CY62147EV30 MoBL®

4-Mbit (256K x 16) Static RAM

Features

- Very high speed: 45 ns
- Temperature ranges
  - Industrial: –40°C to +85°C
  - Automotive-A: –40°C to +85°C
  - Automotive-E: –40°C to +125°C
- Wide voltage range: 2.20V to 3.60V
- Pin compatible with CY62147DV30
- Ultra low standby power
  - Typical standby current: 1 µA
  - Maximum standby current: 7 µA (Industrial)
- Ultra low active power
  - Typical active current: 2 mA at f = 1 MHz
- Easy memory expansion with $\overline{CE}$ [1] and $\overline{OE}$ features
- Automatic power down when deselected
- CMOS for optimum speed and power
- Available in Pb-free 48-ball VFBGA (single/dual CE option) and 44-pin TSOPII packages
- Byte power down feature

Functional Description

The CY62147EV30 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. 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 when addresses are not toggling. Placing the device into standby mode reduces power consumption by more than 99% when deselected ($\overline{CE}$ HIGH or both BLE and BHE are HIGH). The input and output pins (IO_0 through IO_{15}) are placed in a high impedance state when:

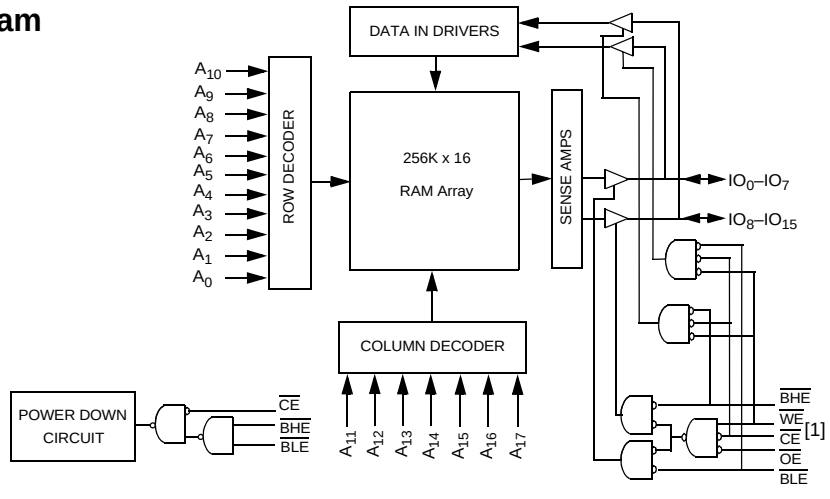
- Deselected ($\overline{CE}$ HIGH)
- Outputs are disabled ($\overline{OE}$ HIGH)
- Both Byte High Enable and Byte Low Enable are disabled ($\overline{BHE}$, $\overline{BLE}$ HIGH)
- Write operation is active ($\overline{CE}$ LOW and $\overline{WE}$ LOW)

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 appear 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 9 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



Note

1. BGA packaged device is offered in single CE and dual CE options. In this data sheet, for a dual CE device, $\overline{CE}$ refers to the internal logical combination of $\overline{CE_1}$ and CE_2 such that when CE_1 is LOW and CE_2 is HIGH, CE is LOW. For all other cases CE is HIGH.

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[2]	Max		Typ[2]	Max	Typ[2]	Max	Typ[2]	Max
CY62147EV30LL	Ind'l/Auto-A	2.2	3.0	3.6	45 ns	2	2.5	15	20	1	7
	Auto-E	2.2	3.0	3.6	55 ns	2	3	15	25	1	20

Pin Configuration

Figure 1. 48-Ball VFBGA (Single Chip Enable) [3, 4]

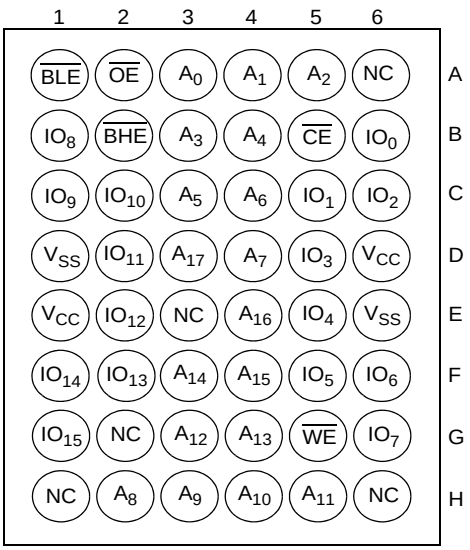


Figure 2. 48-Ball VFBGA (Dual Chip Enable)[3, 4]

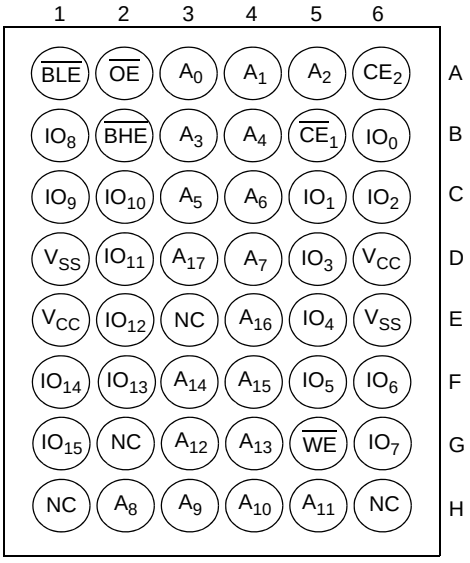
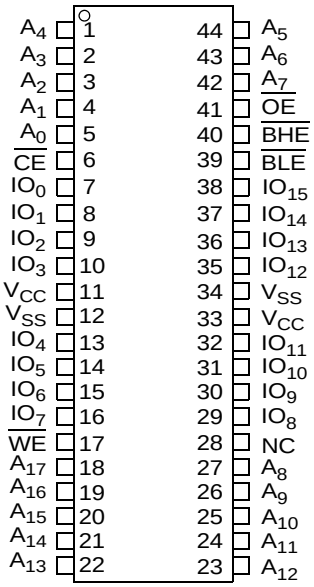


Figure 3. 44-Pin TSOP II [3]



Notes
2. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at $V_{CC} = V_{CC(typ)}$, $T_A = 25°$.
3. NC pins are not connected on the die.
4. Pins H1, G2, and H6 in the BGA package are address expansion pins for 8 Mb, 16 Mb, and 32 Mb, respectively.

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 .....–0.3V to + 3.9V (V_{CCmax} + 0.3V)

DC Voltage Applied to Outputs in High-Z State [5, 6] .....–0.3V to 3.9V (V_{CCmax} + 0.3V)

DC Input Voltage [5, 6] .....–0.3V to 3.9V (V_{CCmax} + 0.3V)

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} [7]
CY62147EV30LL	Ind'l/Auto-A	–40°C to +85°C	2.2V to 3.6V
	Auto-E	–40°C to +125°C	

Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	45 ns (Ind'l/Auto-A)			55 ns (Auto-E)			Unit
			Min	Typ [2]	Max	Min	Typ [2]	Max	
V_{OH}	Output HIGH Voltage	I_{OH} = –0.1 mA	2.0			2.0			V
		I_{OH} = –1.0 mA, $V_{CC} \geq$ 2.70V	2.4			2.4			V
V_{OL}	Output LOW Voltage	I_{OL} = 0.1 mA			0.4			0.4	V
		I_{OL} = 2.1 mA, V_{CC} = 2.70V			0.4			0.4	V
V_{IH}	Input HIGH Voltage	V_{CC} = 2.2V to 2.7V	1.8		V_{CC} + 0.3	1.8		V_{CC} + 0.3	V
		V_{CC}= 2.7V to 3.6V	2.2		V_{CC} + 0.3	2.2		V_{CC} + 0.3	V
V_{IL}	Input LOW Voltage	V_{CC} = 2.2V to 2.7V	–0.3		0.6	–0.3		0.6	V
		V_{CC}= 2.7V to 3.6V	–0.3		0.8	–0.3		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		15	20		15	25	mA
		f = 1 MHz; V_{CC} = $V_{CC(max)}$; I_{OUT} = 0 mA CMOS levels		2	2.5		2	3	
I_{SB1}	Automatic CE Power Down Current — CMOS Inputs	$\overline{CE} \geq V_{CC}$ – 0.2V, $V_{IN} \geq V_{CC}$ – 0.2V, $V_{IN} \leq$ 0.2V, f = f_{max} (Address and Data Only), f = 0 (OE, BHE, BLE and WE), V_{CC} = 3.60V		1	7		1	20	µA
I_{SB2} [8]	Automatic CE Power Down Current — CMOS Inputs	$\overline{CE} \geq V_{CC}$ – 0.2V, $V_{IN} \geq V_{CC}$ – 0.2V or $V_{IN} \leq$ 0.2V, f = 0, V_{CC} = 3.60V		1	7		1	20	µA

Capacitance

For all packages.[9]

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

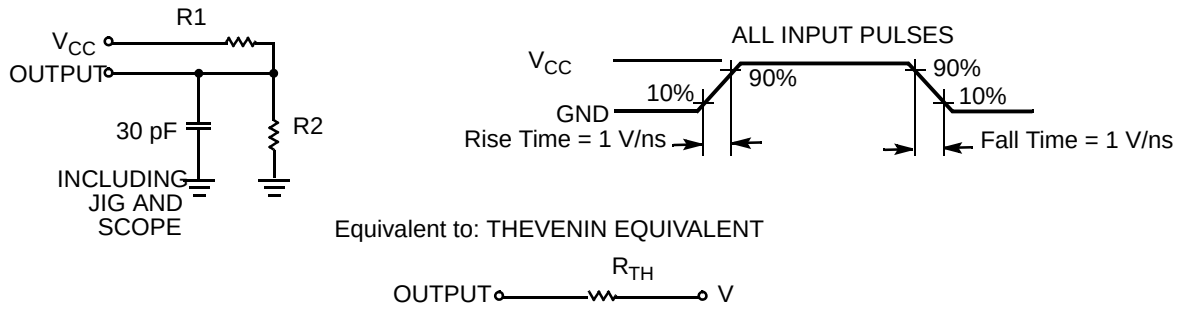
Notes

5. $V_{IL(min)}$ = –2.0V for pulse durations less than 20 ns.
6. $V_{IH(max)}$ = V_{CC} + 0.75V for pulse durations less than 20 ns.
7. Full device AC operation assumes a minimum of 100 µs ramp time from 0 to V_{CC}(min) and 200 µs wait time after V_{CC} stabilization.
8. Only chip enable ($\overline{CE}$) and byte enables ($\overline{BHE}$ and $\overline{BLE}$) need to be tied to CMOS levels to meet the I_{SB2} / I_{CCDR} spec. Other inputs can be left floating.
9. Tested initially and after any design or process changes that may affect these parameters.

Thermal Resistance[9]

Parameter	Description	Test Conditions	VFBGA Package	TSOP II Package	Unit
Θ_{JA}	Thermal Resistance (Junction to Ambient)	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	75	77	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		10	13	°C/W

Figure 4. AC Test Load and Waveforms



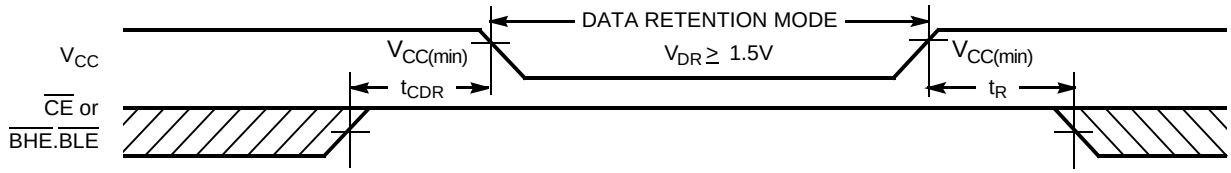
Parameters	2.50V	3.0V	Unit
R1	16667	1103	Ω
R2	15385	1554	Ω
R_{TH}	8000	645	Ω
V_{TH}	1.20	1.75	V

Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions		Min	Typ [2]	Max	Unit
V_{DR}	V_{CC} for Data Retention			1.5			V
I_{CCDR}[8]	Data Retention Current	V_{CC}= 1.5V, $\overline{CE} \geq V_{CC} - 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	Ind'l/Auto-A		0.8	7	µA
			Auto-E			12	
t_{CDR} [9]	Chip Deselect to Data Retention Time			0			ns
t_R [10]	Operation Recovery Time			t_{RC}			ns

Figure 5. Data Retention Waveform[1, 11]



Notes

10. 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.
11. $\overline{BHE}.\overline{BLE}$ is the AND of both $\overline{BHE}$ and $\overline{BLE}$. Deselect the chip by either disabling the chip enable signals or by disabling both $\overline{BHE}$ and $\overline{BLE}$.

Switching Characteristics

Over the Operating Range [12, 13]

Parameter	Description	45 ns (Ind'l/Auto-A)		55 ns (Auto-E)		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}	$\overline{CE}$ LOW 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[14]	5		5		ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z[14, 15]		18		20	ns
t_{LZCE}	$\overline{CE}$ LOW to Low Z[14]	10		10		ns
t_{HZCE}	$\overline{CE}$ HIGH to High Z[14, 15]		18		20	ns
t_{PU}	$\overline{CE}$ LOW to Power Up	0		0		ns
t_{PD}	$\overline{CE}$ HIGH 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[14]	10		10		ns
t_{HZBE}	$\overline{BLE}$/$\overline{BHE}$ HIGH to HIGH Z[14, 15]		18		20	ns
Write Cycle[16]						
t_{WC}	Write Cycle Time	45		55		ns
t_{SCE}	$\overline{CE}$ LOW 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[14, 15]		18		20	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low-Z[14]	10		10		ns

Notes

12. Test conditions for all parameters other than tri-state parameters assume signal transition time of 3 ns (1V/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 Load and Waveforms on page 4.
13. 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.
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 $\overline{WE}$, $\overline{CE}$ = 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 6. Read Cycle No. 1 (Address Transition Controlled)[17, 18]

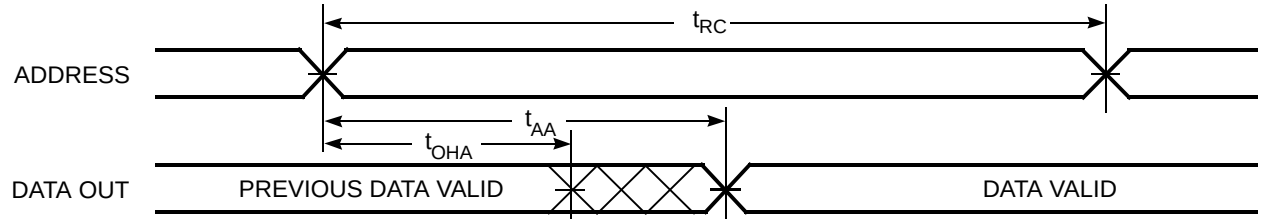
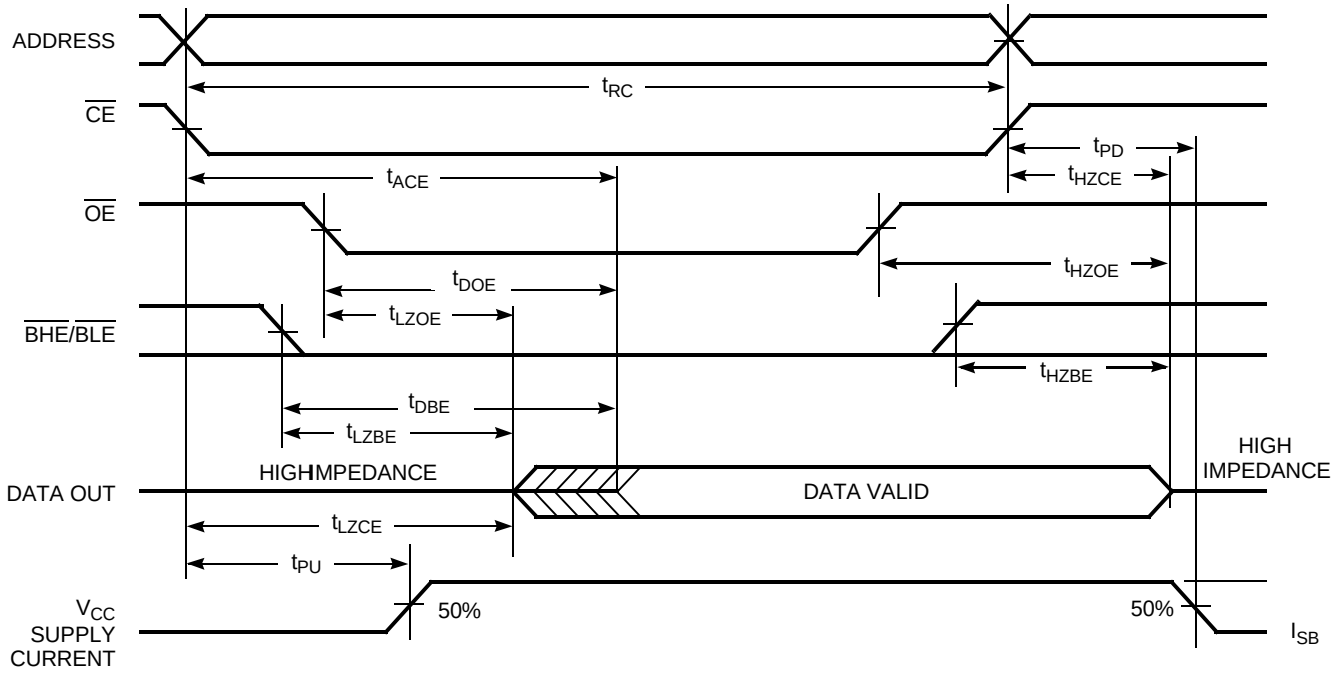


Figure 7. Read Cycle No. 2 ($\overline{OE}$ Controlled)[1, 18, 19]



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

Switching Waveforms (continued)

Figure 8. Write Cycle No. 1 ($\overline{WE}$ Controlled)[1, 16, 20, 21]

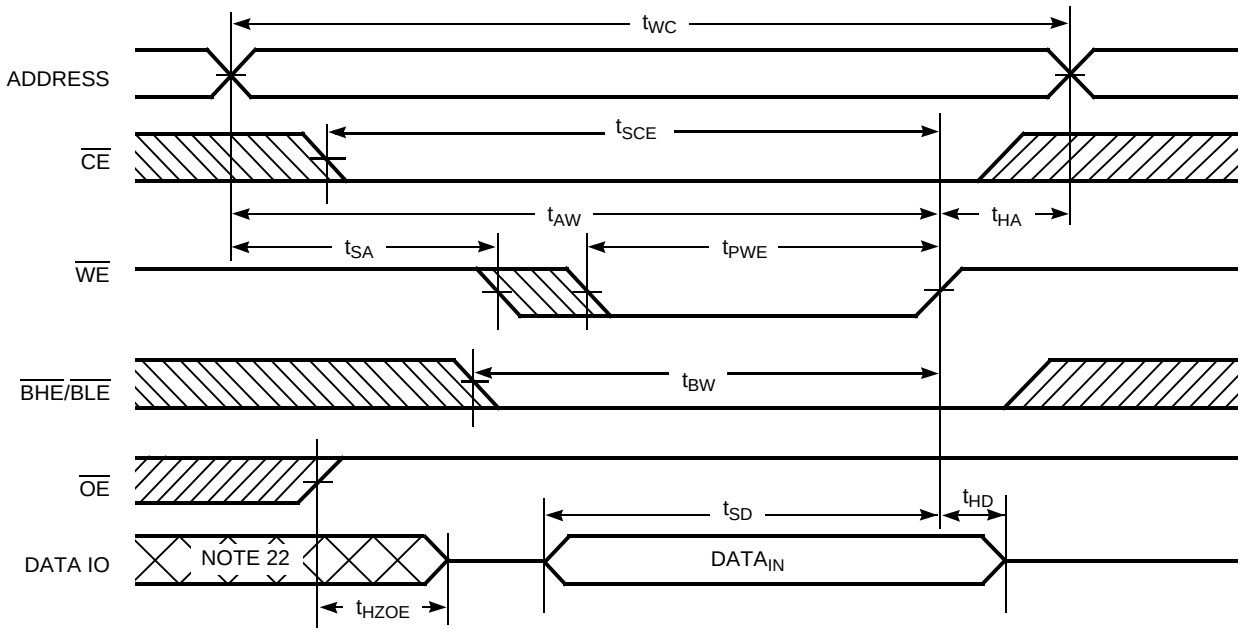
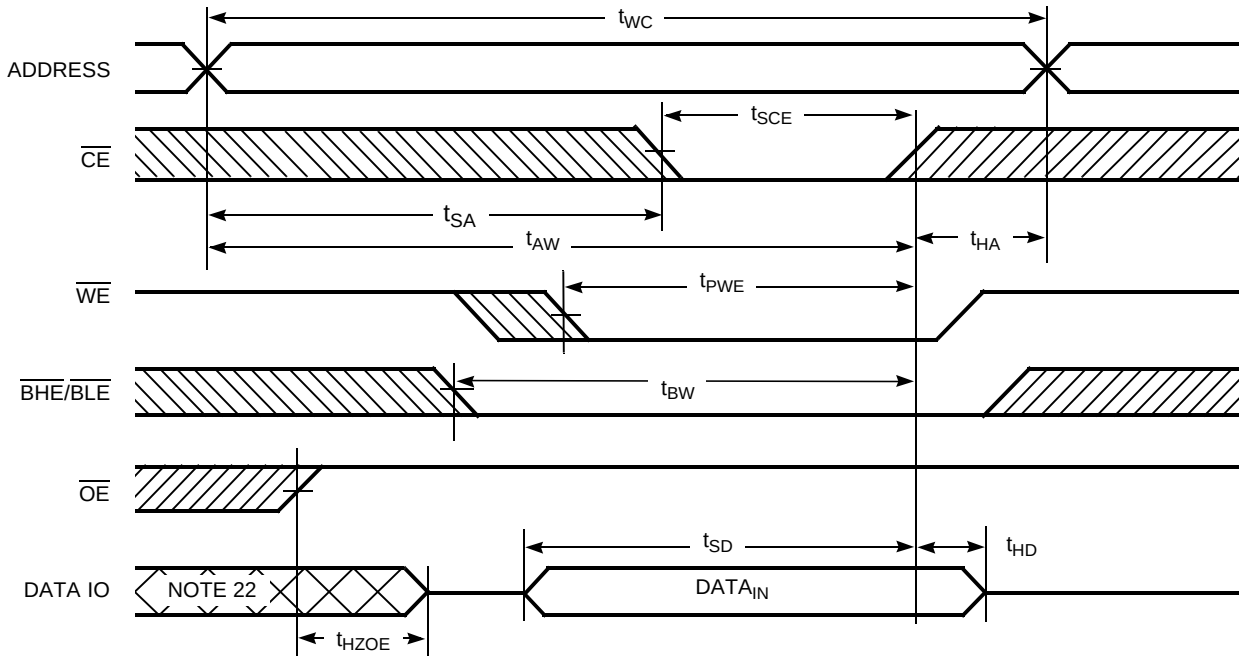


Figure 9. Write Cycle No. 2 ($\overline{CE}$ Controlled)[1, 16, 20, 21]



Switching Waveforms (continued)

Figure 10. Write Cycle No. 3 (WE Controlled, OE LOW)[1, 21]

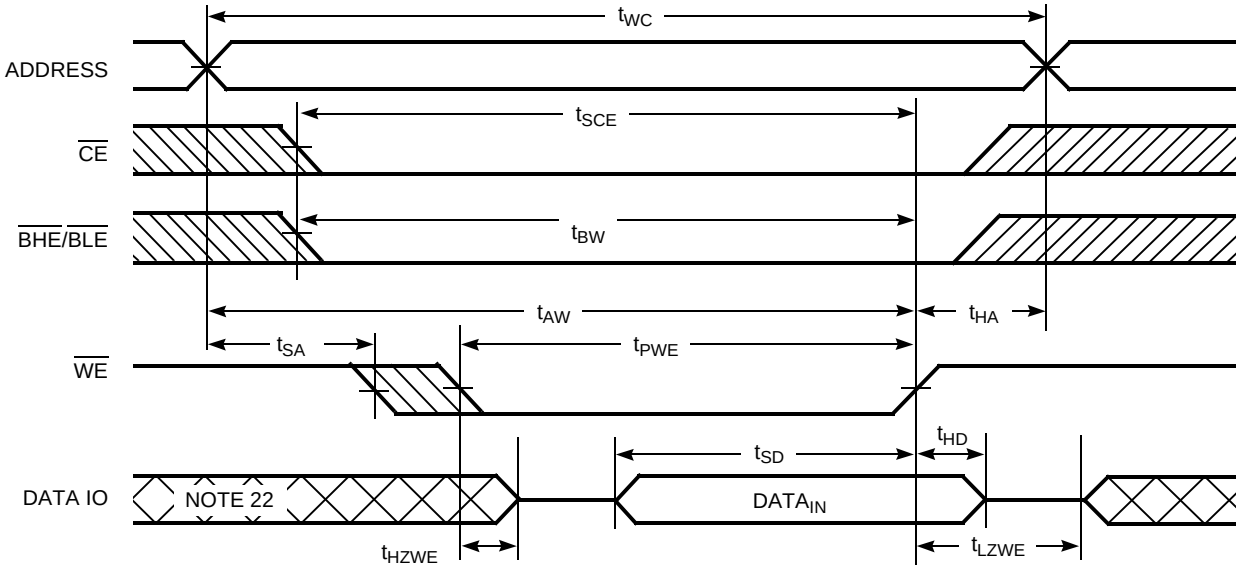
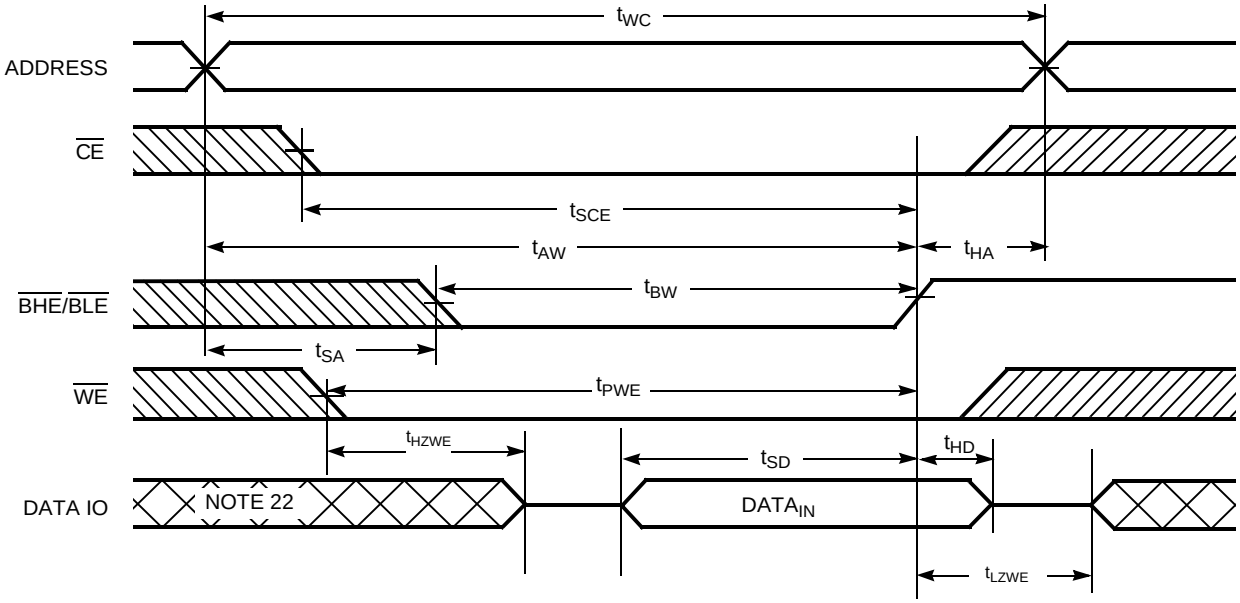


Figure 11. Write Cycle No. 4 (BHE/BLE Controlled, OE LOW)[1, 21]



Notes
20. Data I/O is high impedance if OE = V_{IH}.
21. If CE goes HIGH simultaneously with WE = V_{IH}, the output remains in a high impedance state.
22. During this period, the IOs are in output state. Do not apply input signals.

Truth Table

$\overline{CE}$[1]	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	IOs	Mode	Power
H	X	X	X	X	High Z	Deselect/Power Down	Standby (I_{SB})
L	X	X	H	H	High Z	Deselect/Power Down	Standby (I_{SB})
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

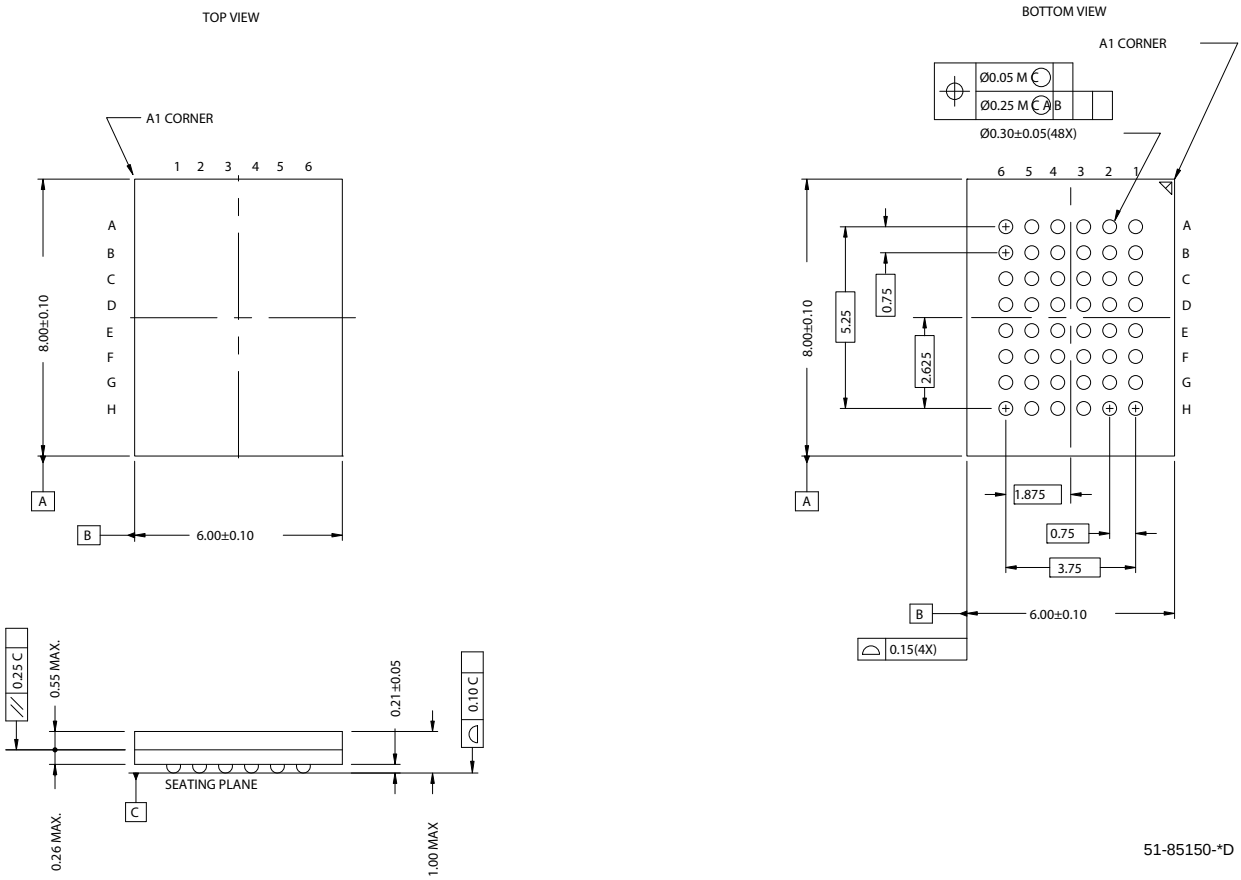
Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62147EV30LL-45BVI	51-85150	48-Ball Very Fine Pitch Ball Grid Array [23]	Industrial
	CY62147EV30LL-45BVXI	51-85150	48-Ball Very Fine Pitch Ball Grid Array (Pb-Free) [23]	
	CY62147EV30LL-45B2XI	51-85150	48-Ball Very Fine Pitch Ball Grid Array (Pb-Free) [24]	
	CY62147EV30LL-45ZSXI	51-85087	44-Pin Thin Small Outline Package II (Pb-Free)	
	CY62147EV30LL-45BVXA	51-85150	48-Ball Very Fine Pitch Ball Grid Array (Pb-Free) [23]	Automotive-A
	CY62147EV30LL-45ZSXA	51-85087	44-Pin Thin Small Outline Package II (Pb-Free)	
55	CY62147EV30LL-55ZSXE	51-85087	44-Pin Thin Small Outline Package II (Pb-Free)	Automotive-E

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

Notes
23. This BGA package is offered with single chip enable.
24. This BGA package is offered with dual chip enable.

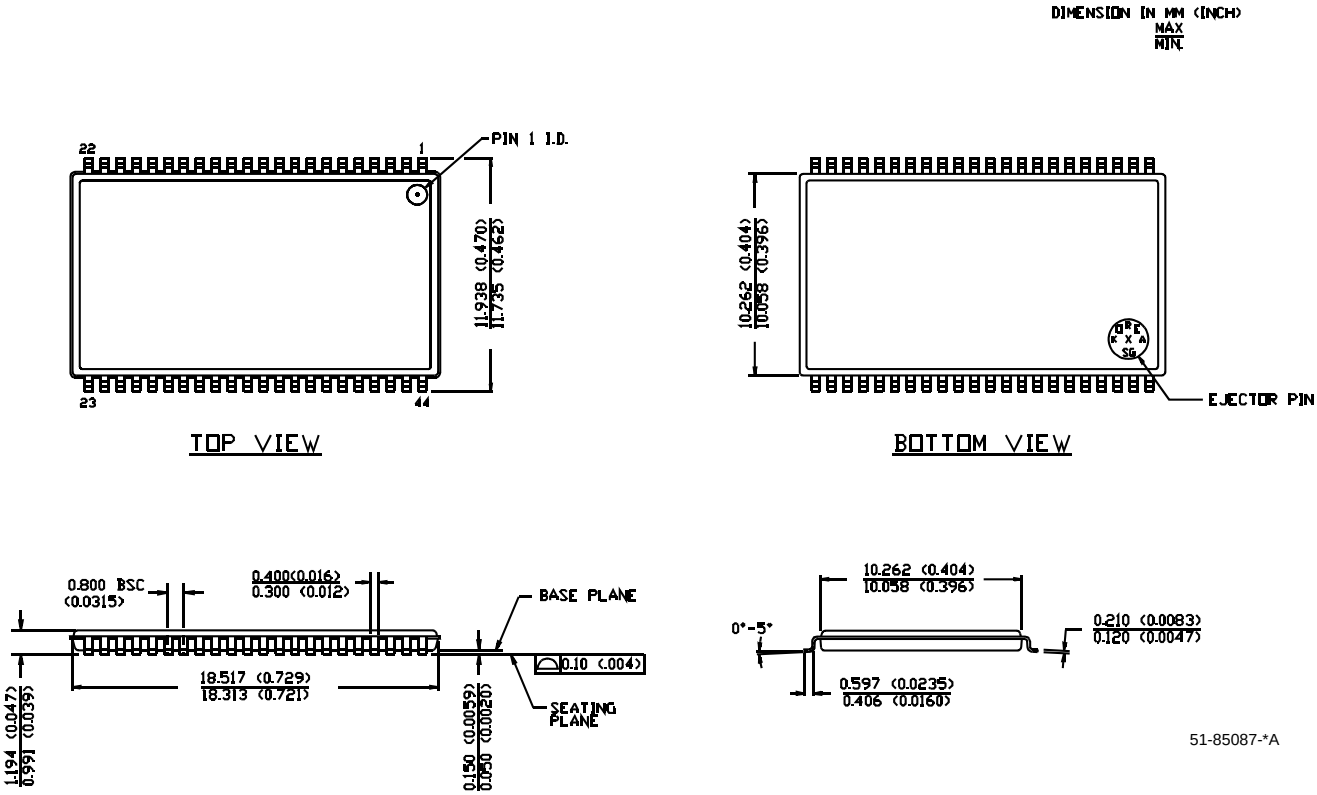
Package Diagrams

Figure 12. 48-Ball VFBGA (6 x 8 x 1 mm), 51-85150



Package Diagrams (continued)

Figure 13. 44-Pin TSOP II, 51-85087



Document History Page

Document Title: CY62147EV30 MoBL® 4-Mbit (256K x 16) Static RAM Document Number: 38-05440				
Rev.	**ECN No.**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	201861	AJU	01/13/04	New Data Sheet
*A	247009	SYT	See ECN	Changed from Advanced Information to Preliminary Moved Product Portfolio to Page 2 Changed Vcc stabilization time in footnote #8 from 100 µs to 200 µs Removed Footnote #15(t_{LZBE}) from Previous Revision Changed I_{CCDR} from 2.0 µA to 2.5 µA Changed typo in Data Retention Characteristics(t_R) from 100 µs to t_{RC} ns Changed t_{OHA} from 6 ns to 10 ns for both 35 ns and 45 ns Speed Bin Changed t_{HZOE}, t_{HZBE}, t_{HZWE} from 12 to 15 ns for 35 ns Speed Bin and 15 to 18 ns for 45 ns Speed Bin Changed t_{SCE} and t_{BW} from 25 to 30 ns for 35 ns Speed Bin and 40 to 35 ns for 45 ns Speed Bin Changed t_{HZCE} from 12 to 18 ns for 35 ns Speed Bin and 15 to 22 ns for 45 ns Speed Bin Changed t_{SD} from 15 to 18 ns for 35 ns Speed Bin and 20 to 22 ns for 45 ns Speed Bin Changed t_{DOE} from 15 to 18 ns for 35 ns Speed Bin Changed Ordering Information to include Pb-Free Packages
*B	414807	ZSD	See ECN	Changed from Preliminary information to Final Changed the address of Cypress Semiconductor Corporation on Page #1 from “3901 North First Street” to “198 Champion Court” Removed 35ns Speed Bin Removed “L” version of CY62147EV30 Changed ball E3 from DNU to NC. Removed redundant foot note on DNU. Changed I_{CC} (Max) value from 2 mA to 2.5 mA and I_{CC} (Typ) value from 1.5 mA to 2 mA at f=1 MHz Changed I_{CC} (Typ) value from 12 mA to 15 mA at f = f_{max} Changed I_{SB1} and I_{SB2} Typ values from 0.7 µA to 1 µA and Max values from 2.5 µA to 7 µA. Changed I_{CCDR} from 2.5 µA to 7 µA. Added I_{CCDR} typical value. Changed AC test load capacitance from 50 pF to 30 pF on Page #4. Changed t_{LZOE} from 3 ns to 5 ns Changed t_{LZCE}, t_{LZBE} and t_{LZWE} from 6 ns to 10 ns Changed t_{HZCE} from 22 ns to 18 ns Changed t_{PWE} from 30 ns to 35 ns. Changed t_{SD} from 22 ns to 25 ns. Updated the package diagram 48-pin VFBGA from *B to *D Updated the ordering information table and replaced the Package Name column with Package Diagram.
*C	464503	NXR	See ECN	Included Automotive Range in product offering Updated the Ordering Information
*D	925501	VKN	See ECN	Added Preliminary Automotive-A information Added footnote #9 related to I_{SB2} and I_{CCDR} Added footnote #14 related AC timing parameters
*E	1045701	VKN	See ECN	Converted Automotive-A and Automotive -E specs from preliminary to final
*F	2577505	VKN/PYRS	10/03/08	Added -45B2XI part (Dual CE option)
*G	2681901	VKN/PYRS	04/01/09	Added CY62147EV30LL-45ZSXA in the ordering information table

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