

## Features

- 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  $\overline{CE}_1$ ,  $CE_2$ , and  $\overline{OE}$  Features
- Automatic Power Down when Deselected
- CMOS for Optimum Speed and Power
- Available in Pb-free 48-ball very fine-pitch ball grid array (VFBGA) packages

## Functional Description

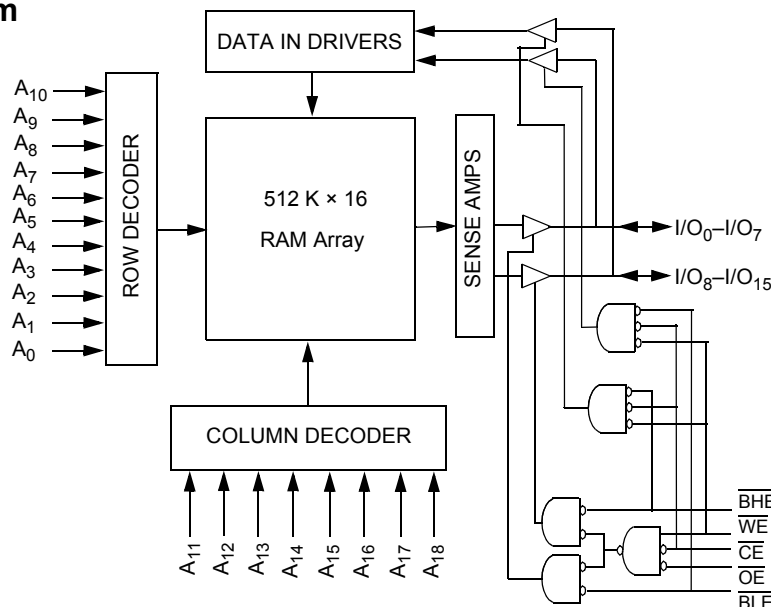
The CY62156ESL is a high performance CMOS static RAM organized as 512K words by 16 bits. This device features advanced circuit design to provide ultra low active current. This is ideal for providing More Battery Life™ (MoBL®) in portable

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 in standby mode when deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW). The input or output pins ( $I/O_0$  through  $I/O_{15}$ ) are placed in a high impedance state when the device is deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW), the outputs are disabled ( $\overline{OE}$  HIGH), Byte High Enable and Byte Low Enable are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or a write operation is active ( $\overline{CE}_1$  LOW,  $CE_2$  HIGH and  $\overline{WE}$  LOW).

To write to the device, take Chip Enable ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH) 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 ( $\overline{CE}_1$  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.

## Logic Block Diagram

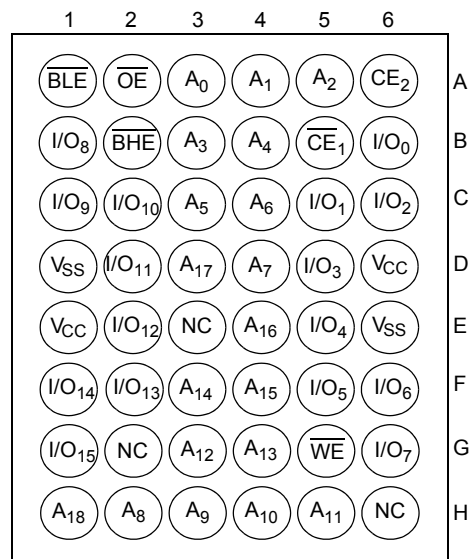


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## Pin Configurations

Figure 1. 48-ball VFBGA pinout (Top View) [1]



## Product Portfolio

Product	Range	V <sub>CC</sub> Range (V) [2]	Speed (ns)	Power Dissipation					
				Operating I <sub>CC</sub> , (mA)				Standby, I <sub>SB2</sub> (μA)	
				f = 1MHz		f = f <sub>max</sub>			
				Typ [3]	Max	Typ [3]	Max	Typ [3]	Max
CY62156ESL	Industrial	2.2 V to 3.6 V and 4.5 V to 5.5 V	45	1.8	3	18	25	2	8

### Notes

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

## Maximum Ratings

Exceeding the maximum ratings may impair 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 .....	-0.5 V to 6.0 V
DC Voltage Applied to Outputs in High Z State <sup>[4, 5]</sup> .....	-0.5 V to 6.0 V
DC Input Voltage <sup>[4, 5]</sup> .....	-0.5 V to 6.0 V

Output Current into Outputs (LOW) .....	20 mA
Static Discharge Voltage (MIL-STD-883, Method 3015) .....	> 2,001V
Latch Up Current .....	> 200 mA

## Operating Range

Device	Range	Ambient Temperature	V <sub>CC</sub> <sup>[6]</sup>
CY62156ESL	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	45 ns			Unit	
			Min	Typ <sup>[1]</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> = 2.1mA	-	-	0.4	
		4.5 ≤ V <sub>CC</sub> ≤ 5.5	I <sub>OL</sub> = 2.1mA	-	-	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/f <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>	Automatic CE Power down Current – CMOS Inputs	CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2 V, CE <sub>2</sub> ≤ 0.2 V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V or V <sub>IN</sub> ≤ 0.2 V, f = f <sub>max</sub> (Address and Data Only), f = 0 (OE, BHE, BLE and WE), V <sub>CC</sub> = V <sub>CC(max)</sub>		-	2	8	μA
I <sub>SB2</sub> <sup>[7]</sup>	Automatic CE Power down Current – CMOS Inputs	CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2 V or CE <sub>2</sub> ≤ 0.2 V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V or V <sub>IN</sub> ≤ 0.2 V, f = 0, V <sub>CC</sub> = V <sub>CC(max)</sub>		-	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.
- Only chip enables (CE<sub>1</sub> and CE<sub>2</sub>) need to be tied to CMOS levels to meet the I<sub>SB2</sub> / I<sub>CCDR</sub> spec. Other inputs can be left floating.

### Capacitance

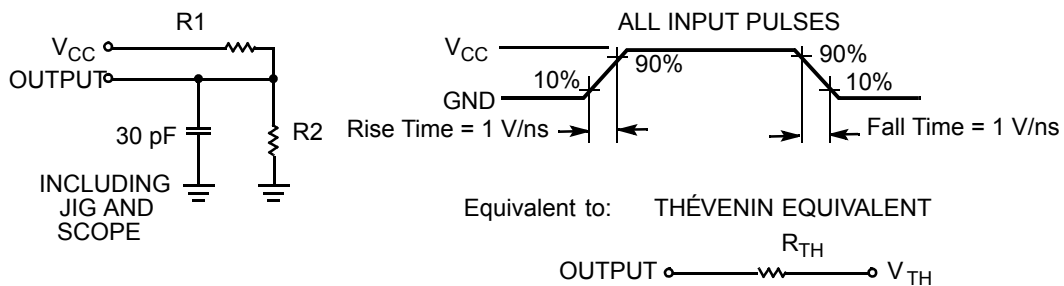
Parameter [8]	Description	Test Conditions	Max	Unit
C <sub>IN</sub>	Input capacitance	T <sub>A</sub> = 25 °C, f = 1 MHz, V <sub>CC</sub> = V <sub>CC(typ)</sub>	10	pF
C <sub>OUT</sub>	Output capacitance		10	pF

### Thermal Resistance

Parameter [8]	Description	Test Conditions	48-ball BGA	Unit
Θ <sub>JA</sub>	Thermal resistance (junction to ambient)	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	72	°C/W
Θ <sub>JC</sub>	Thermal resistance (junction to case)		8.86	°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**

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

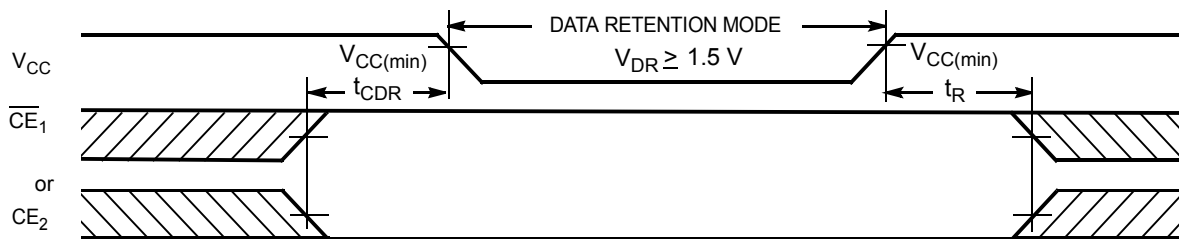
## Data Retention Characteristics

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	$CE_1 \geq V_{CC} - 0.2$ V, $CE_2 \leq 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V, $V_{CC} = 1.5$ V	–	2	5	$\mu$ A
$t_{CDR}$ <sup>[11]</sup>	Chip Deselect to Data Retention Time		0	–	–	ns
$t_R$ <sup>[12]</sup>	Operation Recovery Time		45	–	–	ns

## Data Retention Waveform

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  $V_{CC} = V_{CC(typ)}$ ,  $T_A = 25$  °C.
10. Only chip enables ( $\overline{CE}_1$  and  $\overline{CE}_2$ ) need to be tied to CMOS levels to meet the  $I_{SB2} / I_{CCDR}$  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  $V_{CC(min)} \geq 100$   $\mu$ s or stable at  $V_{CC(min)} \geq 100$   $\mu$ s.

## Switching Characteristics

Over the Operating Range

Parameter <sup>[13]</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
$t_{ACE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Data Valid	–	45	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid	–	22	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low Z <sup>[14]</sup>	5	–	ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High Z <sup>[14, 15]</sup>	–	18	ns
$t_{LZCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Low Z <sup>[14]</sup>	10	–	ns
$t_{HZCE}$	$\overline{CE}_1$ HIGH and $CE_2$ LOW to High Z <sup>[14, 15]</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	–	45	ns
$t_{DBE}$	$\overline{BLE}/\overline{BHE}$ LOW to Data Valid	–	22	ns
$t_{LZBE}$	$\overline{BLE}/\overline{BHE}$ LOW to Low Z <sup>[14]</sup>	5	–	ns
$t_{HZBE}$	$\overline{BLE}/\overline{BHE}$ HIGH to High Z <sup>[14, 15]</sup>	–	18	ns
<b>Write Cycle<sup>[16]</sup></b>				
$t_{WC}$	Write Cycle Time	45	–	ns
$t_{SCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH 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>[14, 15]</sup>	–	18	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low Z <sup>[14]</sup>	10	–	ns

### Notes

13. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns or less, 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 the [Figure 2 on page 5](#).

14. 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.

15.  $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  transitions are measured when the outputs enter a high-impedance state.

16. The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $CE_1 = V_{IL}$ ,  $BHE$ ,  $\overline{BLE}$  or both =  $V_{IL}$ , 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 must be referenced to the edge of the signal that terminates the write.

### Switching Waveforms

Figure 4. Read Cycle No. 1: Address Transition Controlled [17, 18]

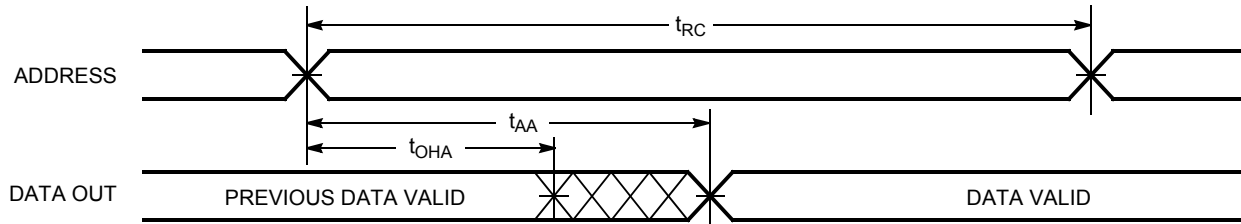
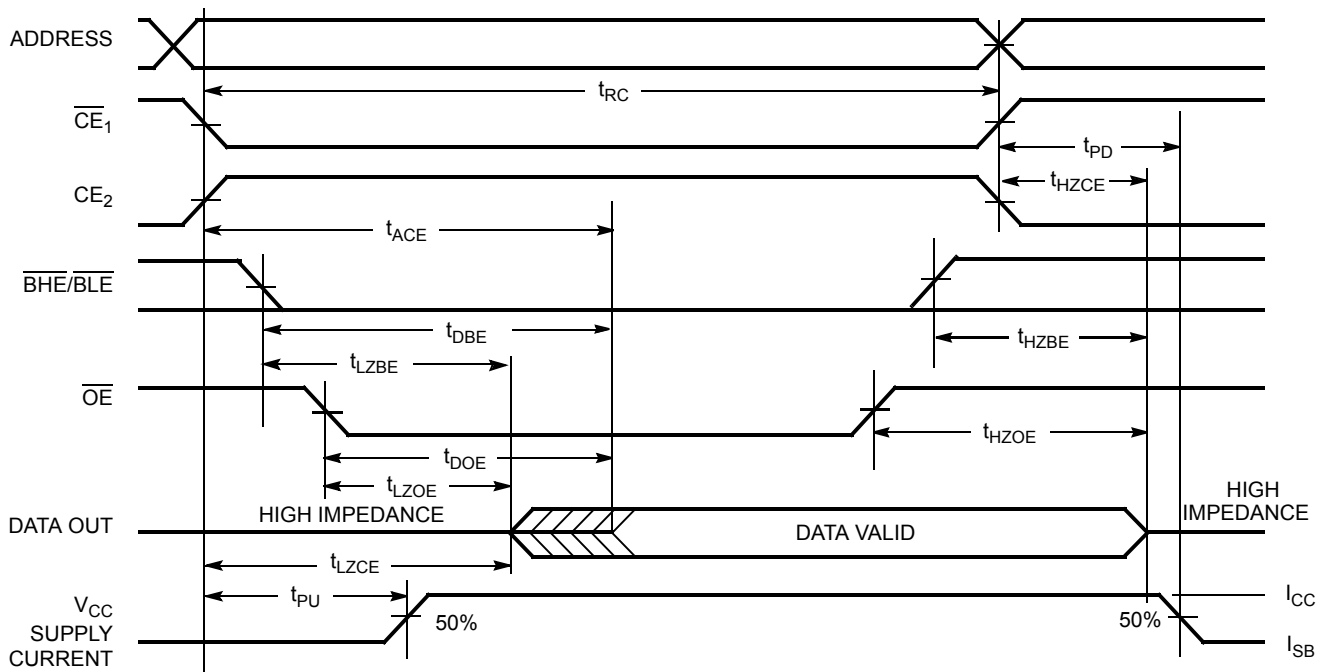


Figure 5. Read Cycle No. 2:  $\overline{OE}$  Controlled [18, 19]



**Notes**

- 17. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}_1 = V_{IL}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$ , or both =  $V_{IL}$ , and  $CE_2 = V_{IH}$ .
- 18.  $\overline{WE}$  is HIGH for read cycle.
- 19. Address valid before or similar to  $\overline{CE}_1$ ,  $\overline{BHE}$ ,  $\overline{BLE}$  transition LOW and  $CE_2$  transition HIGH.



Switching Waveforms (continued)

Figure 6. Write Cycle No 1:  $\overline{WE}$  Controlled [20, 21, 22]

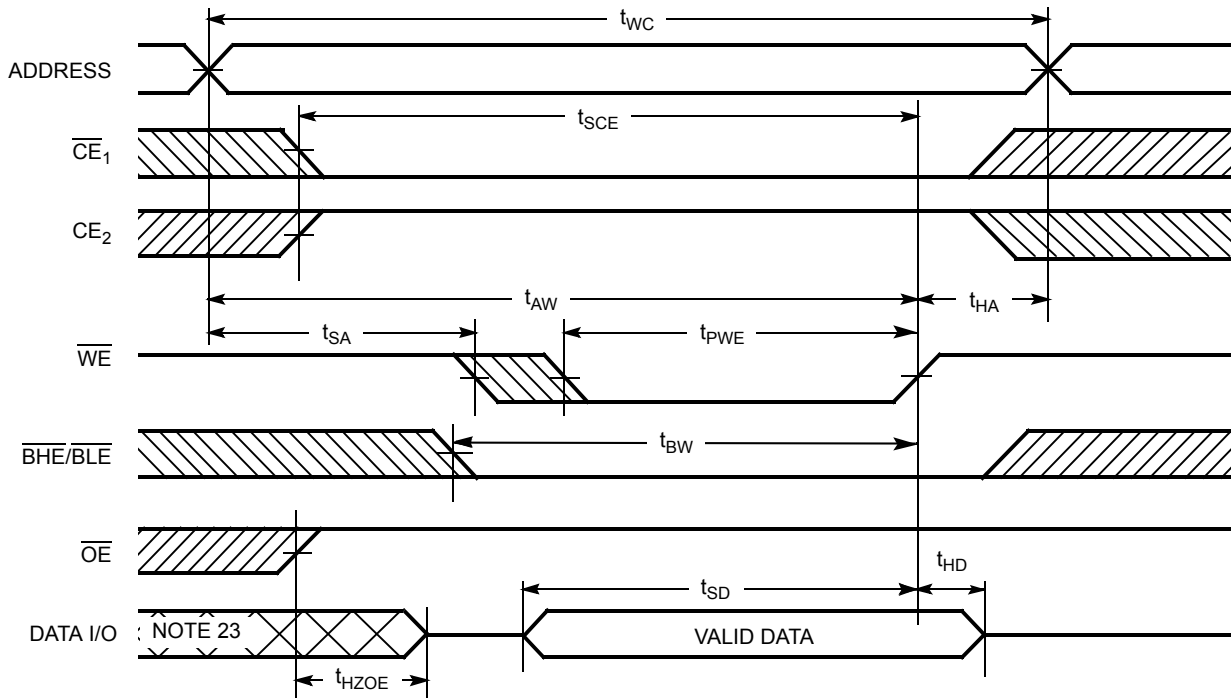
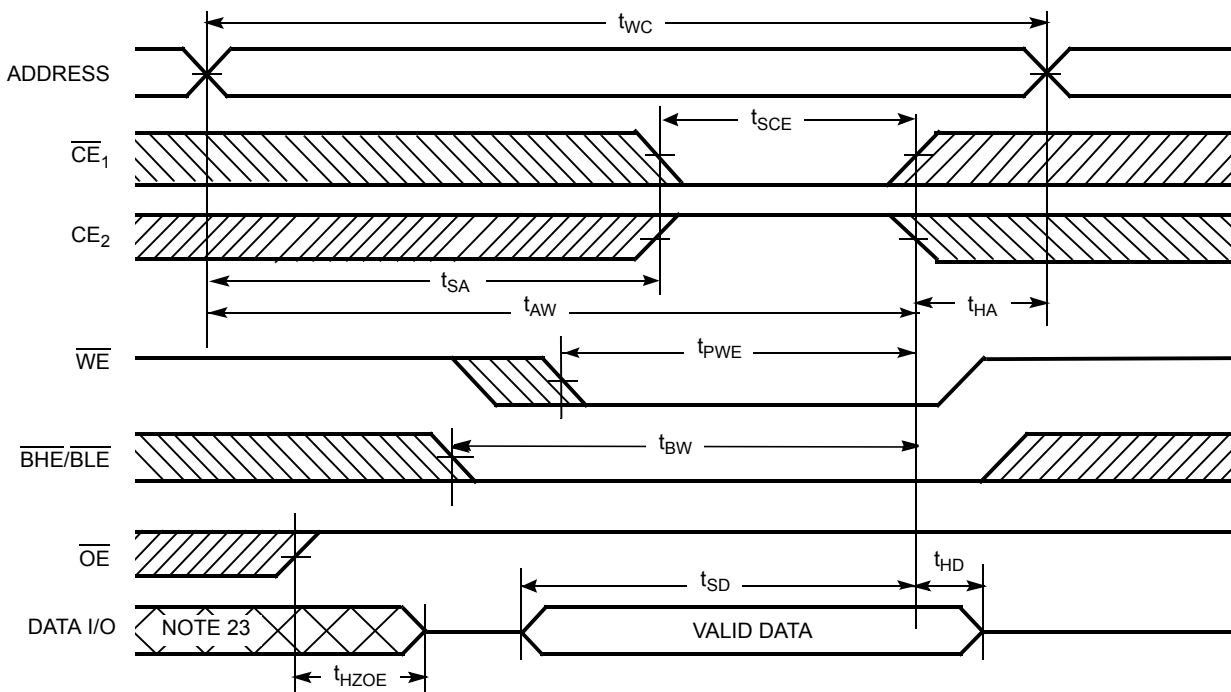


Figure 7. Write Cycle 2:  $\overline{CE}$  Controlled [20, 21, 22]



Notes

- 20. The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $\overline{CE}_1 = V_{IL}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$  or both =  $V_{IL}$ , 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 must be referenced to the edge of the signal that terminates the write.
- 21. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
- 22. 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.
- 23. 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 [24]

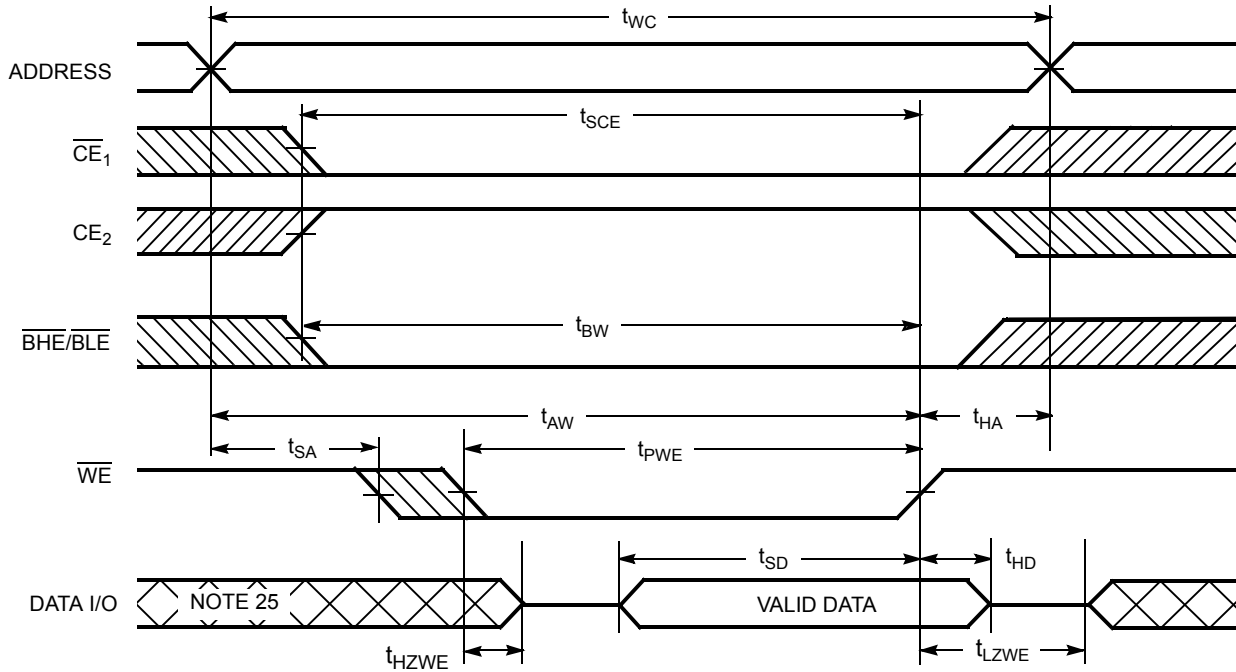
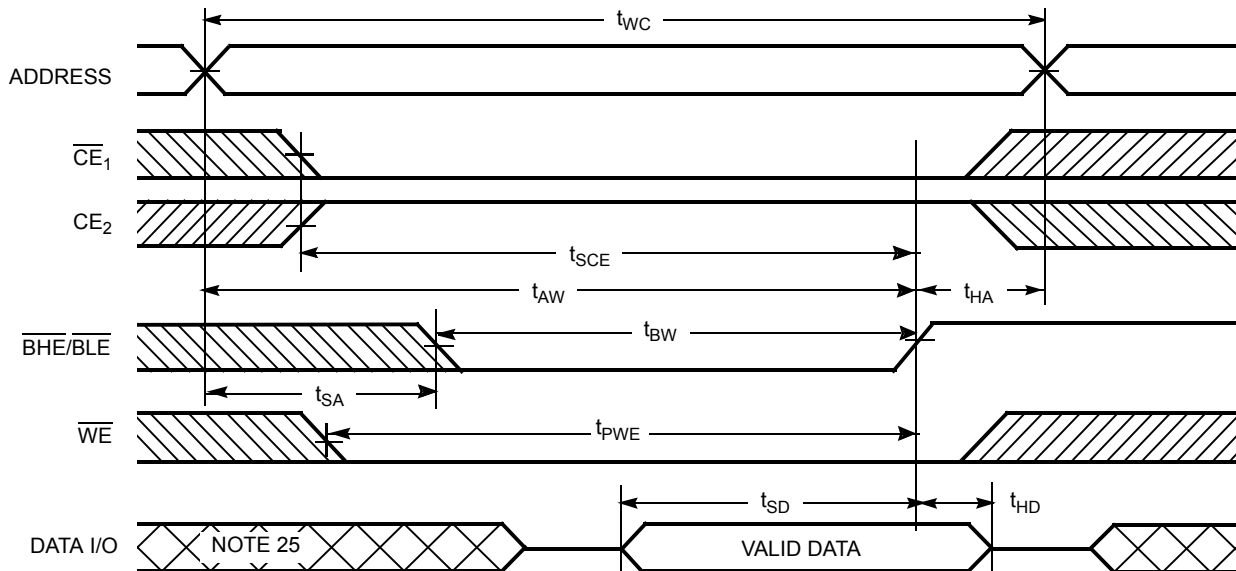


Figure 9. Write Cycle 4:  $\overline{BHE}/\overline{BLE}$  Controlled,  $\overline{OE}$  LOW [24]



Notes

- 24. 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.
- 25. During this period, the I/Os are in output state. Do not apply input signals.

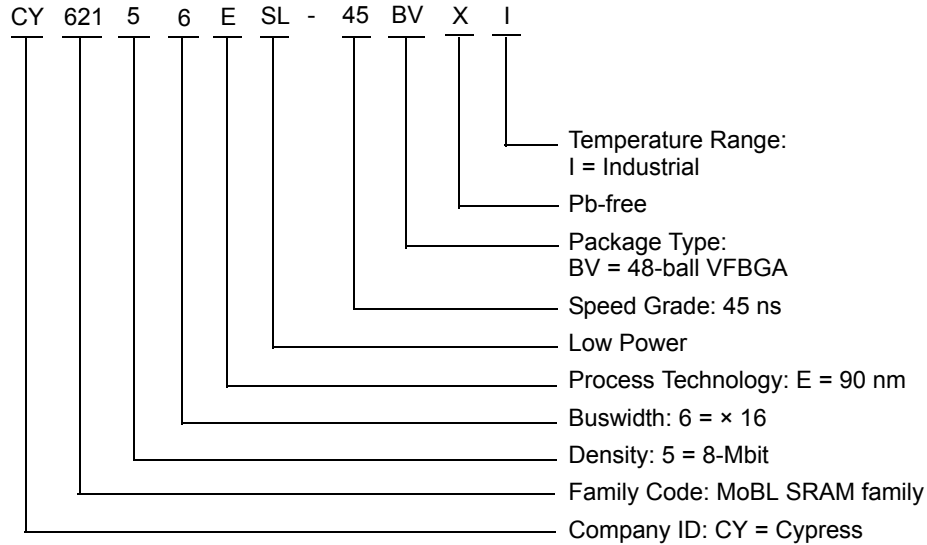
**Truth Table**

CE <sub>1</sub>	CE <sub>2</sub>	WE	OE	BHE	BLE	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect/Power Down	Standby (I <sub>SB</sub> )
X	L	X	X	X	X	High Z	Deselect/Power Down	Standby (I <sub>SB</sub> )
L	H	X	X	H	H	High Z	Output Disabled	Active (I <sub>CC</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	Data Out (I/O <sub>0</sub> –I/O <sub>7</sub> ); High Z (I/O <sub>8</sub> –I/O <sub>15</sub> )	Read	Active (I <sub>CC</sub> )
L	H	H	L	L	H	High Z (I/O <sub>0</sub> –I/O <sub>7</sub> ); Data Out (I/O <sub>8</sub> –I/O <sub>15</sub> )	Read	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> )
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	Data In (I/O <sub>0</sub> –I/O <sub>7</sub> ); High Z (I/O <sub>8</sub> –I/O <sub>15</sub> )	Write	Active (I <sub>CC</sub> )
L	H	L	X	L	H	High Z (I/O <sub>0</sub> –I/O <sub>7</sub> ); Data In (I/O <sub>8</sub> –I/O <sub>15</sub> )	Write	Active (I <sub>CC</sub> )

**Ordering Information**

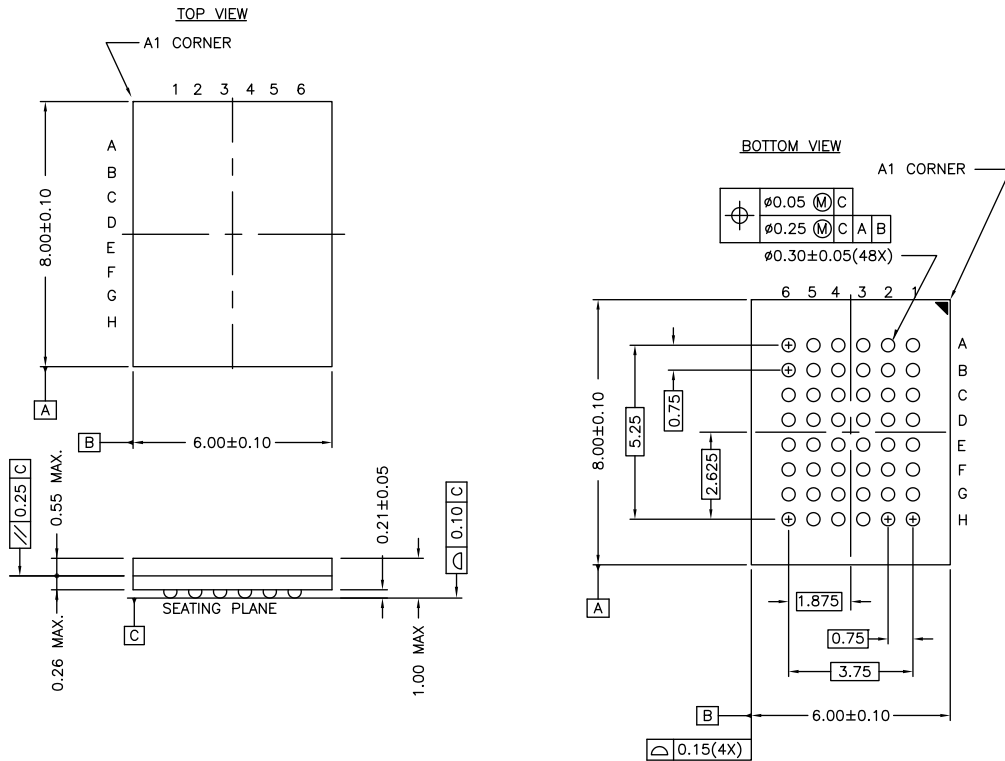
Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62156ESL-45BVXI	51-85150	48-ball VFBGA (Pb-free)	Industrial

**Ordering Code Definitions**



Package Diagrams

Figure 10. 48-ball VFBGA (6 × 8 × 1 mm) BV48/BZ48 Package Outline, 51-85150



NOTE:  
 PACKAGE WEIGHT: See Cypress Package Material Declaration Datasheet (PMDD)  
 posted on the Cypress web.

51-85150 \*H

## Acronyms

Acronym	Description
$\overline{CE}$	chip enable
CMOS	complementary metal oxide semiconductor
I/O	input/output
$\overline{OE}$	output enable
RAM	random access memory
SRAM	static random access memory
VFBGA	very fine-pitch ball grid array
$\overline{WE}$	write enable

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
μA	microampere
μs	microsecond
mA	milliampere
mm	millimeter
ns	nanosecond
Ω	ohm
%	percent
pF	picofarad
V	volt
W	watt

## Document History Page

Document Title: CY62156ESL MoBL <sup>®</sup> , 8-Mbit (512 K × 16) Static RAM Document Number: 001-54995				
Rev.	ECN No.	Orig. of Change	Submission Date	Description of Change
**	2751673	VKN	08/13/09	New data sheet
*A	2899866	AJU	03/26/10	Removed inactive parts from Ordering Information. Updated Package Diagram
*B	3109032	AJU	12/13/2010	Obsolete document.
*C	3903222	AJU	02/19/2013	Changed from Obsolete to Active.  Removed all references of TSOP packages across the document and added 48-ball VFBGA package related information in the corresponding places.  Updated <a href="#">Features</a> .  Updated <a href="#">Functional Description</a> .  Updated <a href="#">Logic Block Diagram</a> .  Updated <a href="#">Ordering Information</a> (Updated part numbers) and added <a href="#">Ordering Code Definitions</a> .  Updated <a href="#">Package Diagrams</a> : Removed spec 51-85087 and spec 51-85183. Added spec 51-85150.  Added <a href="#">Acronyms and Units of Measure</a> .  Updated in new template.
*D	3996550	MEMJ	05/13/2013	Changed status from Preliminary to Final.

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