

## 8-Mbit (512K x 16) Static RAM

### Features

- Very high speed: 45 ns
  - Industrial: -40°C to +85°C
  - Automotive-E: -40°C to +125°C
- Wide voltage range: 4.5V–5.5V
- Ultra low standby power
  - Typical standby current: 2  $\mu$ A
  - Maximum standby current: 8  $\mu$ A (Industrial)
- 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 44-pin TSOP II and 48-ball VFBGA package

### Functional Description<sup>[1]</sup>

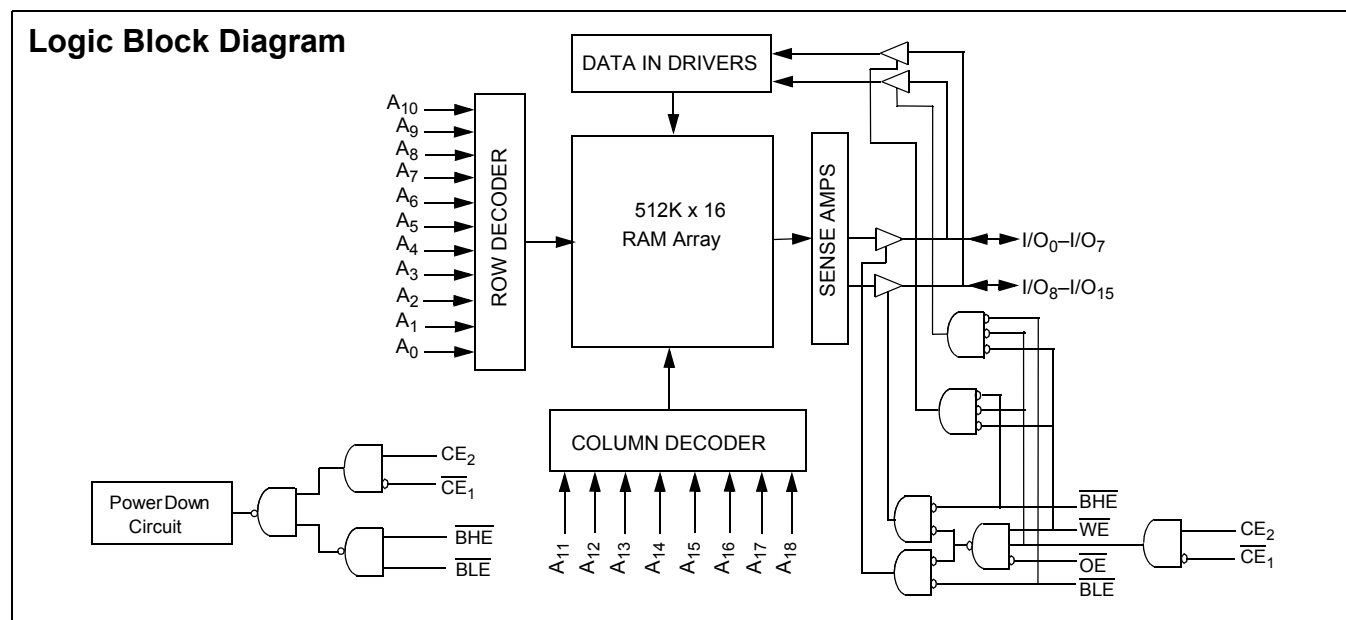
The CY62157E is a high performance CMOS static RAM organized as 512K words by 16 bits. This device features advanced circuit design to provide ultra low active current. This

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 ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW or both BHE and BLE are HIGH). The input or output pins (I/O<sub>0</sub> through I/O<sub>15</sub>) 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 (BHE, BLE HIGH)
- 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<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>18</sub>). If Byte High Enable ( $\overline{BHE}$ ) is LOW, then data from I/O pins (I/O<sub>8</sub> through I/O<sub>15</sub>) is written into the location specified on the address pins (A<sub>0</sub> through A<sub>18</sub>).

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<sub>0</sub> to I/O<sub>7</sub>. If Byte High Enable ( $\overline{BHE}$ ) 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.



#### Note

1. For best practice recommendations, please refer to the Cypress application note [AN1064, SRAM System Guidelines](#).

## Contents

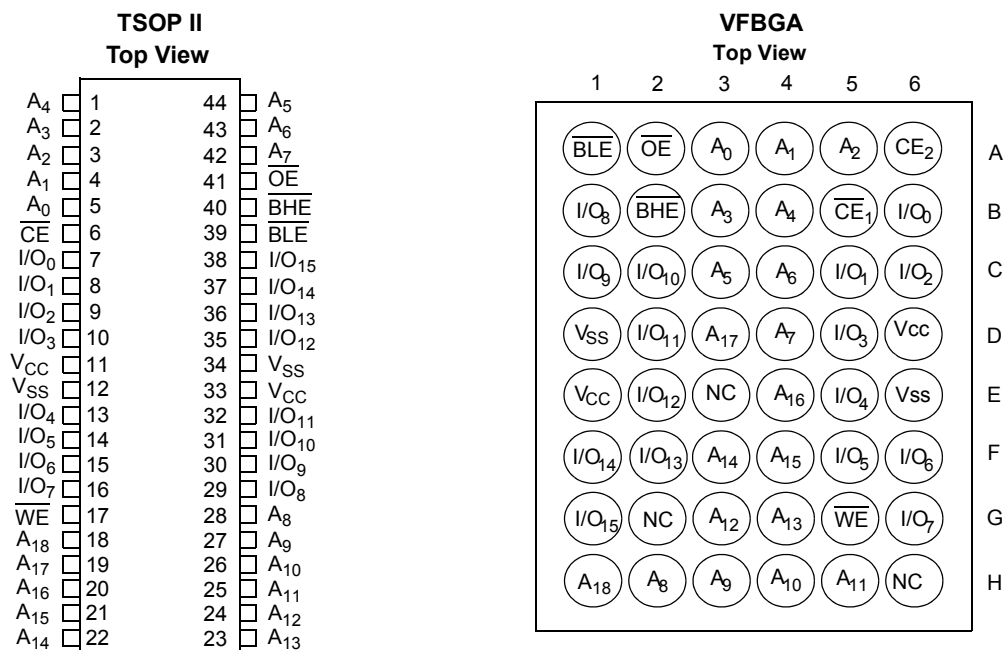
Product Portfolio .....	3	Switching Waveforms .....	7
Pin Configuration .....	3	Truth Table .....	10
Maximum Ratings .....	4	Ordering Information .....	11
Operating Range .....	4	Ordering Code Definitions .....	11
Electrical Characteristics .....	4	Package Diagrams .....	12
Capacitance .....	4	Document History Page .....	14
AC Test Loads and Waveforms .....	5	Sales, Solutions, and Legal Information .....	15
Data Retention Characteristics .....	5	Worldwide Sales and Design Support .....	15
Data Retention Waveform.....	5	Products .....	15
Thermal Resistance .....	5	PSoC Solutions .....	15
Switching Characteristics .....	6		

## Product Portfolio

Product	Range	V <sub>CC</sub> Range (V)			Speed (ns)	Power Dissipation					
						Operating I <sub>CC</sub> , (mA)				Standby, I <sub>SB2</sub> (μA)	
		f = 1 MHz		f = f <sub>max</sub>							
Min	Typ <sup>[2]</sup>	Max		Typ <sup>[2]</sup>	Max	Typ <sup>[2]</sup>	Max	Typ <sup>[2]</sup>	Max		
CY62157ELL	Industrial	4.5	5.0	5.5	45	1.8	3	18	25	2	8
CY62157ELL	Automotive	4.5	5.0	5.5	55	1.8	4	18	35	2	30

## Pin Configuration

The following pictures show the TSOP II and VFBGA pinouts.<sup>[3, 4]</sup>



### Notes

- 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.
- NC pins are not connected on the die.
- The 44-pin TSOP II package has only one chip enable (CE) pin.

## 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 ..... -0.5V to 6.0V

DC Voltage Applied to Outputs  
in High-Z State<sup>[5, 6]</sup> ..... -0.5V to 6.0V

DC Input Voltage<sup>[5, 6]</sup> ..... -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 <sub>CC</sub> <sup>[7]</sup>
CY62157ELL	Industrial	-40°C to +85°C	4.5V to 5.5V
	Automotive	-40°C to +125°C	

## Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	45 ns (Industrial)			55 ns (Automotive)			Unit
			Min	Typ <sup>[8]</sup>	Max	Min	Typ <sup>[8]</sup>	Max	
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -1 mA	2.4			2.4			V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 2.1 mA			0.4			0.4	V
V <sub>IH</sub>	Input HIGH Voltage	V <sub>CC</sub> = 4.5V to 5.5V	2.2		V <sub>CC</sub> + 0.5	2.2		V <sub>CC</sub> + 0.5	V
V <sub>IL</sub>	Input LOW Voltage	V <sub>CC</sub> = 4.5V to 5.5V	-0.5		0.8	-0.5		0.8	V
I <sub>IX</sub>	Input Leakage Current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-1		+1	-4		+4	μA
I <sub>OZ</sub>	Output Leakage Current	GND ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , Output Disabled	-1		+1	-4		+4	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>CC(max)</sub>		18	25		18	35	mA
		f = 1 MHz I <sub>OUT</sub> = 0 mA CMOS levels		1.8	3		1.8	4	
I <sub>SB1</sub>	Automatic CE Power Down Current — CMOS Inputs	CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2V or CE <sub>2</sub> ≤ 0.2V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V, V <sub>IN</sub> ≤ 0.2V, 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		2	30	μA
I <sub>SB2</sub> <sup>[9]</sup>	Automatic CE Power Down Current — CMOS Inputs	CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2V or CE <sub>2</sub> ≤ 0.2V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ 0.2V, f = 0, V <sub>CC</sub> = V <sub>CC(max)</sub>		2	8		2	30	μA

## Capacitance<sup>[10]</sup>

Parameter	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

### Notes

5. V<sub>IL(min)</sub> = -2.0V for pulse durations less than 20 ns for I < 30 mA.

6. V<sub>IH(max)</sub> = V<sub>CC</sub> + 0.75V for pulse durations less than 20 ns.

7. Full device AC operation assumes a 100 μs ramp time from 0 to V<sub>CC(min)</sub> and 200 μs wait time after V<sub>CC</sub> stabilization.

8. 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.

9. Chip enables (CE<sub>1</sub> and CE<sub>2</sub>) and byte enables (BHE and BLE) need to be tied to CMOS levels to meet the I<sub>SB2</sub> / I<sub>CDDR</sub> spec. Other inputs can be left floating.

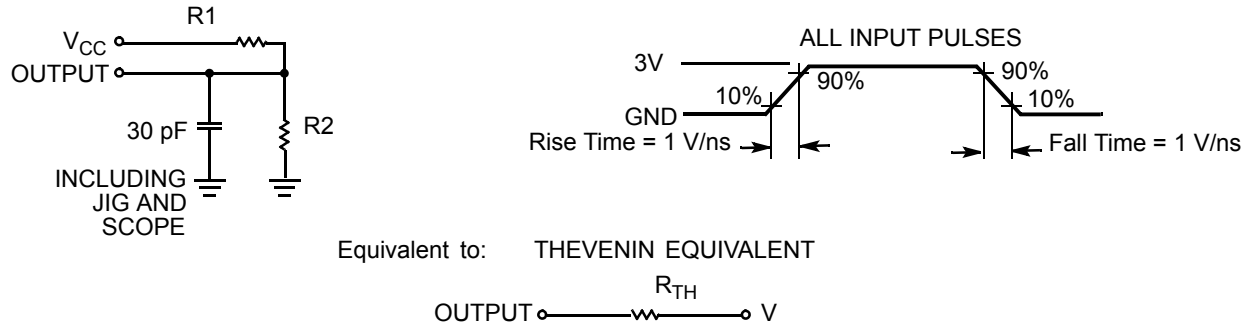
10. Tested initially and after any design or process changes that may affect these parameters.

## Thermal Resistance <sup>[11]</sup>

Parameter	Description	Test Conditions	TSOP II	VFBGA	Unit
$\Theta_{JA}$	Thermal Resistance (Junction to Ambient)	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	77	72	°C/W
$\Theta_{JC}$	Thermal Resistance (Junction to Case)		13	8.86	°C/W

## AC Test Loads and Waveforms

Figure 1. AC Test Loads and Waveforms



Parameters	Values	Unit
R1	1800	$\Omega$
R2	990	$\Omega$
$R_{TH}$	639	$\Omega$
$V_{TH}$	1.77	V

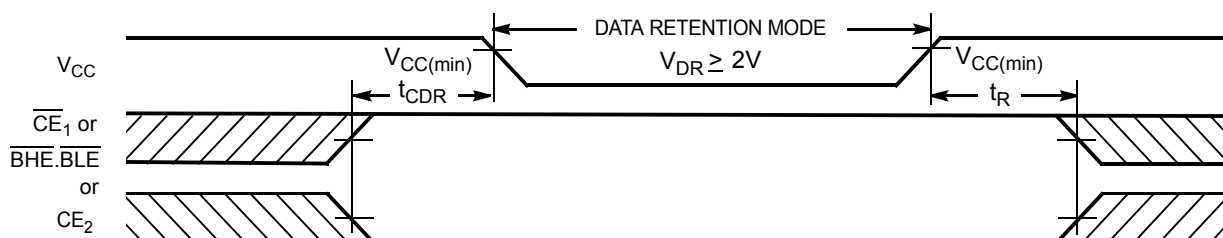
## Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ <sup>[12]</sup>	Max	Unit
$V_{DR}$	$V_{CC}$ for Data Retention		2			V
$I_{CCDR}$	Data Retention Current	$V_{CC}=2V$ , $\overline{CE}_1 \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$ , $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$				$\mu A$
		Industrial			8	
		Automotive			30	
$t_{CDR}^{[11]}$	Chip Deselect to Data Retention Time		0			ns
$t_R^{[13]}$	Operation Recovery Time		$t_{RC}$			ns

## Data Retention Waveform <sup>[14]</sup>

Figure 2. Data Retention Waveform



### Notes

- Tested initially and after any design or process changes that may affect these parameters.
- Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at  $V_{CC} = V_{CC(typ)}$ ,  $T_A = 25^\circ C$ .
- Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(min)} \geq 100 \mu s$  or stable at  $V_{CC(min)} \geq 100 \mu s$ .
- BHE.BLE is the AND of both BHE and 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<sup>[15, 16]</sup>

Parameter	Description	45 ns (Industrial)		55 ns (Automotive)		Unit
		Min	Max	Min	Max	
Read Cycle						
t <sub>RC</sub>	Read Cycle Time	45		55		ns
t <sub>AA</sub>	Address to Data Valid		45		55	ns
t <sub>OHA</sub>	Data Hold from Address Change	10		10		ns
t <sub>ACE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Data Valid		45		55	ns
t <sub>DOE</sub>	$\overline{OE}$ LOW to Data Valid		22		25	ns
t <sub>LZOE</sub>	$\overline{OE}$ LOW to Low-Z <sup>[17]</sup>	5		5		ns
t <sub>HZOE</sub>	$\overline{OE}$ HIGH to High-Z <sup>[17, 18]</sup>		18		20	ns
t <sub>LZCE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Low-Z <sup>[17]</sup>	10		10		ns
t <sub>HZCE</sub>	$\overline{CE}_1$ HIGH and CE <sub>2</sub> LOW to High-Z <sup>[17, 18]</sup>		18		20	ns
t <sub>PU</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Power Up	0		0		ns
t <sub>PD</sub>	$\overline{CE}_1$ HIGH and CE <sub>2</sub> LOW to Power Down		45		55	ns
t <sub>DBE</sub>	$\overline{BLE/BHE}$ LOW to Data Valid		45		55	ns
t <sub>LZBE</sub>	$\overline{BLE/BHE}$ LOW to Low-Z <sup>[17]</sup>	10		10		ns
t <sub>HZBE</sub>	$\overline{BLE/BHE}$ HIGH to HIGH-Z <sup>[17, 18]</sup>		18		20	ns
Write Cycle <sup>[19]</sup>						
t <sub>WC</sub>	Write Cycle Time	45		55		ns
t <sub>SCE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Write End	35		40		ns
t <sub>AW</sub>	Address Setup to Write End	35		40		ns
t <sub>HA</sub>	Address Hold from Write End	0		0		ns
t <sub>SA</sub>	Address Setup to Write Start	0		0		ns
t <sub>PWE</sub>	$\overline{WE}$ Pulse Width	35		40		ns
t <sub>BW</sub>	$\overline{BLE/BHE}$ LOW to Write End	35		40		ns
t <sub>SD</sub>	Data Setup to Write End	25		25		ns
t <sub>HD</sub>	Data Hold from Write End	0		0		ns
t <sub>HZWE</sub>	$\overline{WE}$ LOW to High-Z <sup>[17, 18]</sup>		18		20	ns
t <sub>LZWE</sub>	$\overline{WE}$ HIGH to Low-Z <sup>[17]</sup>	10		10		ns

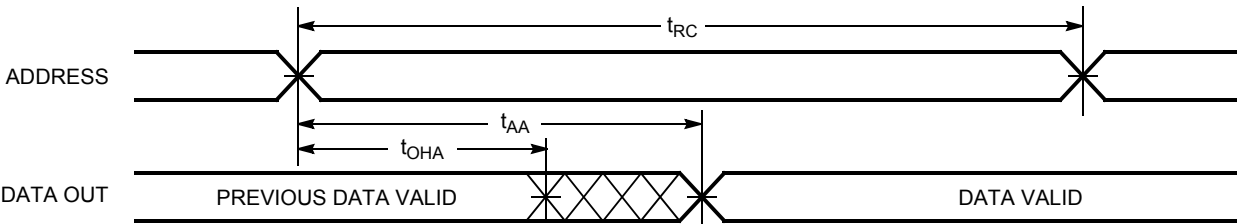
### Notes

15. 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 "AC Test Loads and Waveforms" on page 5.
16. AC timing parameters are subject to byte enable signals (BHE or BLE) not switching when chip is disabled. See application note AN13842 for further clarification.
17. 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.
18.  $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  transitions are measured when the outputs enter a high impedance state.
19. The internal write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $CE_1 = V_{IL}$ ,  $BHE$ ,  $BLE$ , 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.



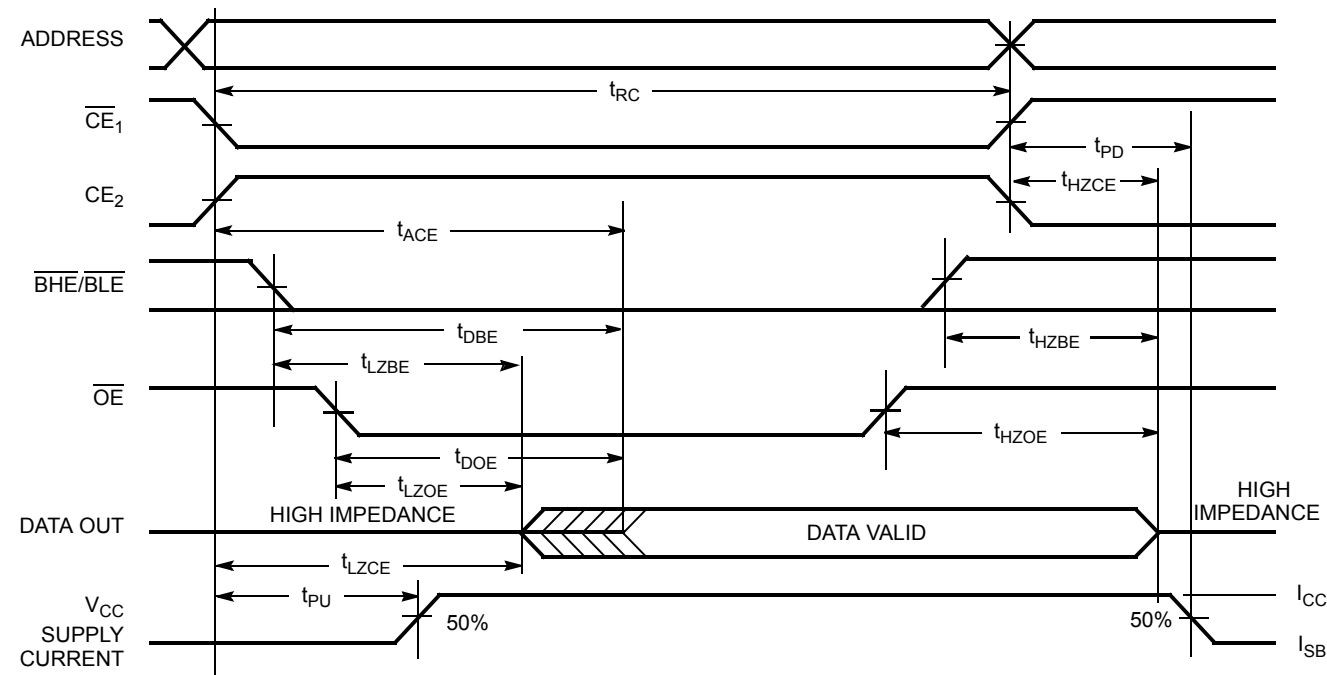
### Read Cycle No. 1 (Address Transition Controlled)<sup>[20, 21]</sup>

### Figure 3. Read Cycle No. 1

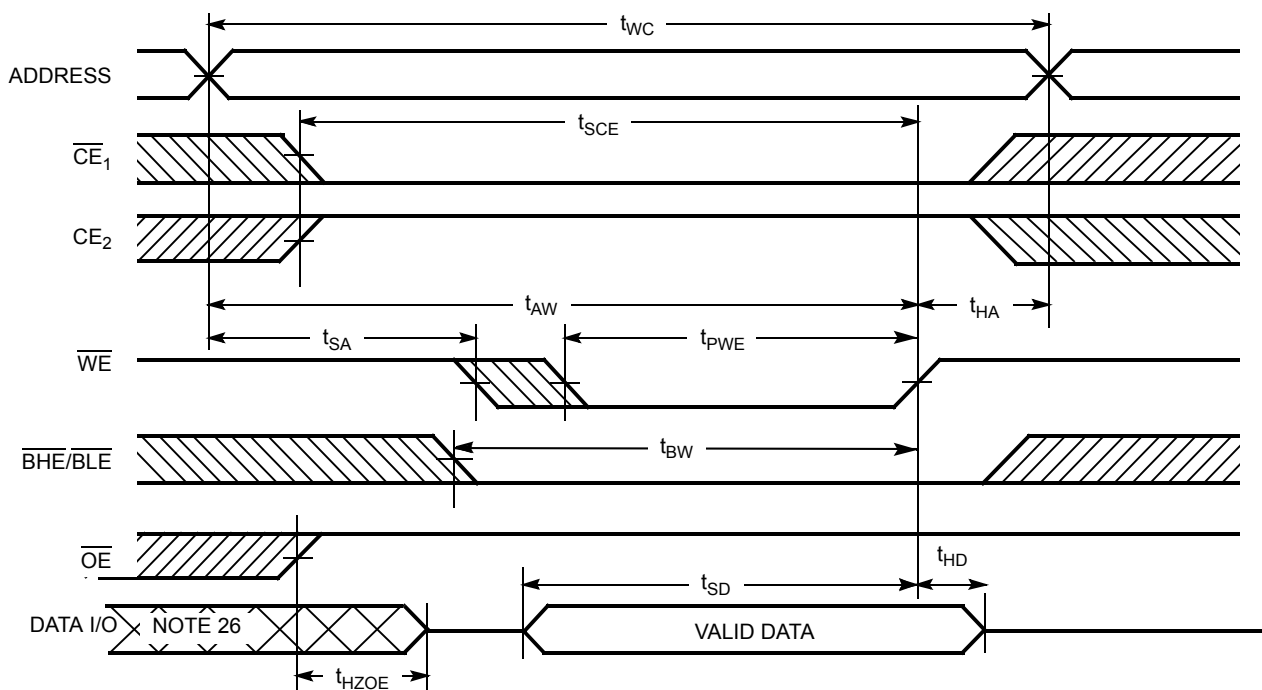
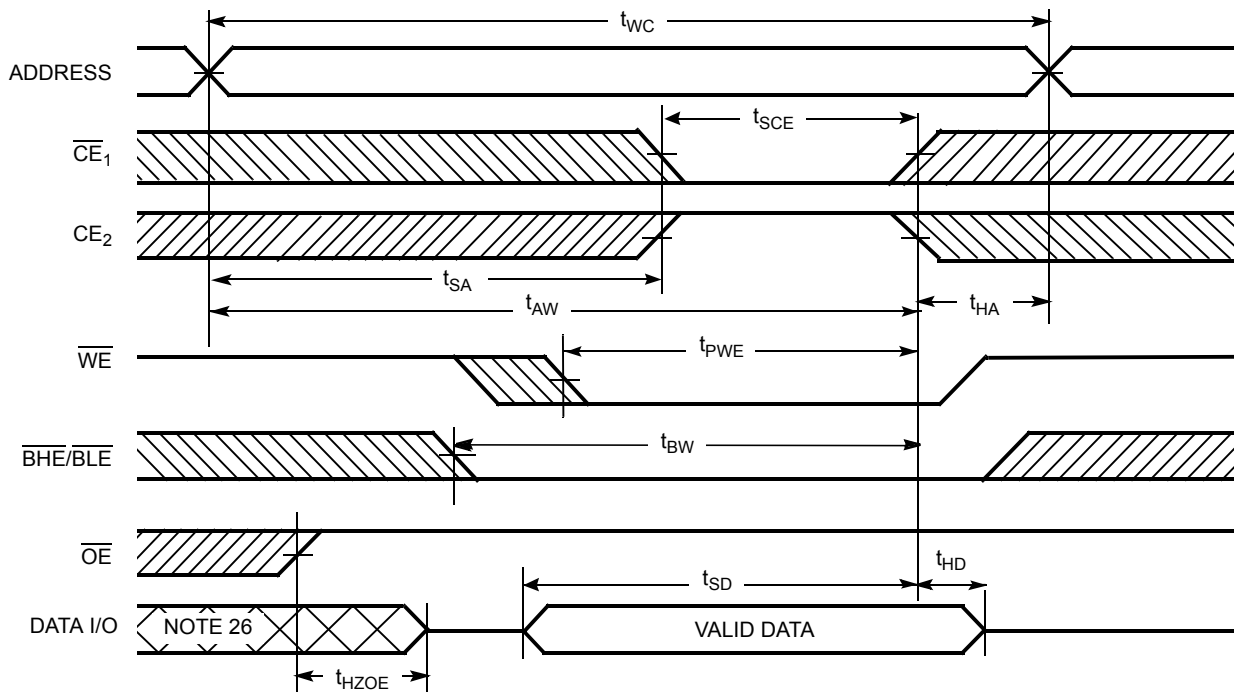


### Read Cycle No. 2 ( $\overline{\text{OE}}$ Controlled)<sup>[21, 22]</sup>

### Figure 4. Read Cycle No. 2



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

**Switching Waveforms (continued)**
**Write Cycle No. 1 ( $\overline{WE}$  Controlled)<sup>[23, 24, 25]</sup>**
**Figure 5. Write Cycle No. 1**

**Write Cycle No. 2 ( $\overline{CE}_1$  or  $CE_2$  Controlled)<sup>[23, 24, 25]</sup>**
**Figure 6. Write Cycle No. 2**

**Notes**

23. 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.

24. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .

25. 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.

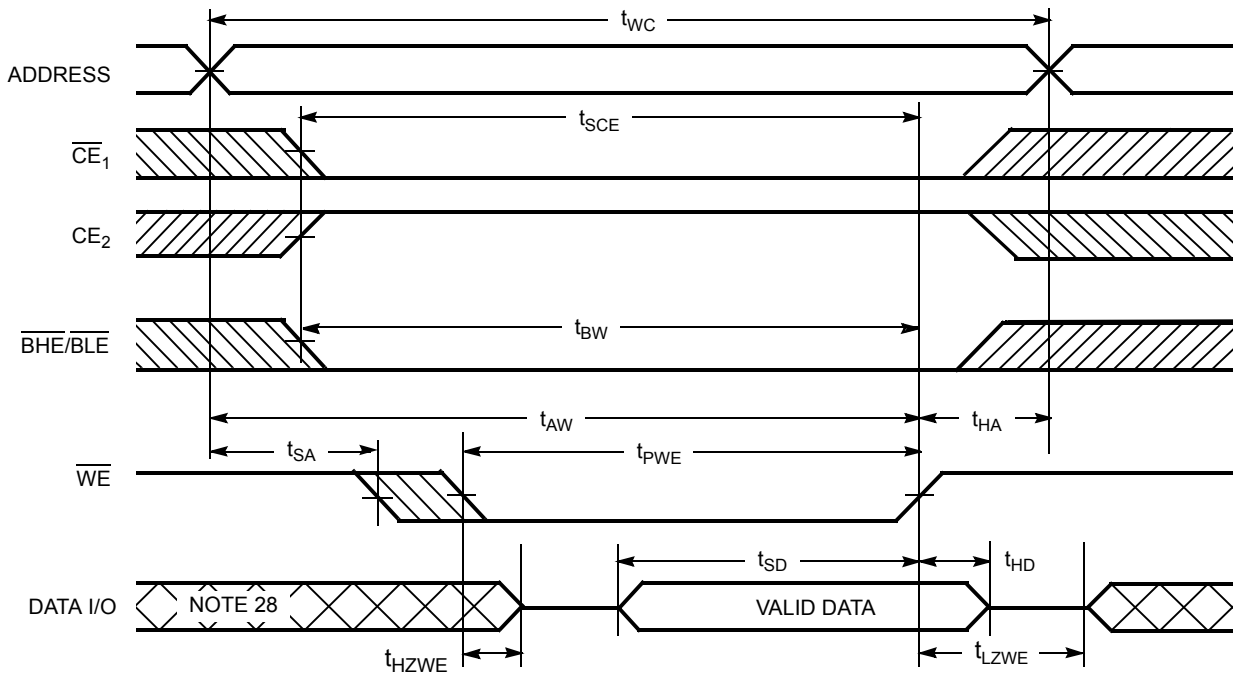
26. During this period, the I/Os are in output state. Do not apply input signals.



## Switching Waveforms (continued)

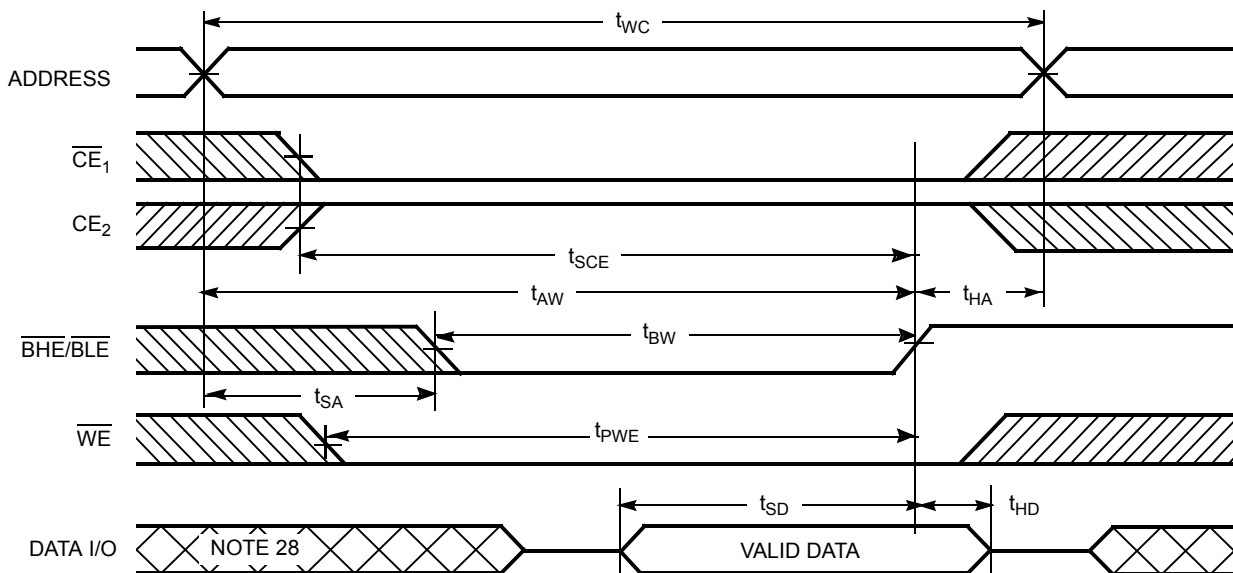
**Write Cycle No. 3** ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[27]</sup>

**Figure 7. Write Cycle No. 3**



**Write Cycle No. 4** ( $\overline{\text{BHE/BLE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[27]</sup>

**Figure 8. Write Cycle No. 4**



### Notes

27. If  $\overline{\text{CE}}_1$  goes HIGH and  $\text{CE}_2$  goes LOW simultaneously with  $\overline{\text{WE}} = V_{\text{IH}}$ , the output remains in a high impedance state.  
 28. During this period, the I/Os are in output state. Do not apply input signals.

## Truth Table

$\overline{CE}_1$	$\overline{CE}_2$	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X <sup>[29]</sup>	X	X	X	X	High-Z	Deselect/Power Down	Standby ( $I_{SB}$ )
X <sup>[29]</sup>	L	X	X	X	X	High-Z	Deselect/Power Down	Standby ( $I_{SB}$ )
X <sup>[29]</sup>	X <sup>[29]</sup>	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	Data Out ( $I/O_0$ – $I/O_7$ ); High-Z ( $I/O_8$ – $I/O_{15}$ )	Read	Active ( $I_{CC}$ )
L	H	H	L	L	H	High-Z ( $I/O_0$ – $I/O_7$ ); Data Out ( $I/O_8$ – $I/O_{15}$ )	Read	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 ( $I_{CC}$ )
L	H	L	X	L	L	Data In ( $I/O_0$ – $I/O_{15}$ )	Write	Active ( $I_{CC}$ )
L	H	L	X	H	L	Data In ( $I/O_0$ – $I/O_7$ ); High-Z ( $I/O_8$ – $I/O_{15}$ )	Write	Active ( $I_{CC}$ )
L	H	L	X	L	H	High-Z ( $I/O_0$ – $I/O_7$ ); Data In ( $I/O_8$ – $I/O_{15}$ )	Write	Active ( $I_{CC}$ )

### Note

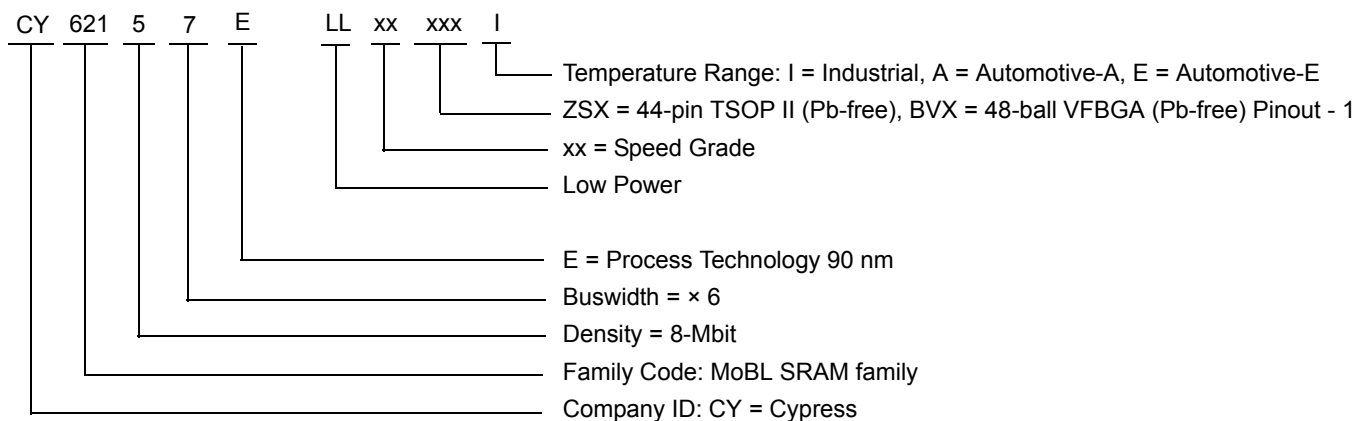
29. The 'X' (Don't care) state for the Chip enables in the truth table refer to the logic state (either HIGH or LOW). Intermediate voltage levels on these pins is not permitted.

## Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62157ELL-45ZSXI	51-85087	44-pin Thin Small Outline Package Type II (Pb-free)	Industrial
55	CY62157ELL-55ZSXE	51-85087	44-pin Thin Small Outline Package Type II (Pb-free)	Automotive
	CY62157ELL-55BVXE	51-85150	48-ball Very Fine Pitch Ball Grid Array (Pb-free)	

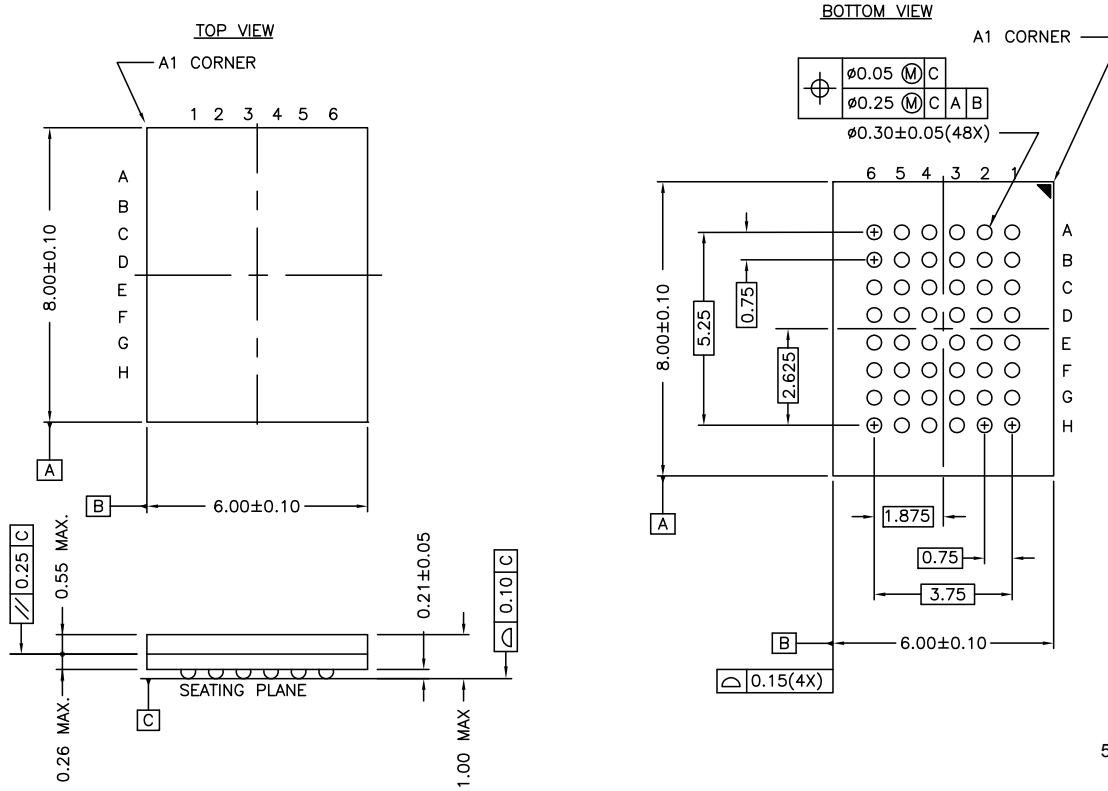
Contact your local Cypress sales representative for availability of these parts.

## Ordering Code Definitions



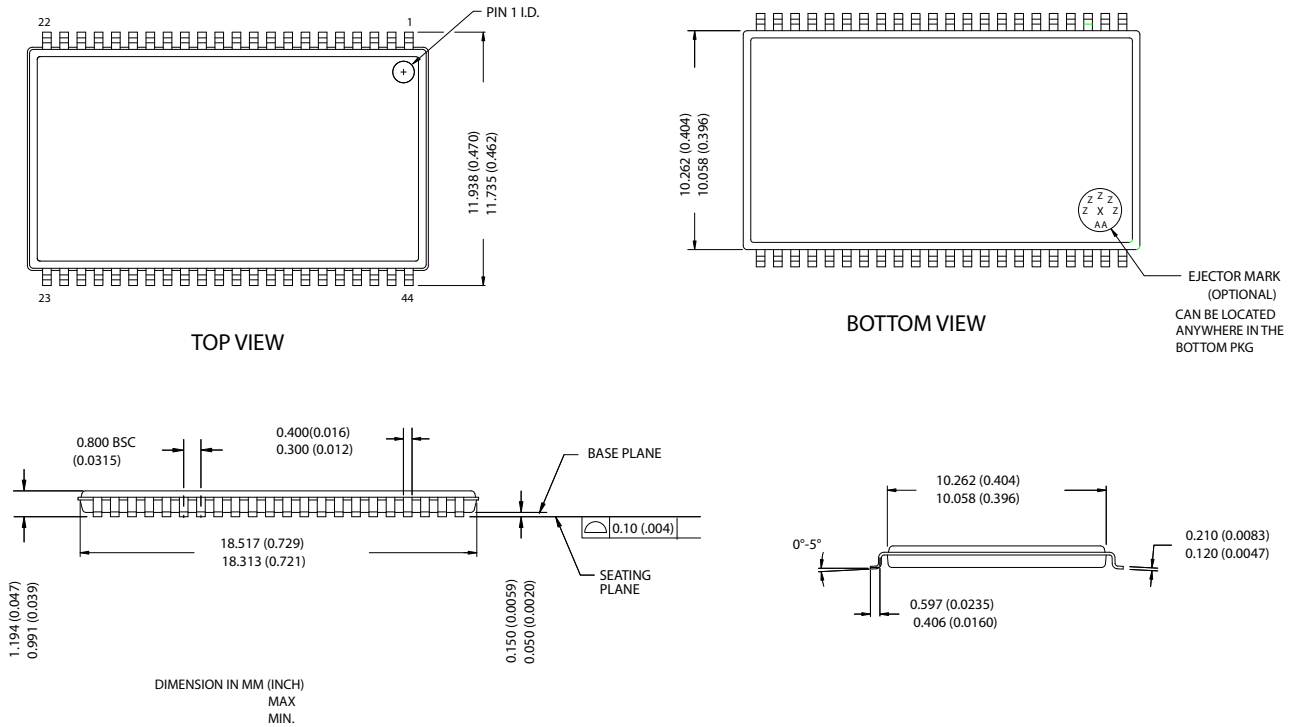
## Package Diagrams

Figure 9. 48-Ball VFBGA (6 x 8 x 1 mm), 51-85150



**Package Diagrams** (continued)

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



51-85087-°C

## Document History Page

Document Title: CY62157E MoBL®, 8-Mbit (512K x 16) Static RAM Document Number: 38-05695				
Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
**	291273	See ECN	PCI	New data sheet
*A	457689	See ECN	NXR	Added Automotive Product Removed Industrial Product Removed 35 ns and 45 ns speed bins Removed "L" bin Updated AC Test Loads table Corrected $t_R$ in Data Retention Characteristics from 100 $\mu$ s to $t_{RC}$ ns Updated the Ordering Information and replaced the Package Name column with Package Diagram
*B	467033	See ECN	NXR	Added Industrial Product (Final Information) Removed 48 ball VFBGA package and its relevant information Changed the $I_{CC(typ)}$ value of Automotive from 2 mA to 1.8 mA for $f = 1$ MHz Changed the $I_{SB2(typ)}$ value of Automotive from 5 $\mu$ A to 1.8 $\mu$ A Modified footnote #4 to include current limit Updated the Ordering Information table
*C	569114	See ECN	VKN	Added 48 ball VFBGA package Updated Logic Block Diagram Added footnote #3 Updated the Ordering Information table
*D	925501	See ECN	VKN	Added footnote #9 related to $I_{SB2}$ and $I_{CCDR}$ Added footnote #14 related AC timing parameters
*E	1045801	See ECN	VKN	Converted Automotive specs from preliminary to final
*F	2934396	06/03/10	VKN	Added footnote #23 related to chip enable Updated package diagrams Updated template.
*G	3110053	12/14/2010	PRAS	Changed Table Footnotes to Footnotes. Added Ordering Code Definitions.

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### PSoC Solutions

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PSoC 1 | PSoC 3 | PSoC 5

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