overline{WE}$ LOW)

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 IO pins (IO_0 through IO_7) is written into the location specified on the address pins (A_0 through A_{17}). If Byte High Enable ($\overline{BHE}$) is LOW, then data from IO pins (IO_8 through IO_{15}) is written into the location specified on the address pins (A_0 through A_{17}).

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 appears on IO_0 to IO_7. If Byte High Enable ($\overline{BHE}$) is LOW, then data from memory appears on IO_8 to IO_{15}. See the "Truth Table" on page 10 for a complete description of read and write modes.

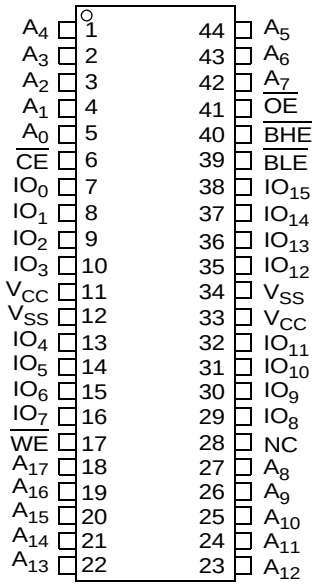
For best practice recommendations, refer to the Cypress application note AN1064, SRAM System Guidelines.

Logic Block Diagram



Pin Configuration

Figure 1. 44-Pin TSOP II (Top View) [1]



Product Portfolio

Product	Range	V_{CC} Range (V) [2]	Speed (ns)	Power Dissipation					
				Operating I_{CC}, (mA)				Standby, I_{SB2} (µA)	
				f = 1MHz		f = f_{max}			
				Typ [3]	Max	Typ [3]	Max	Typ [3]	Max
CY62146ESL	Industrial	2.2V–3.6V and 4.5V–5.5V	45	2	2.5	15	20	1	7

Notes
1. NC pins are not connected on the die.
2. Datasheet specifications are not guaranteed for V_{CC} in the range of 3.6V to 4.5V.
3. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V_{CC} = 3V, and V_{CC} = 5V, T_A = 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.....–0.5V to 6.0V

DC Voltage Applied to Outputs in High-Z State[4, 5] .....–0.5V to 6.0V

DC Input Voltage[4, 5] .....–0.5V to 6.0V

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

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

Latch up Current..... >200 mA

Operating Range

Device	Range	Ambient Temperature	V_{CC}[6]
CY62146ESL	Industrial	–40°C to +85°C	2.2V–3.6V, and 4.5V–5.5V

Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions		45 ns			Unit
				Min	Typ [3]	Max	
V_{OH}	Output HIGH Voltage	$2.2 \le V_{CC} \le 2.7$	I_{OH} = –0.1 mA	2.0			V
		$2.7 \le V_{CC} \le 3.6$	I_{OH} = –1.0 mA	2.4			
		$4.5 \le V_{CC} \le 5.5$	I_{OH} = –1.0 mA	2.4			
V_{OL}	Output LOW Voltage	$2.2 \le V_{CC} \le 2.7$	I_{OL} = 0.1 mA			0.4	V
		$2.7 \le V_{CC} \le 3.6$	I_{OL} = 2.1mA			0.4	
		$4.5 \le V_{CC} \le 5.5$	I_{OL} = 2.1mA			0.4	
V_{IH}	Input HIGH Voltage	$2.2 \le V_{CC} \le 2.7$		1.8		V_{CC} + 0.3	V
		$2.7 \le V_{CC} \le 3.6$		2.2		V_{CC} + 0.3	
		$4.5 \le V_{CC} \le 5.5$		2.2		V_{CC} + 0.5	
V_{IL}	Input LOW Voltage	$2.2 \le V_{CC} \le 2.7$		–0.3		0.6	V
		$2.7 \le V_{CC} \le 3.6$		–0.3		0.8	
		$4.5 \le V_{CC} \le 5.5$		–0.5		0.8	
I_{IX}	Input Leakage Current	$GND \le V_I \le V_{CC}$		–1		+1	µA
I_{OZ}	Output Leakage Current	$GND \le V_O \le V_{CC}$, Output Disabled		–1		+1	µA
I_{CC}	V_{CC} Operating Supply Current	$f = f_{max} = 1/t_{RC}$	$V_{CC} = V_{CCmax}$, I_{OUT} = 0 mA, CMOS levels		15	20	mA
		f = 1 MHz			2	2.5	
I_{SB1}	Automatic CE Power down Current — CMOS Inputs	$\overline{CE} \ge V_{CC}$ – 0.2V, $V_{IN} \ge V_{CC}$ – 0.2V or $V_{IN} \le 0.2V$, f = f_{max} (Address and Data Only), f = 0 ($\overline{OE}$, $\overline{BHE}$, $\overline{BLE}$ and $\overline{WE}$), $V_{CC} = V_{CC(max)}$			1	7	µA
I_{SB2}	Automatic CE Power down Current — CMOS Inputs	$\overline{CE} \ge V_{CC}$ – 0.2V, $V_{IN} \ge V_{CC}$ – 0.2V or $V_{IN} \le 0.2V$, f = 0, $V_{CC} = V_{CC(max)}$			1	7	µA

Notes

4. V_{IL}(min) = –2.0V for pulse durations less than 20 ns.
5. V_{IH}(max) = V_{CC} + 0.75V for pulse durations less than 20 ns.
6. 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.

Capacitance

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

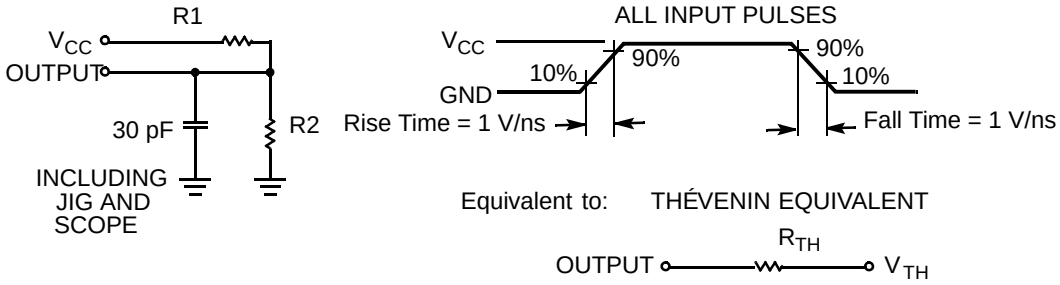
Parameter	Description	Test Conditions	Max	Unit
C_{IN}	Input Capacitance	T_A = 25°C, f = 1 MHz, V_{CC} = $V_{CC(typ)}$	10	pF
C_{OUT}	Output Capacitance		10	pF

Thermal Resistance

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

Parameter	Description	Test Conditions	TSOP II	Unit
Θ_{JA}	Thermal Resistance (Junction to Ambient)	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	77	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		13	°C/W

AC Test Loads and Waveforms



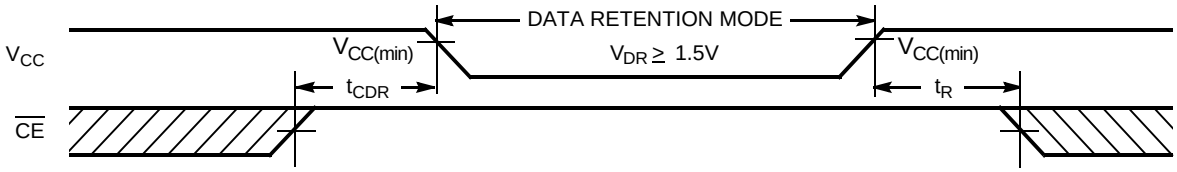
Parameters	2.5V	3.0V	5.0V	Unit
R1	16667	1103	1800	Ω
R2	15385	1554	990	Ω
R_{TH}	8000	645	639	Ω
V_{TH}	1.20	1.75	1.77	V

Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions		Min	Typ[3]	Max	Unit
V_{DR}	V_{CC} for Data Retention			1.5			V
I_{CCDR}	Data Retention Current	$\overline{CE} \geq V_{CC} - 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	V_{CC} = 1.5V		1	7	µA
t_{CDR} [7]	Chip Deselect to Data Retention Time			0			ns
t_R [8]	Operation Recovery Time			t_{RC}			ns

Data Retention Waveform



Notes

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

Switching Characteristics

Over the Operating Range [9]

Parameter	Description	45 ns		Unit
		Min	Max	
Read Cycle				
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[10]	5		ns
t_{HZOE}	$\overline{OE}$ HIGH to High-Z[10, 11]		18	ns
t_{LZCE}	$\overline{CE}$ LOW to Low-Z[10]	10		ns
t_{HZCE}	$\overline{CE}$ HIGH to High-Z[10, 11]		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		22	ns
t_{LZBE}	$\overline{BLE}$/$\overline{BHE}$ LOW to Low-Z[10]	5		ns
t_{HZBE}	$\overline{BLE}$/$\overline{BHE}$ HIGH to HIGH-Z[10, 11]		18	ns
Write Cycle[12]				
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[10, 11]		18	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low-Z[10]	10		ns

Notes

9. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3V, and output loading of the specified I_{OL}/I_{OH} as shown in the AC Test Loads and Waveforms on page 4.
10. 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.
11. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the outputs enter a high-impedance state.
12. 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 2. Read Cycle No.1: Address Transition Controlled. [13, 14]

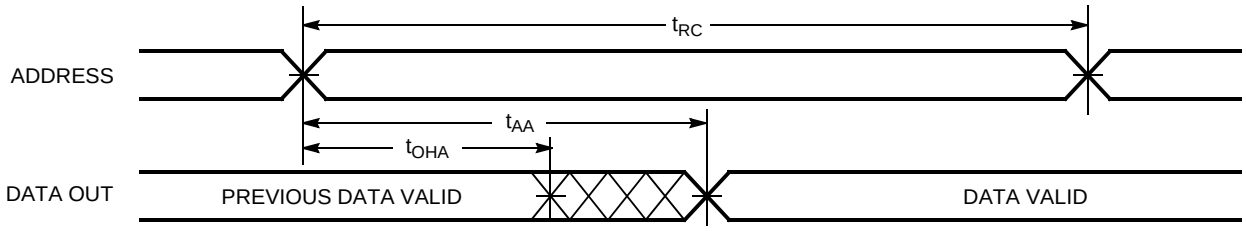
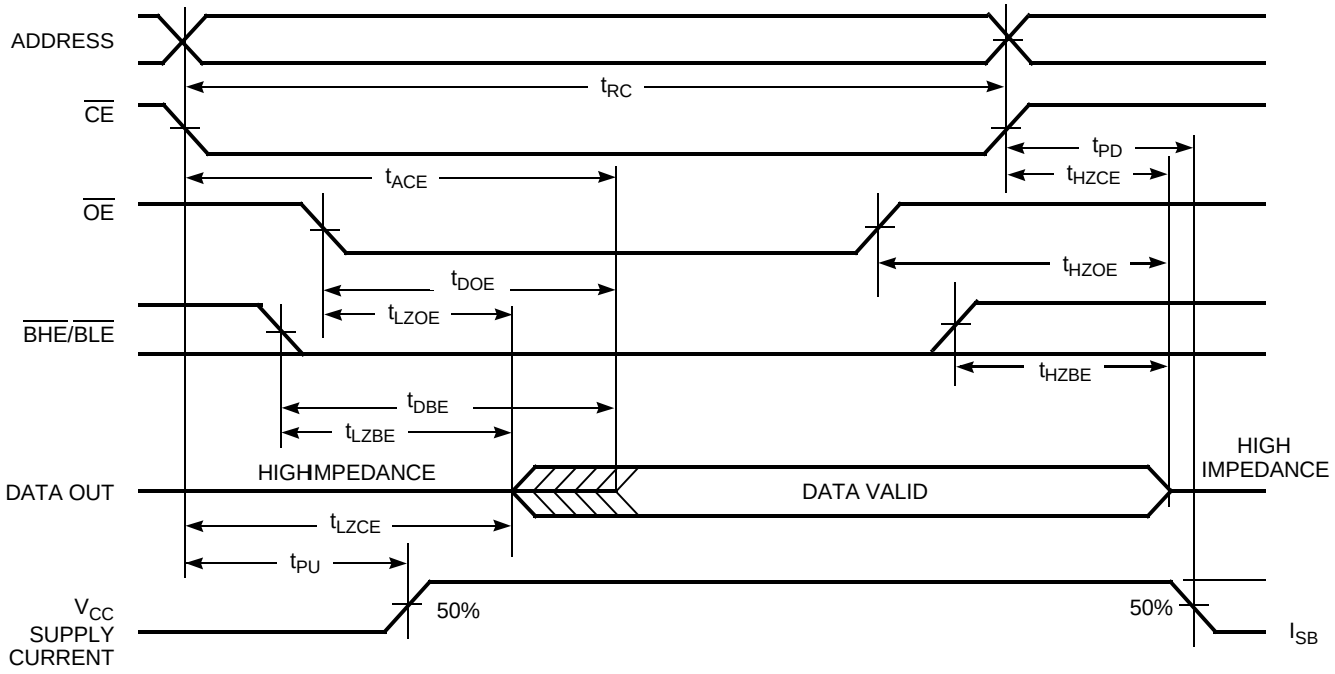


Figure 3. Read Cycle No. 2: $\overline{OE}$ Controlled [14, 15]



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

Switching Waveforms (continued)

Figure 4. Write Cycle No 1: $\overline{WE}$ Controlled [12, 16, 17]

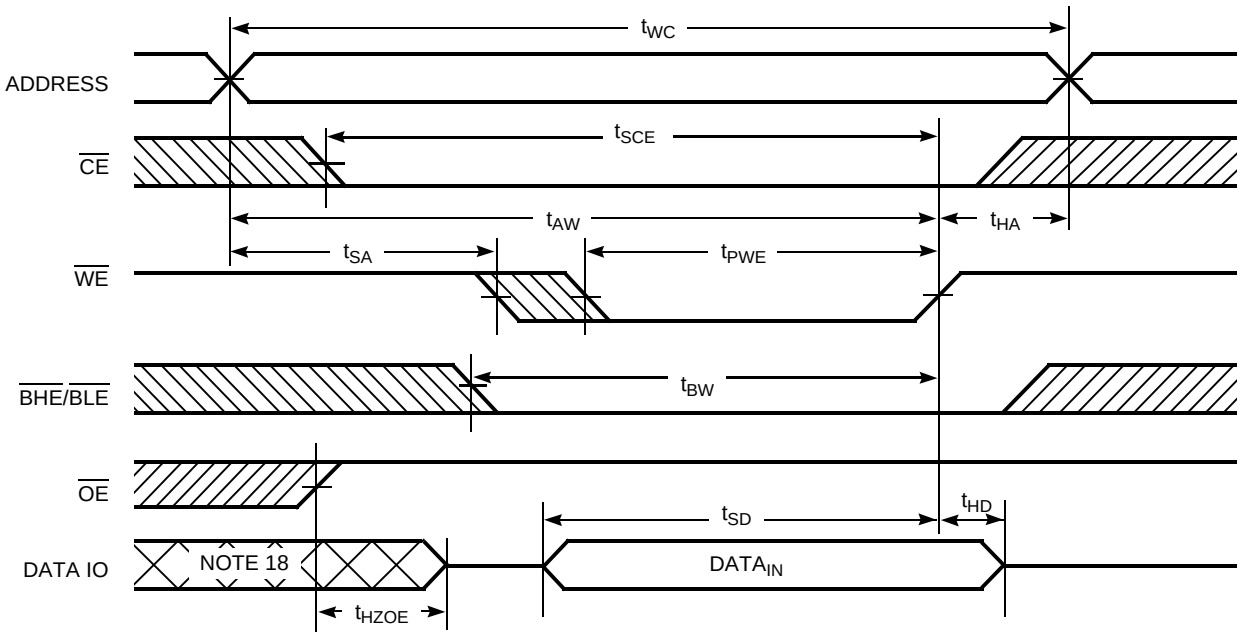
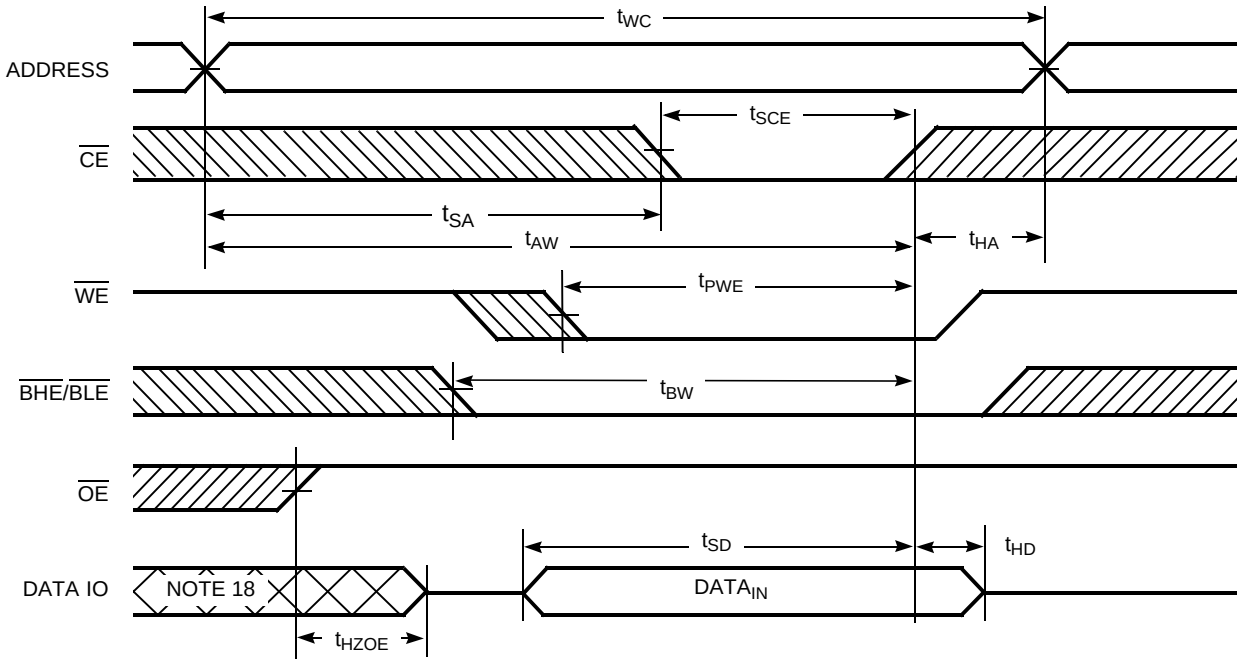


Figure 5. Write Cycle 2: $\overline{CE}$ Controlled [12, 16, 17]



Notes
16. Data IO is high impedance if $\overline{OE}$ = V_{IH}.
17. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ = V_{IH}, the output remains in a high impedance state.
18. During this period, the IOs are in output state. Do not apply input signals.

Switching Waveforms (continued)

Figure 6. Write Cycle 3: $\overline{WE}$ controlled, $\overline{OE}$ LOW [17]

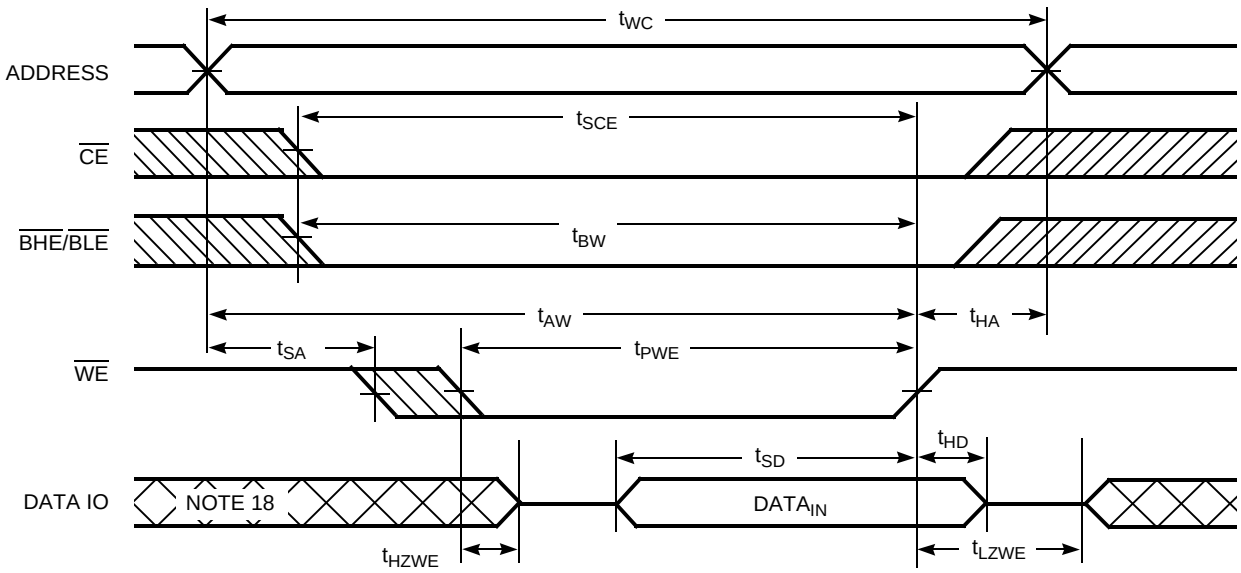
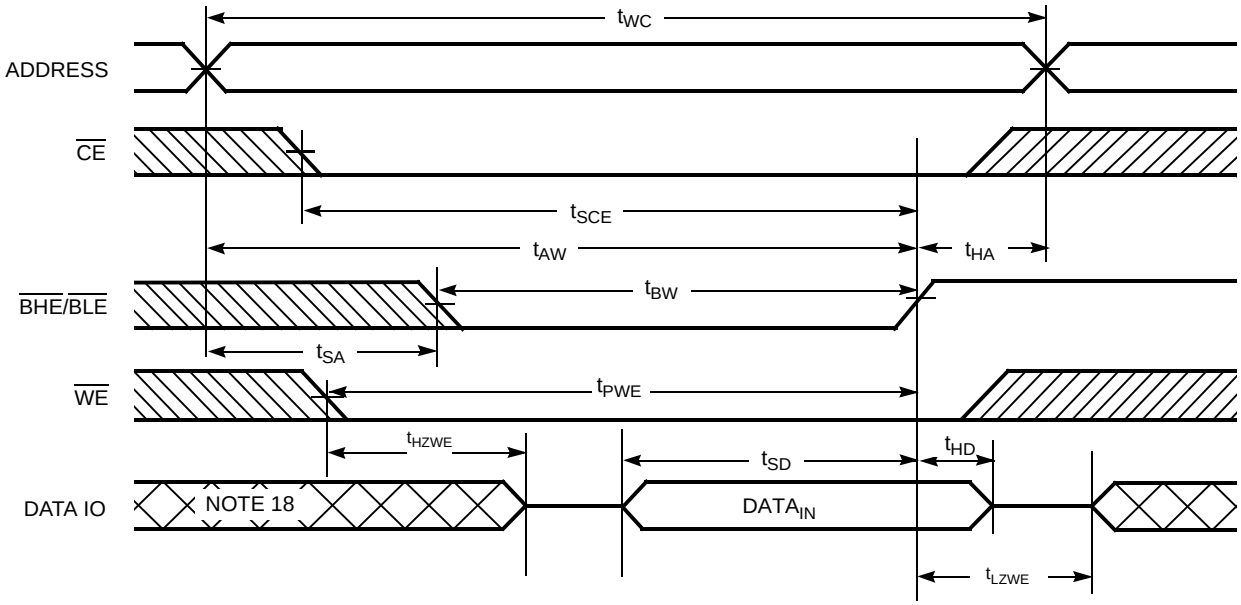


Figure 7. Write Cycle 4: $\overline{BHE}$/$\overline{BLE}$ Controlled, $\overline{OE}$ LOW [17]



Truth Table

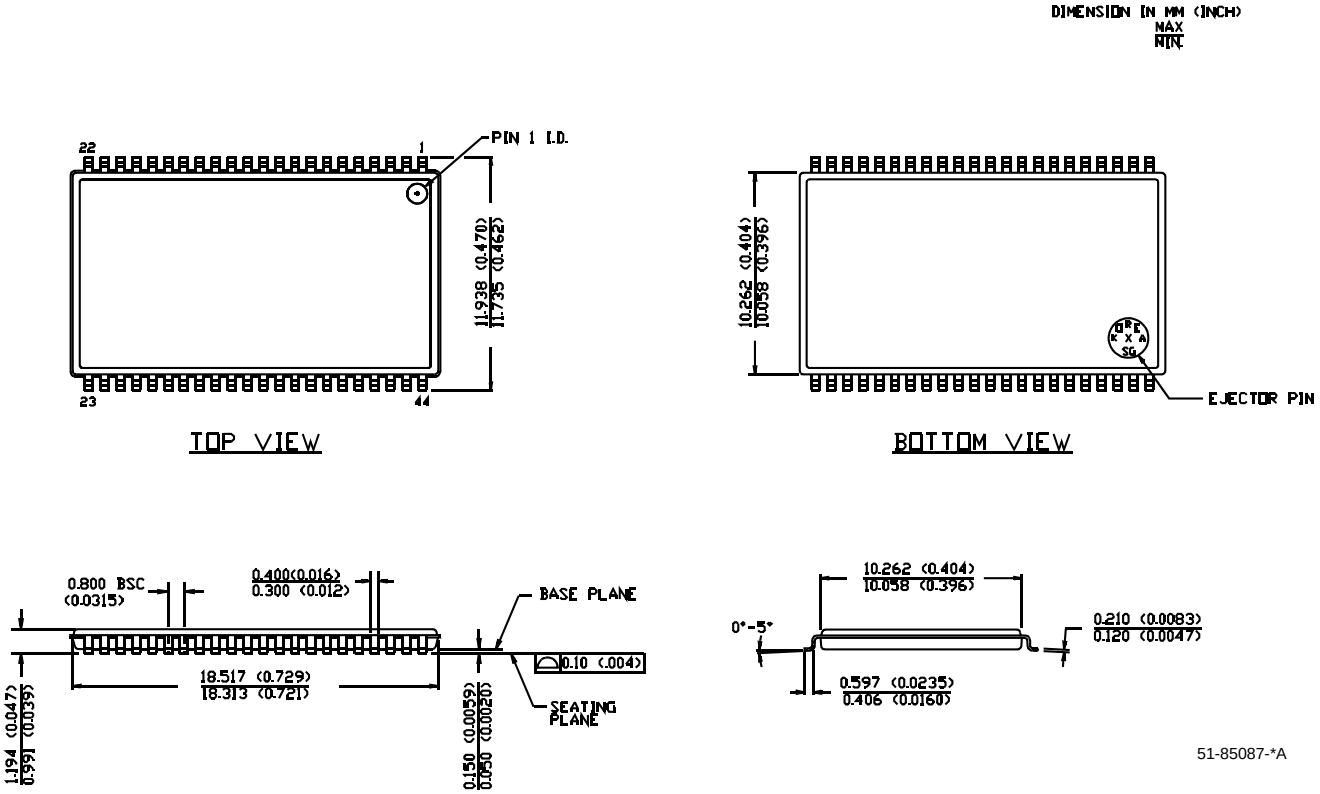
$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	High-Z	Deselect/Power down	Standby (I_{SB})
L	X	X	H	H	High-Z	Output Disabled	Active (I_{CC})
L	H	L	L	L	Data Out (IO_0–IO_{15})	Read	Active (I_{CC})
L	H	L	H	L	Data Out (IO_0–IO_7); IO_8–IO_{15} in High-Z	Read	Active (I_{CC})
L	H	L	L	H	Data Out (IO_8–IO_{15}); IO_0–IO_7 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 (IO_0–IO_{15})	Write	Active (I_{CC})
L	L	X	H	L	Data In (IO_0–IO_7); IO_8–IO_{15} in High-Z	Write	Active (I_{CC})
L	L	X	L	H	Data In (IO_8–IO_{15}); IO_0–IO_7 in High-Z	Write	Active (I_{CC})

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62146ESL-45ZSXI	51-85087	44-pin Thin Small Outline Package Type II (Pb-free)	Industrial

Package Diagrams

Figure 8. 44-Pin TSOP II, 51-85087



Document History Page

Document Title: CY62146ESL MoBL® 4-Mbit (256K x 16) Static RAM Document Number: 001-43142				
REV.	**ECN NO.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	1875228	See ECN	VKN/AESA	New Data Sheet