CY62157E MoBL®

8-Mbit (512 K × 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: 4.5 V–5.5 V
- Ultra low standby power
  - Typical standby current: 2 µA
  - Maximum standby current: 8 µA (Industrial)
- Ultra low active power
  - Typical active current: 1.8 mA at f = 1 MHz
- Ultra low standby power
- 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

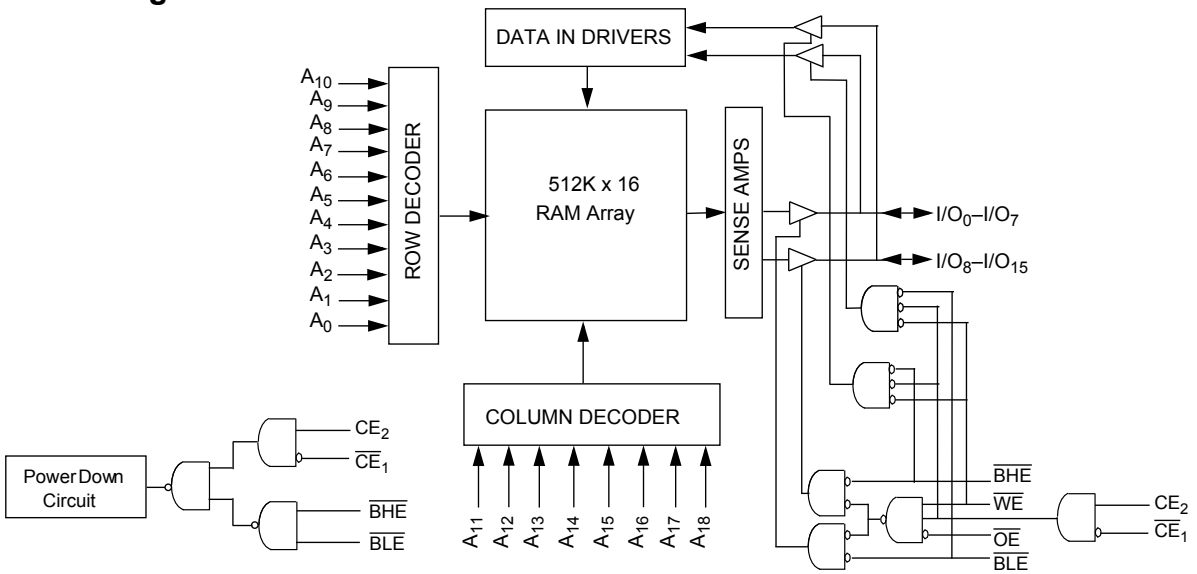
The CY62157E is a high performance CMOS static RAM organized as 512K words by 16 bits. This device features advanced circuit design to provide ultra low active current. This is ideal for providing More Battery Life™ (MoBL®) in portable applications such as cellular telephones. The device also has an automatic power down feature that significantly reduces power consumption when addresses are not toggling. Place the device into standby mode when deseleMoBL®cted ($\overline{CE}_1$ HIGH or CE_2 LOW or both $\overline{BHE}$ and $\overline{BLE}$ are HIGH). The input or 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)
- 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 Truth Table on page 12 for a complete description of read and write modes.

Logic Block Diagram



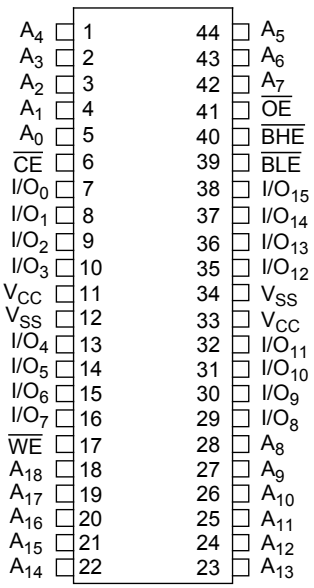
Contents

Product Portfolio

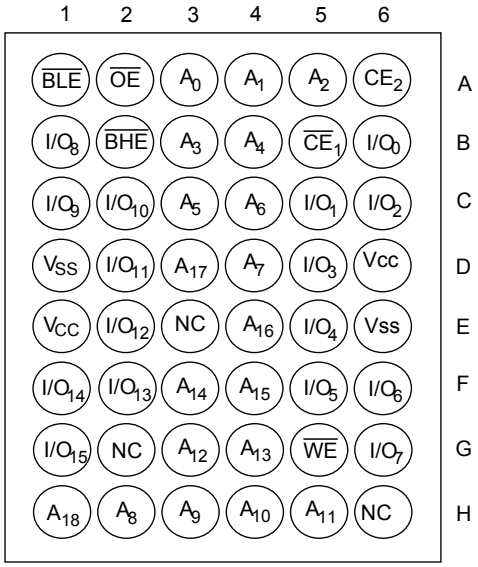
Product	Range	V_{CC} Range (V)			Speed (ns)	Power Dissipation					
						Operating I_{CC}, (mA)				Standby, I_{SB2} (µA)	
						f = 1 MHz		f = f_{max}			
		Min	Typ[1]	Max		Typ[1]	Max	Typ[1]	Max	Typ[1]	Max
CY62157ELL	Industrial	4.5	5.0	5.5	45	1.8	3	18	25	2	8
CY62157ELL	Automotive	4.5	5.0	5.5	55	1.8	4	18	35	2	30

Pin Configuration [2, 3]

44-pin TSOP II
Top View



48-ball VFBGA
Top View



Notes
1. 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.
2. NC pins are not connected on the die.
3. The 44-pin TSOP II package has only one chip enable ($\overline{CE}$) 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 .....–0.5 V to 6.0 V

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

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

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

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

Latch up Current .....> 200 mA

Operating Range

Device	Range	Ambient Temperature	V_{CC}[6]
CY62157ELL	Industrial	–40 °C to +85 °C	4.5 V to 5.5 V
	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[7]	Max	Min	Typ[7]	Max	
V_{OH}	Output HIGH Voltage	I_{OH} = –1 mA		2.4	–	–	2.4	–	–	V
V_{OL}	Output LOW Voltage	I_{OL} = 2.1 mA		–	–	0.4	–	–	0.4	V
V_{IH}	Input HIGH Voltage	V_{CC} = 4.5 V to 5.5 V		2.2	–	V_{CC} + 0.5	2.2	–	V_{CC} + 0.5	V
V_{IL}	Input LOW Voltage	V_{CC} = 4.5 V to 5.5 V		–0.5	–	0.8	–0.5	–	0.8	V
I_{IX}	Input Leakage Current	GND ≤ V_I ≤ V_{CC}		–1	–	+1	–4	–	+4	µA
I_{OZ}	Output Leakage Current	GND ≤ V_O ≤ V_{CC}, Output Disabled		–1	–	+1	–4	–	+4	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	–	18	25	–	18	35	mA
		f = 1 MHz		–	1.8	3	–	1.8	4	
I_{SB1} [8]	Automatic CE 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, V_{IN} ≤ 0.2 V, f = f_{max} (Address and Data Only), f = 0 ($\overline{OE}$ and $\overline{WE}$), V_{CC} = $V_{CC(max)}$		–	2	8	–	2	30	µA
I_{SB2} [8]	Automatic CE 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} = $V_{CC(max)}$		–	2	8	–	2	30	µA

Notes

4. $V_{IL(min)}$ = –2.0 V for pulse durations less than 20 ns for I < 30 mA.
5. $V_{IH(max)}$ = V_{CC} + 0.75 V 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.
7. 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.
8. Chip enables ($\overline{CE_1}$ and CE_2) and byte enables ($\overline{BHE}$ and $\overline{BLE}$) need to be tied to CMOS levels to meet the I_{SB1} / I_{SB2} / I_{CCDR} spec. Other inputs can be left floating.

Capacitance

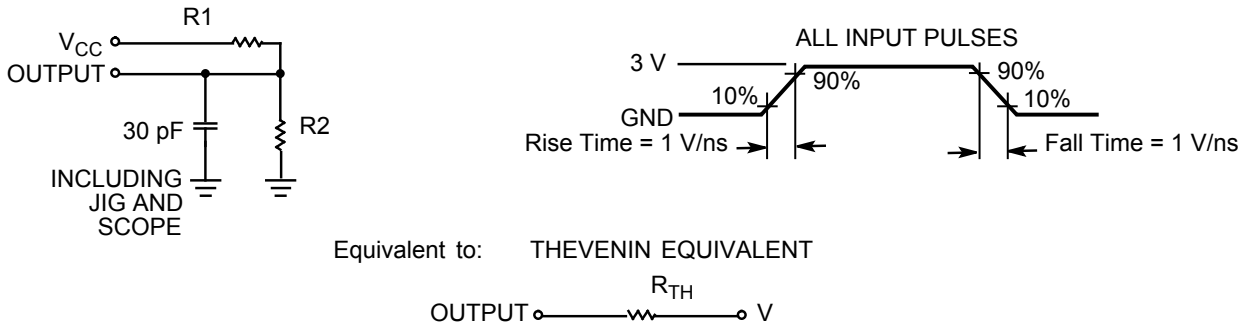
Parameter[9]	Description	Test Conditions	Max	Unit
C_{IN}	Input Capacitance	T_A = 25 °C, f = 1 MHz, V_{CC} = $V_{CC(typ)}$	10	pF
C_{OUT}	Output Capacitance		10	pF

Thermal Resistance

Parameter[9]	Description	Test Conditions	44-pin TSOP II	48-ball VFBGA	Unit
Θ_{JA}	Thermal Resistance (Junction to Ambient)	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	77	72	°C/W
Θ_{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	Ω
R2	990	Ω
R_{TH}	639	Ω
V_{TH}	1.77	V

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

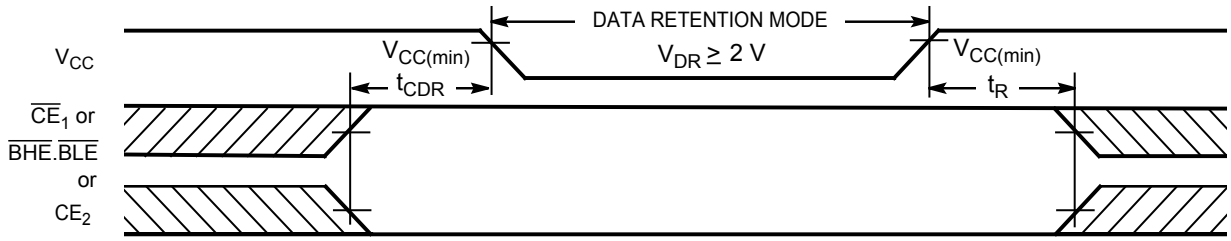
Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions		Min	Typ [10]	Max	Unit
V_{DR}	V_{CC} for Data Retention			2	–	–	V
I_{CCDR}[11]	Data Retention Current	V_{CC} = 2 V, $\overline{CE_1} \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V or ($\overline{BHE}$ and $\overline{BLE}$) ≥ V_{CC} – 0.2 V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V	Industrial	–	–	8	µA
			Automotive	–	–	30	
t_{CDR} [12]	Chip Deselect to Data Retention Time			0	–	–	ns
t_R [13]	Operation Recovery Time		CY62157ELL-45	45	–	–	ns
			CY62157ELL-55	55	–	–	

Data Retention Waveform

Figure 2. Data Retention Waveform[14]



Notes

10. 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.
11. Chip enables ($\overline{CE_1}$ and CE_2) and byte enables ($\overline{BHE}$ and $\overline{BLE}$) need to be tied to CMOS levels to meet the I_{SB1} / I_{SB2} / I_{CCDR} spec. Other inputs can be left floating.
12. Tested initially and after any design or process changes that may affect these parameters.
13. 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.
14. $\overline{BHE}.\overline{BLE}$ is the AND of both $\overline{BHE}$ and $\overline{BLE}$. Deselect the chip by either disabling chip enable signals or by disabling both $\overline{BHE}$ and $\overline{BLE}$.

Switching Characteristics

Over the Operating Range

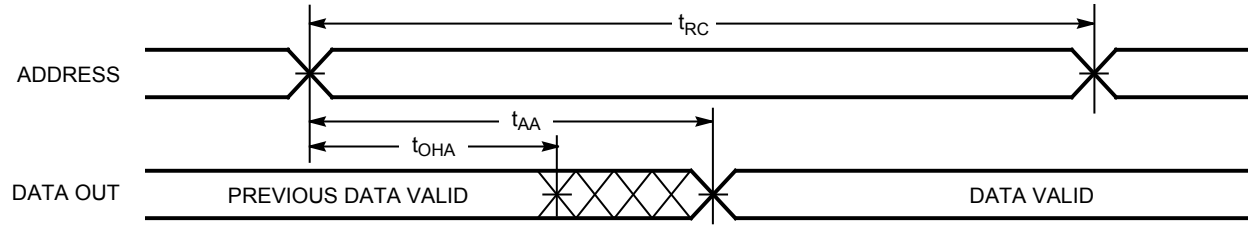
Parameter[15, 16]	Description	45 ns (Industrial)		55 ns (Automotive)		Unit
		Min	Max	Min	Max	
Read Cycle						
t_{RC}	Read Cycle Time	45	–	55	–	ns
t_{AA}	Address to Data Valid	–	45	–	55	ns
t_{OHA}	Data Hold from Address Change	10	–	10	–	ns
t_{ACE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Data Valid	–	45	–	55	ns
t_{DOE}	$\overline{OE}$ LOW to Data Valid	–	22	–	25	ns
t_{LZOE}	$\overline{OE}$ LOW to Low Z[17]	5	–	5	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z[17, 18]	–	18	–	20	ns
t_{LZCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Low Z[17]	10	–	10	–	ns
t_{HZCE}	$\overline{CE}_1$ HIGH and CE_2 LOW to High Z[17, 18]	–	18	–	20	ns
t_{PU}	$\overline{CE}_1$ LOW and CE_2 HIGH to Power Up	0	–	0	–	ns
t_{PD}	$\overline{CE}_1$ HIGH and CE_2 LOW to Power Down	–	45	–	55	ns
t_{DBE}	$\overline{BLE}$/$\overline{BHE}$ LOW to Data Valid	–	45	–	55	ns
t_{LZBE}	$\overline{BLE}$/$\overline{BHE}$ LOW to Low Z[17]	10	–	10	–	ns
t_{HZBE}	$\overline{BLE}$/$\overline{BHE}$ HIGH to High Z[17, 18]	–	18	–	20	ns
Write Cycle[19]						
t_{WC}	Write Cycle Time	45	–	55	–	ns
t_{SCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Write End	35	–	40	–	ns
t_{AW}	Address Setup to Write End	35	–	40	–	ns
t_{HA}	Address Hold from Write End	0	–	0	–	ns
t_{SA}	Address Setup to Write Start	0	–	0	–	ns
t_{PWE}	$\overline{WE}$ Pulse Width	35	–	40	–	ns
t_{BW}	$\overline{BLE}$/$\overline{BHE}$ LOW to Write End	35	–	40	–	ns
t_{SD}	Data Setup to Write End	25	–	25	–	ns
t_{HD}	Data Hold from Write End	0	–	0	–	ns
t_{HZWE}	$\overline{WE}$ LOW to High Z[17, 18]	–	18	–	20	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low Z[17]	10	–	10	–	ns

Notes

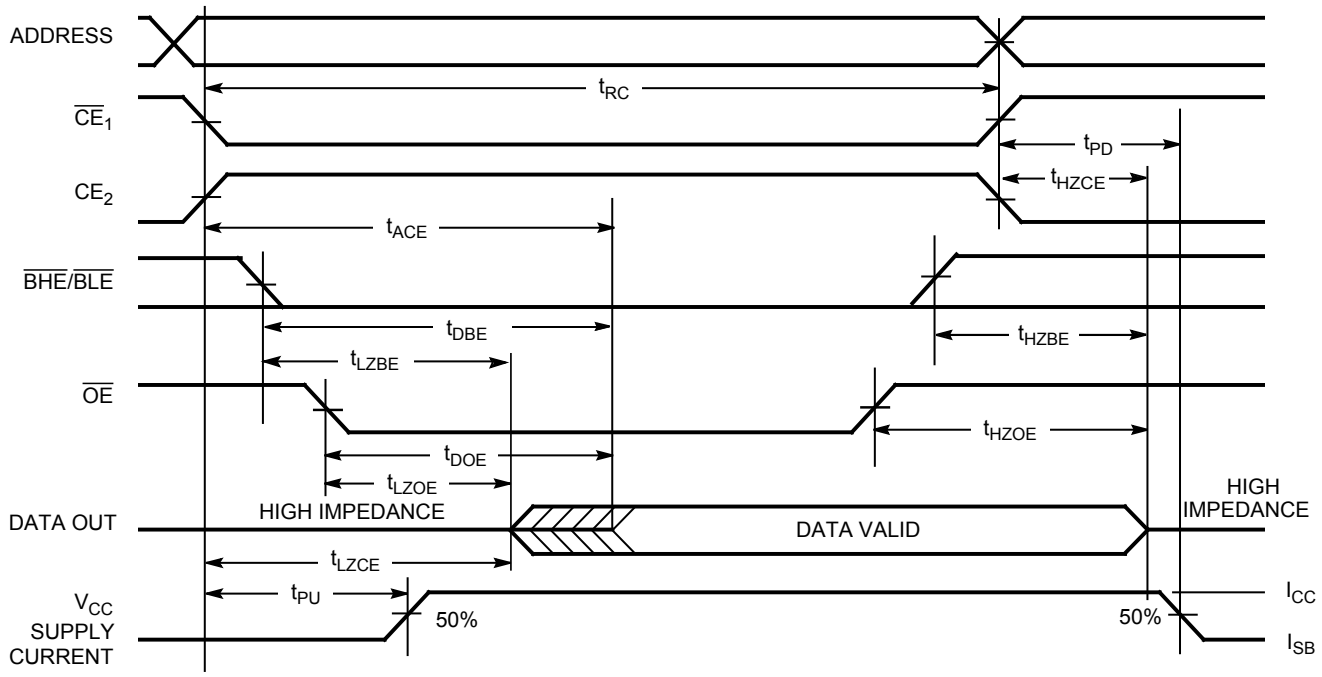
15. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns or less, timing reference levels of $V_{CC(typ)}/2$, input pulse levels of 0 to $V_{CC(typ)}$, and output loading of the specified I_{OL}/I_{OH} as shown in the AC Test Loads and Waveforms on page 5.
16. AC timing parameters are subject to byte enable signals ($\overline{BHE}$ or $\overline{BLE}$) 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 $\overline{WE}$, $\overline{CE}_1 = V_{IL}$, $\overline{BHE}$, $\overline{BLE}$, 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.

Switching Waveforms

Read Cycle No. 1 (Address Transition Controlled) [20, 21]



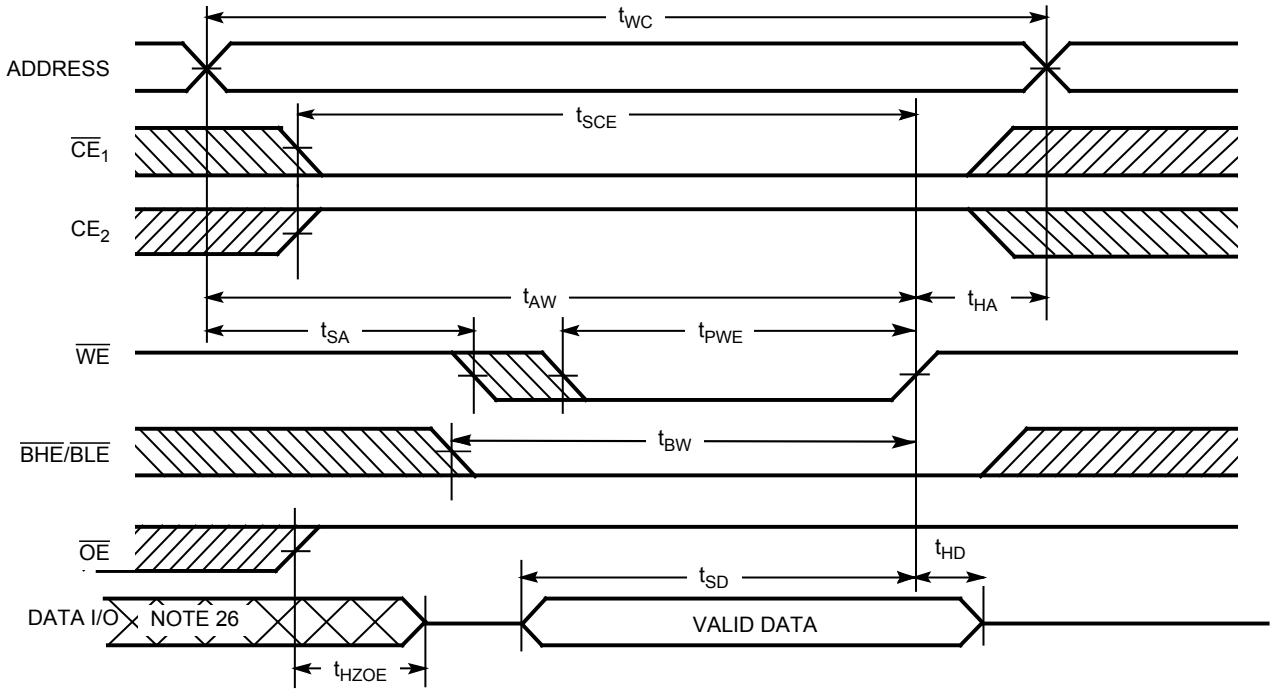
Read Cycle No. 2 ($\overline{OE}$ Controlled) [21, 22]



Notes
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) [23, 24, 25]

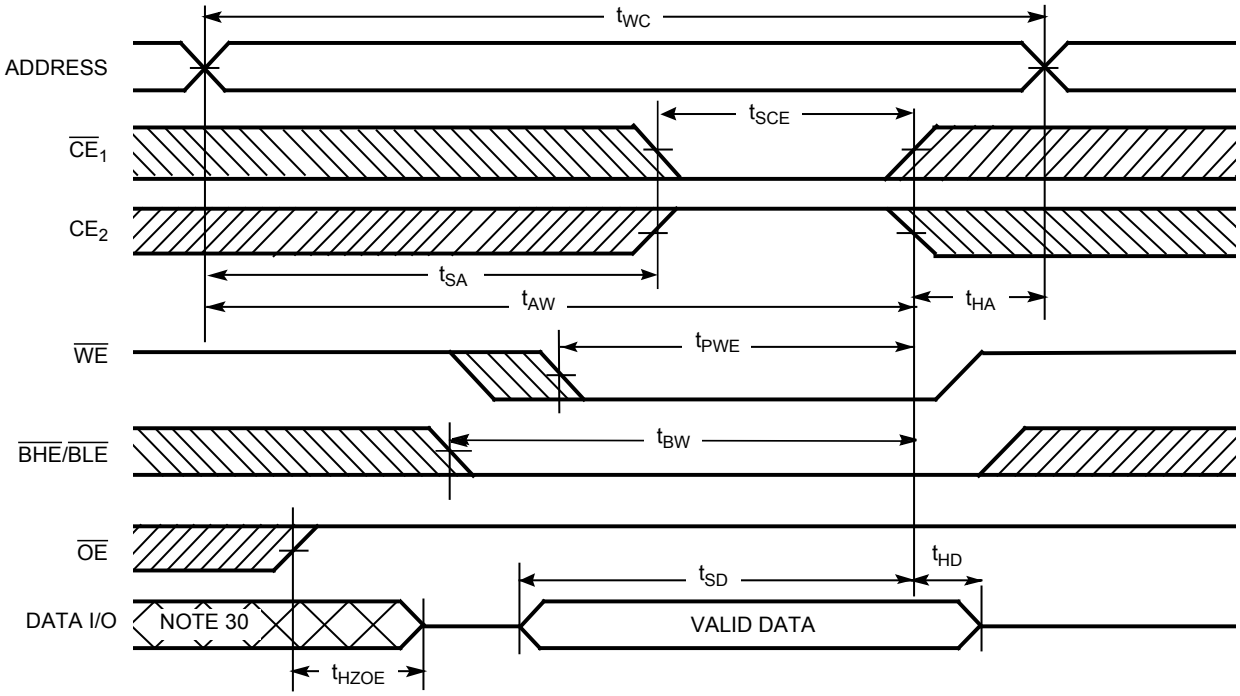


Notes

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. 2 ($\overline{CE}_1$ or CE_2 Controlled) [27, 28, 29]

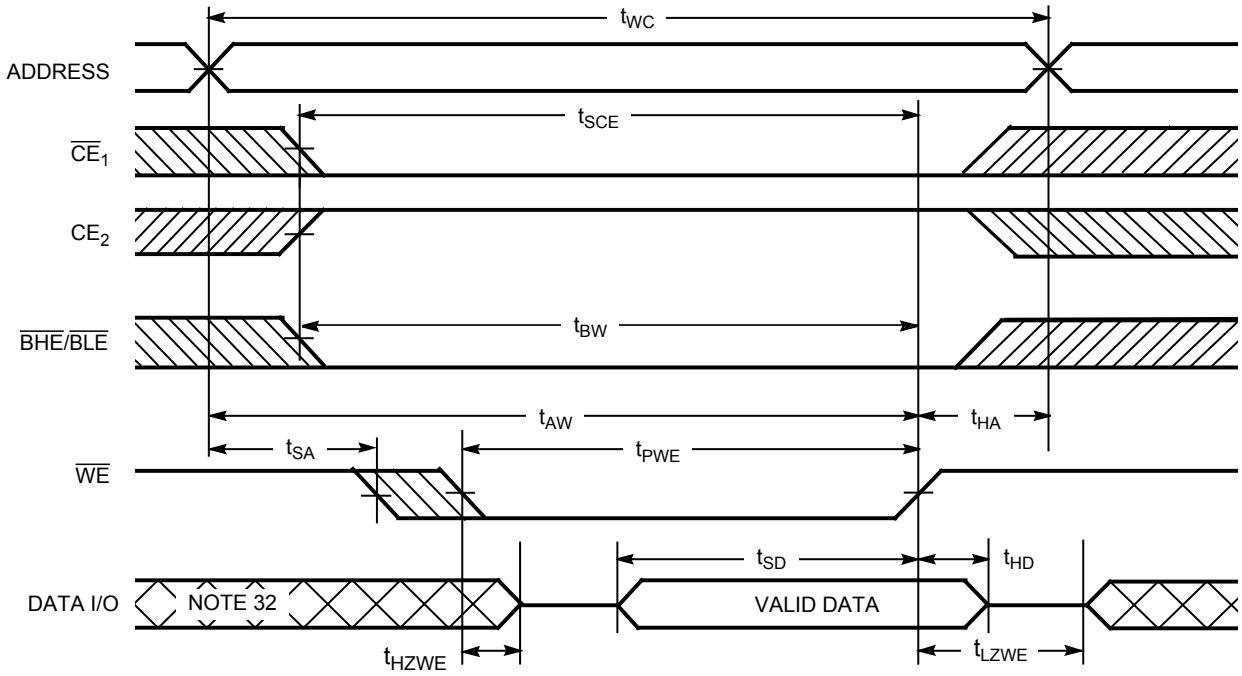


Notes

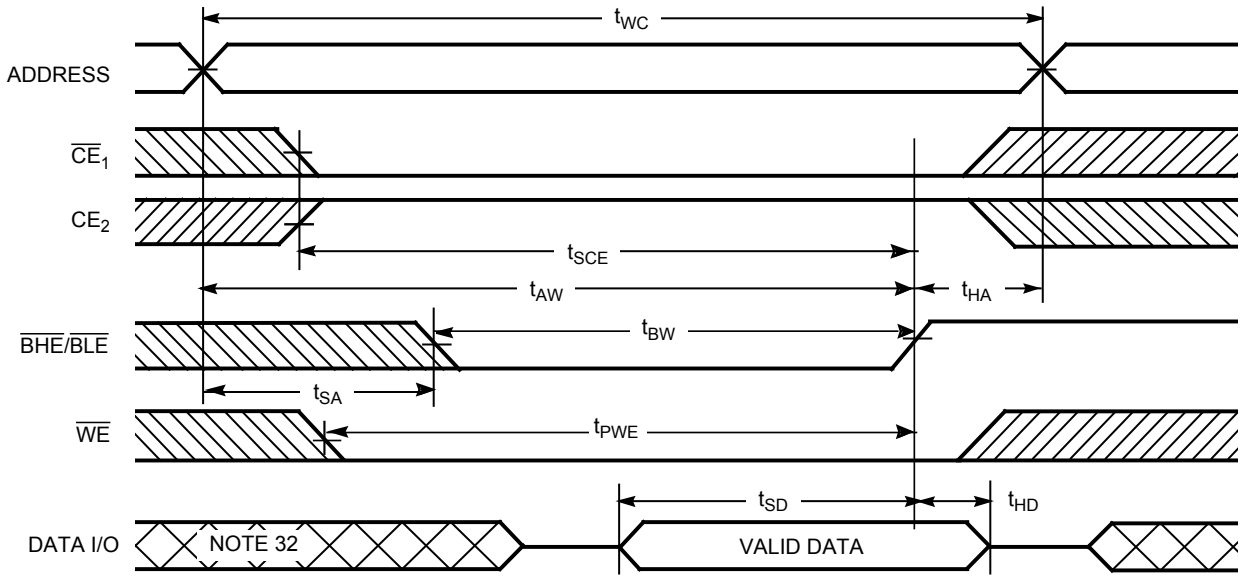
27. The internal write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE}_1$ = V_{IL}, $\overline{BHE}$, $\overline{BLE}$, or both = V_{IL}, and CE_2 = V_{IH}. All signals must be active to initiate a write and any of these signals can terminate a write by going inactive. The data input setup and hold timing must be referenced to the edge of the signal that terminates the write.
28. Data I/O is high impedance if $\overline{OE}$ = V_{IH}.
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. Do not apply input signals.

Switching Waveforms (continued)

Write Cycle No. 3 (WE Controlled, OE LOW) [31]



Write Cycle No. 4 (BHE/BLE Controlled, OE LOW) [31]



Notes
31. 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.
32. During this period, the I/Os are in output state. Do not apply input signals.

Truth Table

$\overline{CE_1}$	CE_2	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X[33]	X	X	X	X	High Z	Deselect/Power Down	Standby (I_{SB})
X[33]	L	X	X	X	X	High Z	Deselect/Power Down	Standby (I_{SB})
X[33]	X[33]	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})

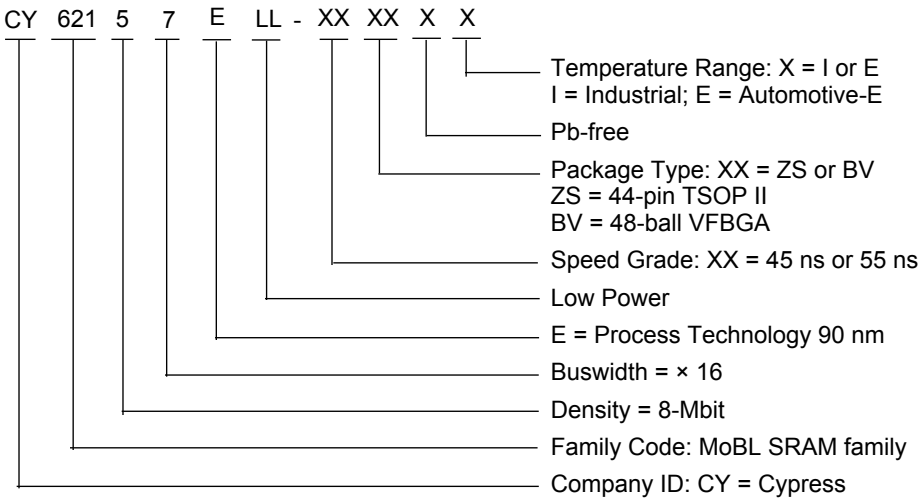
Note
33. The 'X' (Don't care) state for the Chip enables in the truth table refer to the logic state (either HIGH or LOW). Intermediate voltage levels on these pins is not permitted.

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)	

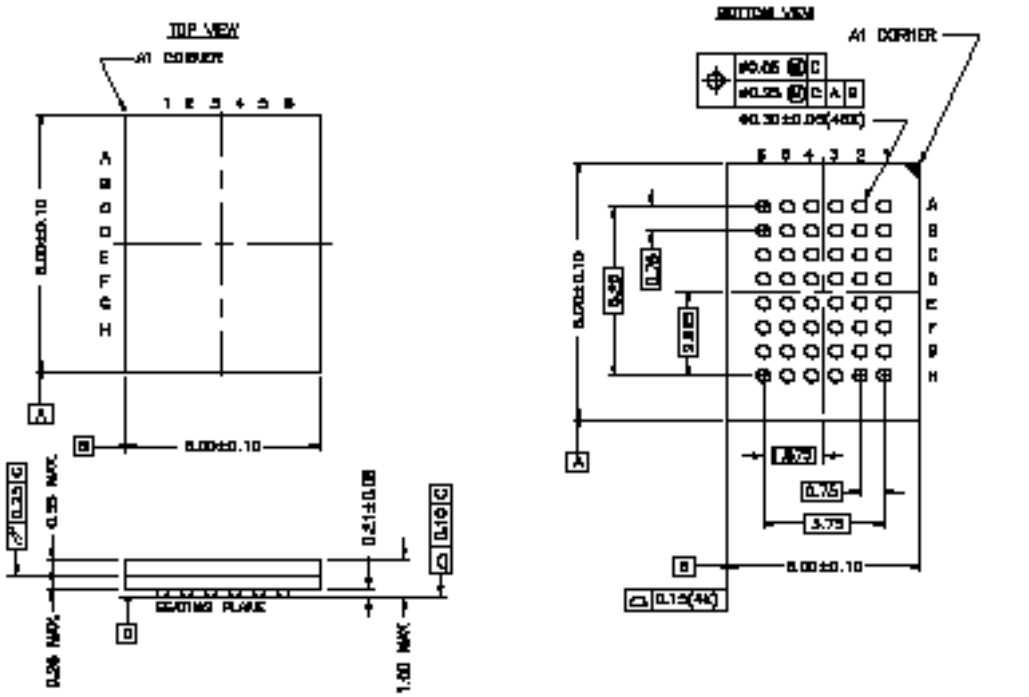
Contact your local Cypress sales representative for availability of these parts.

Ordering Code Definitions



Package Diagrams

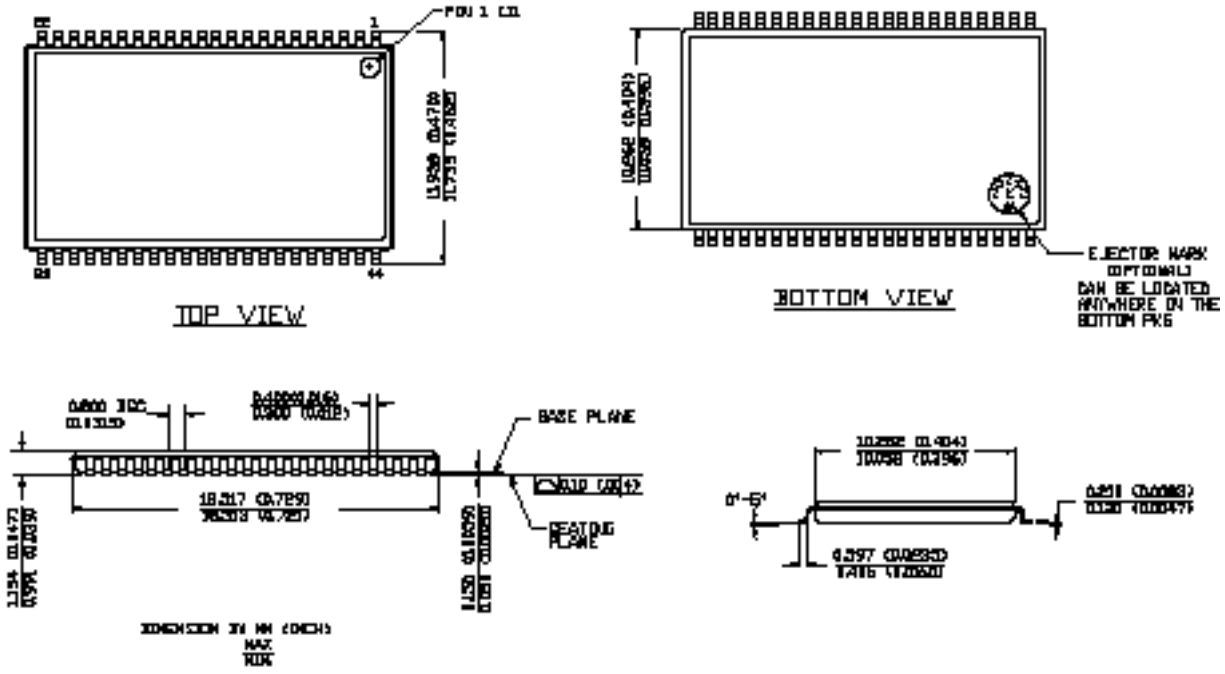
Figure 3. 48-ball VFBGA (6 × 8 × 1 mm) BV48/BZ48, 51-85150



51-85150 *F

Package Diagrams (continued)

Figure 4. 44-pin TSOP Z44-II, 51-85087



51-85087 *C

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
TTL	transistor-transistor logic
TSOP	thin small outline package
VFBGA	very fine-pitch ball grid array
$\overline{WE}$	write enable

Document Conventions

Units of Measure

Symbol	Unit of Measure
°C	degree Celcius
MHz	Mega Hertz
µA	micro Amperes
µs	micro seconds
mA	milli Amperes
mm	milli meter
ns	nano seconds
Ω	ohms
%	percent
pF	pico Farad
V	Volts
W	Watts

Document History Page

Document Title: CY62157E MoBL®, 8-Mbit (512 K × 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 μs 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 = 1MHz Changed the $I_{SB2(typ)}$ value of Automotive from 5 μA to 1.8 μA 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.
*H	3269641	05/30/2011	RAME	Removed the note “For best practice recommendations, please refer to the Cypress application note AN1064, SRAM System Guidelines.” and its reference in Functional Description. Updated Electrical Characteristics. Updated Data Retention Characteristics. Added Acronyms and Units of Measure. Updated in new template.

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