CY62147EV30 MoBL®

Automotive 4-Mbit (256K x 16) Static RAM

Features

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

Functional Description

The CY62147EV30 is a high performance CMOS static RAM (SRAM) 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 percent when deselected ($\overline{CE}$ HIGH or both $\overline{BLE}$ and $\overline{BHE}$ are HIGH). The input and output pins (I/O_0 through I/O_{15}) are placed in a high impedance state when:

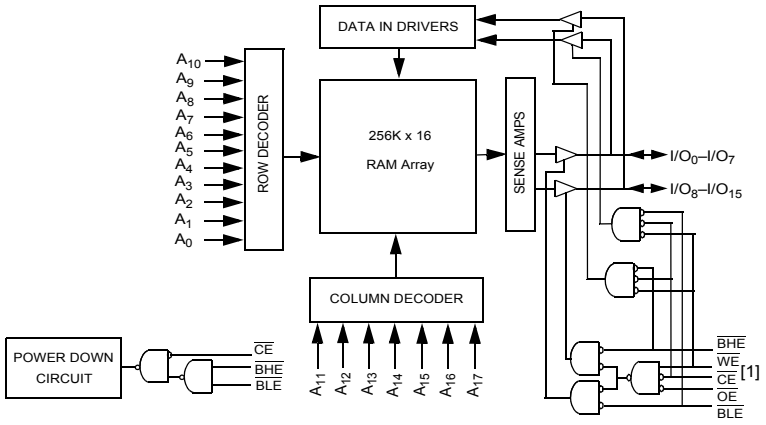
- Deselected ($\overline{CE}$ HIGH)
- Outputs are disabled ($\overline{OE}$ HIGH)
- Both Byte High Enable and Byte Low Enable are disabled ($\overline{BHE}$, $\overline{BLE}$ HIGH)
- Write operation is active ($\overline{CE}$ LOW and $\overline{WE}$ LOW)

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 I/O pins (I/O_0 through I/O_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 I/O pins (I/O_8 through I/O_{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 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 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



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 $\overline{CE}_1$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH.

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[2]	Max		Typ[2]	Max	Typ[2]	Max	Typ[2]	Max
CY62147EV30LL	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]

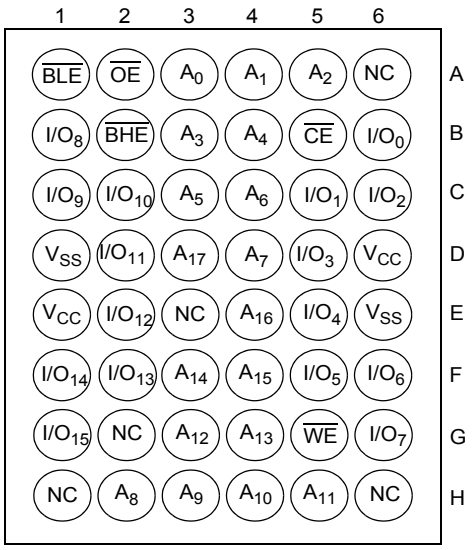


Figure 2. 48-Ball VFBGA (Dual Chip Enable)[3, 4]

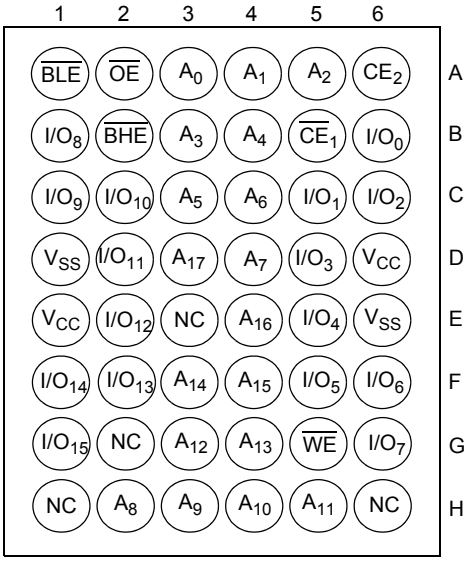
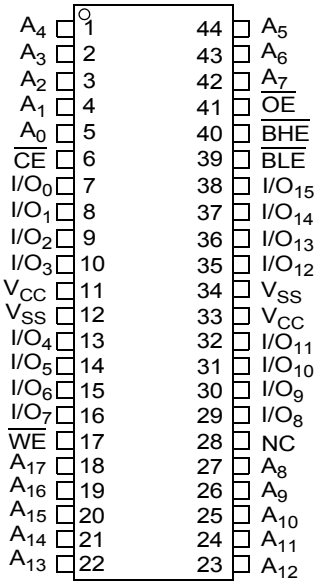


Figure 3. 44-Pin TSOP II [3]



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

DC voltage applied to outputs in High Z state [5, 6] ..... –0.3 V to 3.9 V (V_{CCmax} + 0.3 V)

DC input voltage [5, 6] ..... –0.3 V to 3.9 V (V_{CCmax} + 0.3 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} [7]
CY62147EV30LL	Auto-A	–40 °C to +85 °C	2.2 V to 3.6 V
	Auto-E	–40 °C to +125 °C	

Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	45 ns (Auto-A)			55 ns (Auto-E)			Unit
			Min	Typ [8]	Max	Min	Typ [8]	Max	
V_{OH}	Output HIGH voltage	I_{OH} = –0.1 mA	2.0	–	–	2.0	–	–	V
		I_{OH} = –1.0 mA, $V_{CC} \geq$ 2.70 V	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} = 2.70 V	–	–	0.4	–	–	0.4	V
V_{IH}	Input HIGH voltage	V_{CC} = 2.2 V to 2.7 V	1.8	–	V_{CC} + 0.3	1.8	–	V_{CC} + 0.3	V
		V_{CC}= 2.7 V to 3.6 V	2.2	–	V_{CC} + 0.3	2.2	–	V_{CC} + 0.3	V
V_{IL}	Input LOW voltage	V_{CC} = 2.2 V to 2.7 V	–0.3	–	0.6	–0.3	–	0.6	V
		V_{CC}= 2.7 V to 3.6 V	–0.3	–	0.8	–0.3		0.8	V
I_{IX}	Input leakage current	GND ≤ $V_I \leq V_{CC}$	–1	–	+1	–4	–	+4	µA
I_{OZ}	Output leakage current	GND ≤ $V_O \leq V_{CC}$, 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	$\overline{CE} \geq V_{CC}$ – 0.2 V, $V_{IN} \geq V_{CC}$ – 0.2 V, $V_{IN} \leq$ 0.2 V, f = f_{max} (address and data only), f = 0 ($\overline{OE}$, $\overline{BHE}$, $\overline{BLE}$ and $\overline{WE}$), V_{CC} = 3.60 V	–	1	7	–	1	20	µA
I_{SB2} [9]	Automatic CE power-down current — CMOS inputs	$\overline{CE} \geq V_{CC}$ – 0.2 V, $V_{IN} \geq V_{CC}$ – 0.2 V or $V_{IN} \leq$ 0.2 V, f = 0, V_{CC} = 3.60 V	–	1	7	–	1	20	µA

Capacitance

For all packages.[10]

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

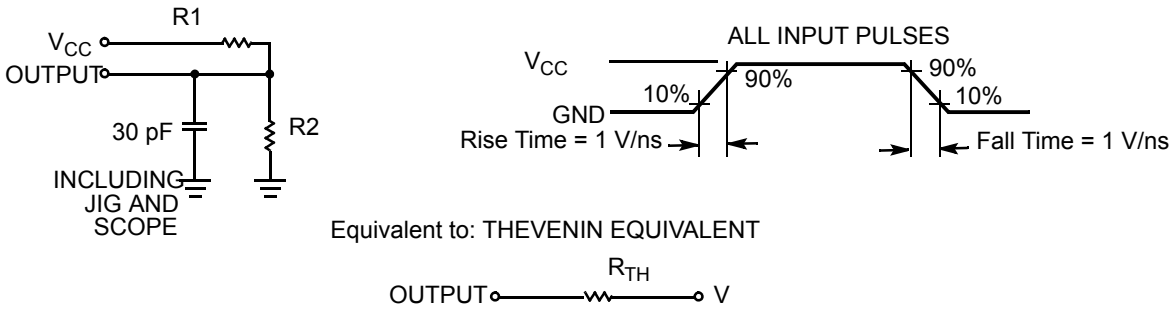
Notes

5. $V_{IL(min)}$ = –2.0 V for pulse durations less than 20 ns.
6. $V_{IH(max)}$ = V_{CC} + 0.75 V 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. 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.
9. 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.
10. Tested initially and after any design or process changes that may affect these parameters.

Thermal Resistance[13]

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



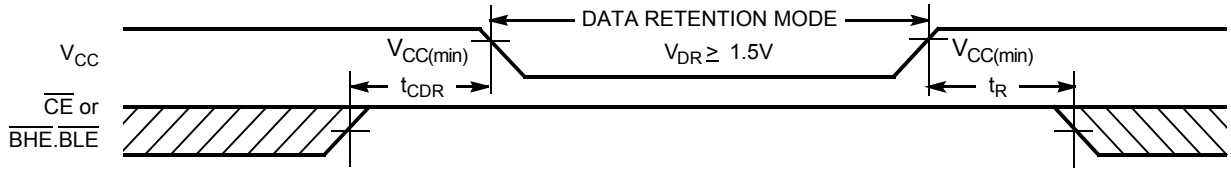
Parameters	2.50 V	3.0 V	Unit
R1	16667	1103	Ω
R2	15385	1554	Ω
R_{TH}	8000	645	Ω
V_{TH}	1.20	1.75	V

Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions		Min	Typ [11]	Max	Unit
V_{DR}	V_{CC} for data retention			1.5	–	–	V
I_{CCDR}[12]	Data retention current	V_{CC}= 1.5 V, $\overline{CE} \geq V_{CC} - 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V	Auto-A	–	0.8	7	µA
			Auto-E	–	–	12	
t_{CDR} [13]	Chip deselect to data retention time			0	–	–	ns
t_R [14]	Operation recovery time		CY62147EV30LL-45	45	–	–	ns
			CY62147EV30LL-55	55	–	–	

Figure 5. Data Retention Waveform[15, 16]



Notes

11. 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.
12. 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.
13. Tested initially and after any design or process changes that may affect these parameters.
14. 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.
15. 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 $\overline{CE_2}$ such that when $\overline{CE_1}$ is LOW and $\overline{CE_2}$ is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH.
16. $\overline{BHE}.\overline{BLE}$ 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

Parameter[17, 18]	Description	45 ns (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[19]	5	–	5	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z[19, 20]	–	18	–	20	ns
t_{LZCE}	$\overline{CE}$ LOW to Low Z[19]	10	–	10	–	ns
t_{HZCE}	$\overline{CE}$ HIGH to High Z[19, 20]	–	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[19]	10	–	10	–	ns
t_{HZBE}	$\overline{BLE}$/$\overline{BHE}$ HIGH to HIGH Z[19, 20]	–	18	–	20	ns
Write Cycle[21]						
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[19, 20]	–	18	–	20	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low Z[19]	10	–	10	–	ns

Notes

17. 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 5.
18. 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.
19. 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.
20. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the outputs enter a high impedance state.
21. 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[22, 23]

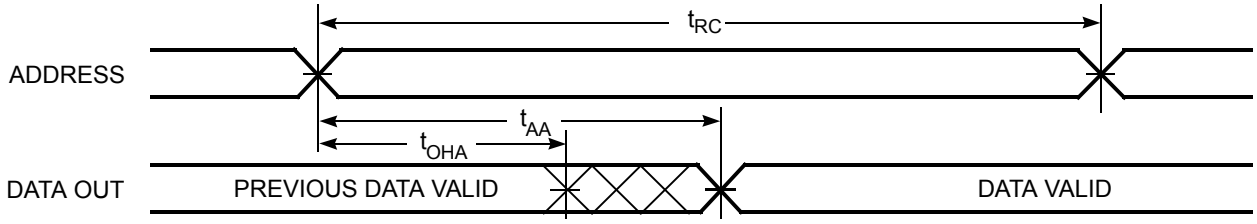
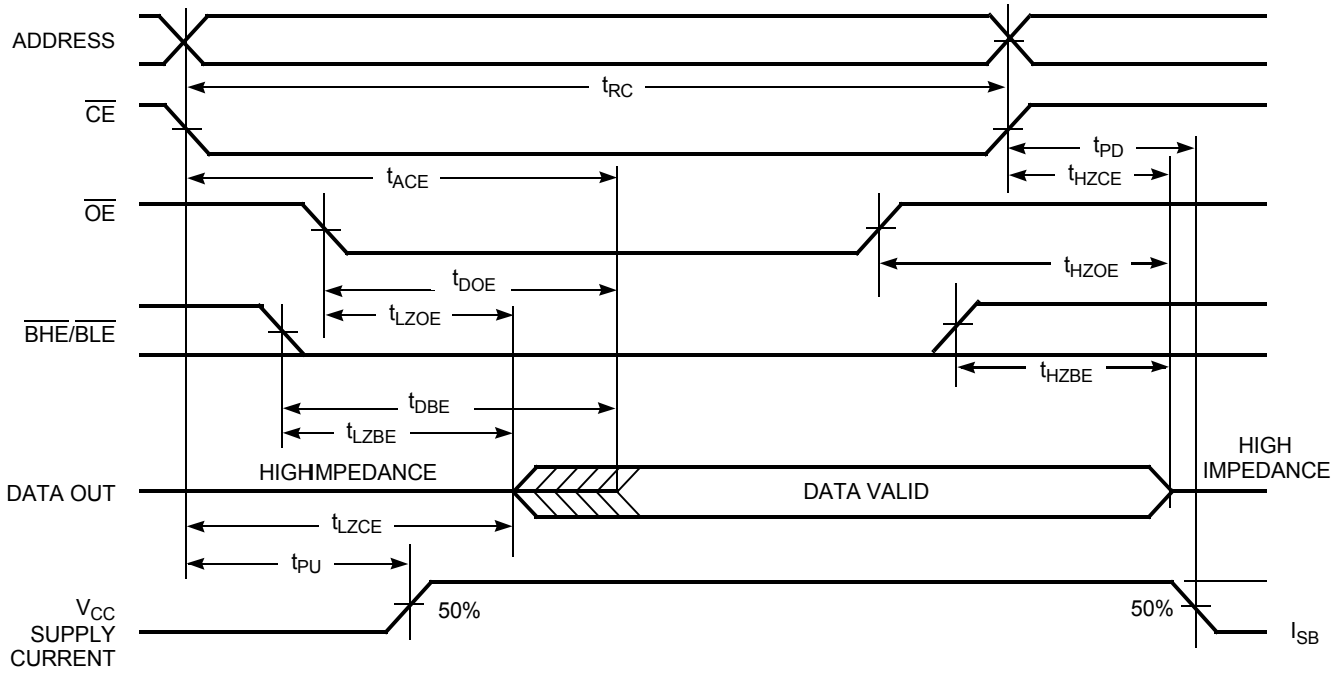


Figure 7. Read Cycle No. 2: $\overline{OE}$ Controlled[23, 24, 25]



Notes
22. The device is continuously selected. $\overline{OE}$, $\overline{CE}$ = V_{IL}, $\overline{BHE}$, $\overline{BLE}$, or both = V_{IL}.
23. $\overline{WE}$ is HIGH for read cycle.
24. 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 $\overline{CE_1}$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH.
25. 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 [26, 27, 28, 29]

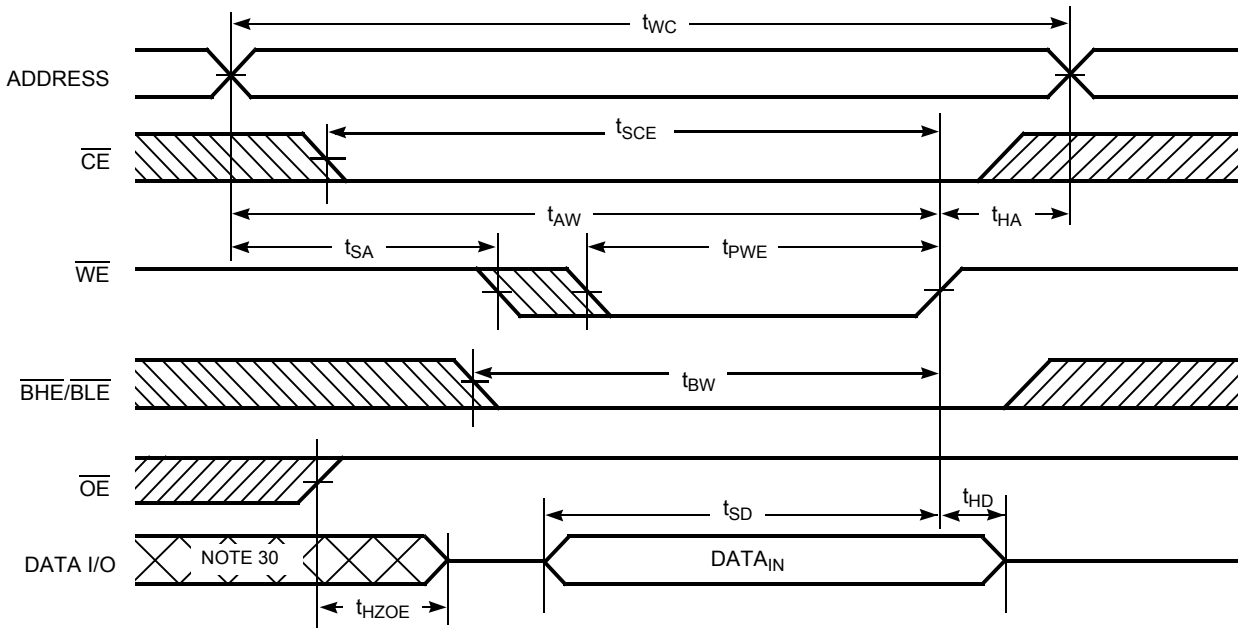
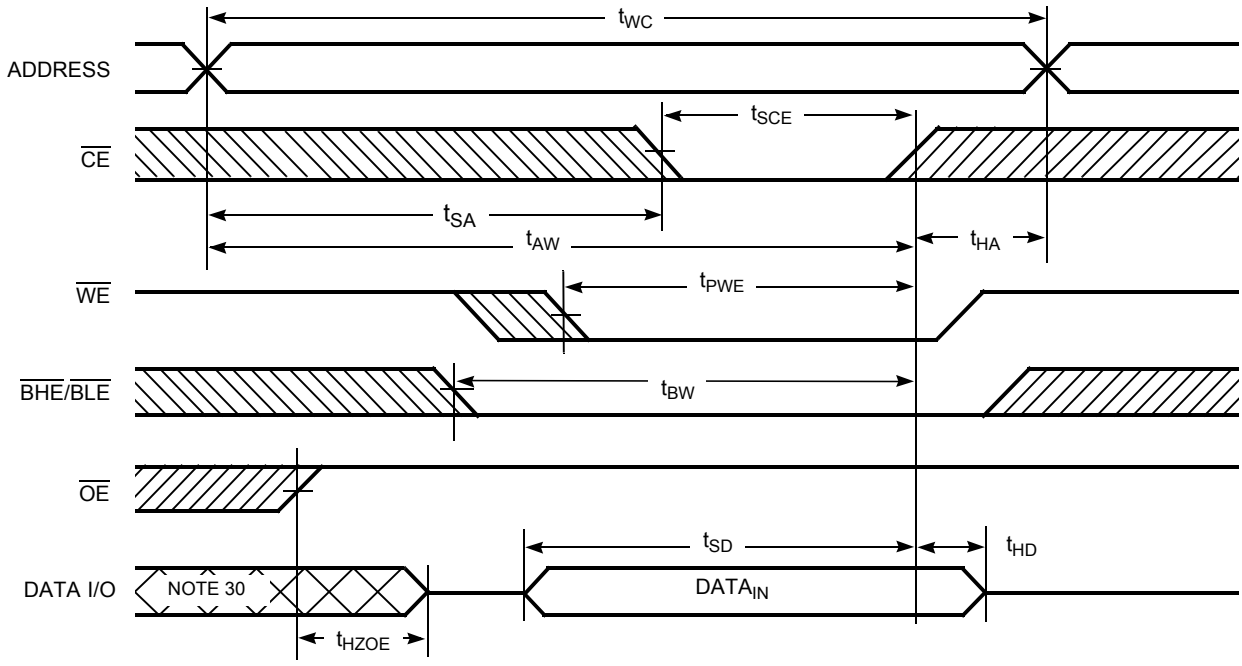


Figure 9. Write Cycle No. 2: $\overline{CE}$ Controlled[26, 27, 28, 29]



Notes

26. 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 $\overline{CE_1}$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH.
27. 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.
28. Data I/O is high impedance if $\overline{OE}$ = V_{IH}.
29. If $\overline{CE}$ goes HIGH 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)

Figure 10. Write Cycle No. 3: $\overline{WE}$ Controlled, $\overline{OE}$ LOW[31, 32]

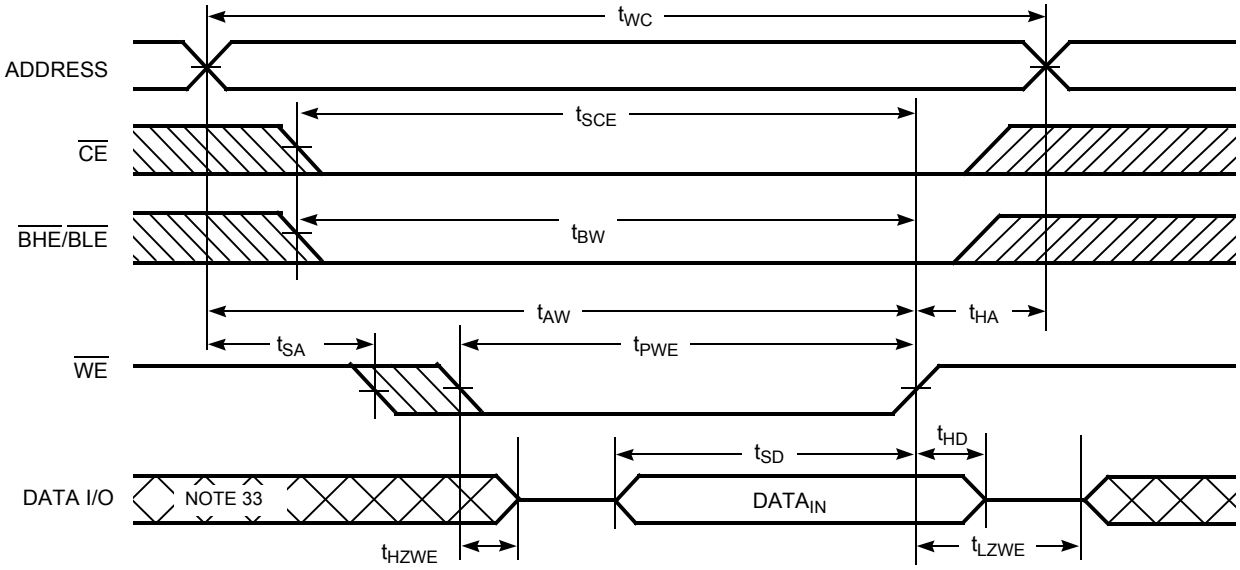
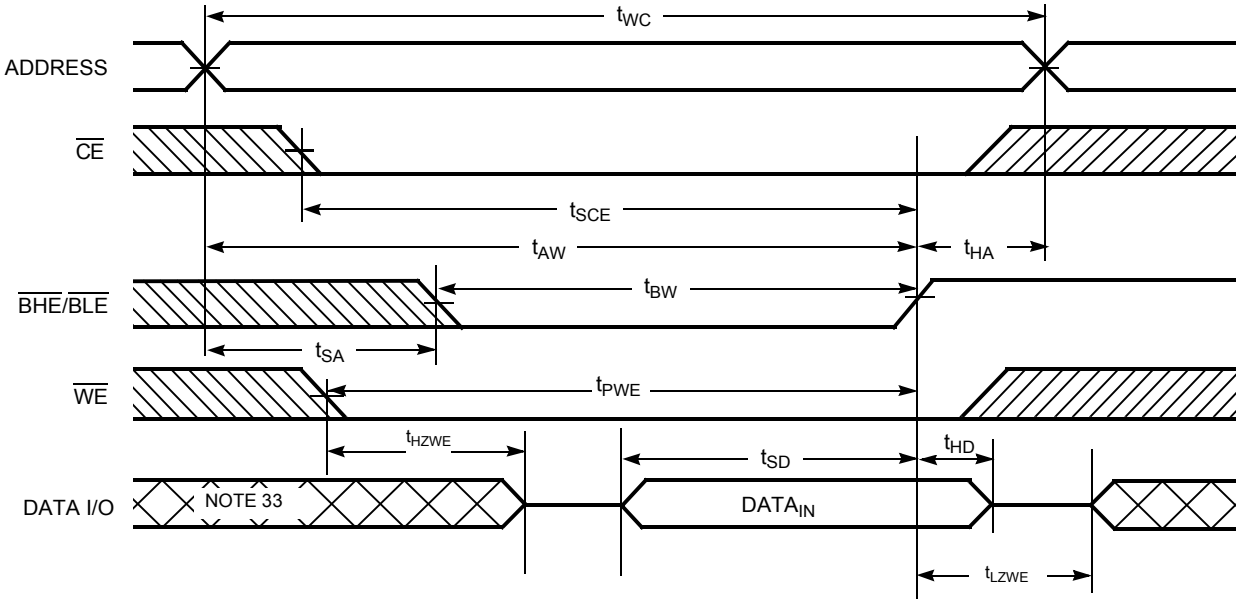


Figure 11. Write Cycle No. 4: $\overline{BHE}/\overline{BLE}$ Controlled, $\overline{OE}$ LOW[31, 32]



Notes
31. 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 $\overline{CE_1}$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH.
32. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ = V_{IH}, the output remains in a high impedance state.
33. During this period, the I/Os are in output state. Do not apply input signals.

Truth Table

$\overline{CE}$[34, 35]	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	I/Os	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 (I/O_0–I/O_{15})	Read	Active (I_{CC})
L	H	L	H	L	Data out (I/O_0–I/O_7); I/O_8–I/O_{15} in High Z	Read	Active (I_{CC})
L	H	L	L	H	Data out (I/O_8–I/O_{15}); I/O_0–I/O_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 (I/O_0–I/O_{15})	Write	Active (I_{CC})
L	L	X	H	L	Data in (I/O_0–I/O_7); I/O_8–I/O_{15} in High Z	Write	Active (I_{CC})
L	L	X	L	H	Data in (I/O_8–I/O_{15}); I/O_0–I/O_7 in High Z	Write	Active (I_{CC})

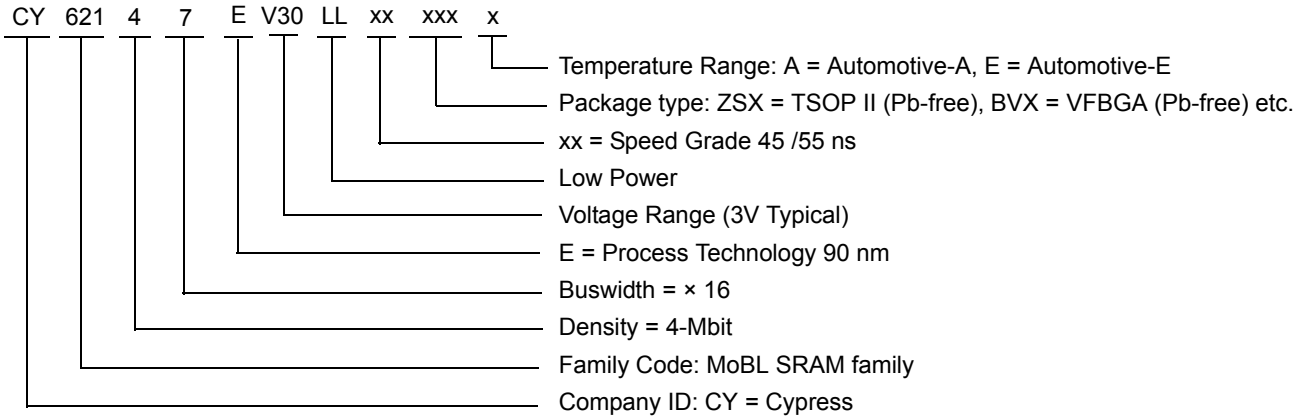
Notes
34. BGA packaged device is offered in single CE and dual CE options. In this data sheet, for a dual CE device, $\overline{CE}$ refers to the internal logical combination of $\overline{CE}_1$ and CE_2 such that when $\overline{CE}_1$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH.
35. For the Dual Chip Enable device, $\overline{CE}$ refers to the internal logical combination of $\overline{CE}_1$ and CE_2 such that when $\overline{CE}_1$ is LOW and CE_2 is HIGH, $\overline{CE}$ is LOW. For all other cases $\overline{CE}$ is HIGH. Intermediate voltage levels is not permitted on any of the Chip Enable pins (CE for the Single Chip Enable device; $\overline{CE}_1$ and CE_2 for the Dual Chip Enable device).

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
45	CY62147EV30LL-45BVXA	51-85150	48-Ball Very Fine Pitch Ball Grid Array (Pb-free) [36]	Automotive-A
	CY62147EV30LL-45B2XA	51-85150	48-Ball Very Fine Pitch Ball Grid Array (Pb-free) [37]	
	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.

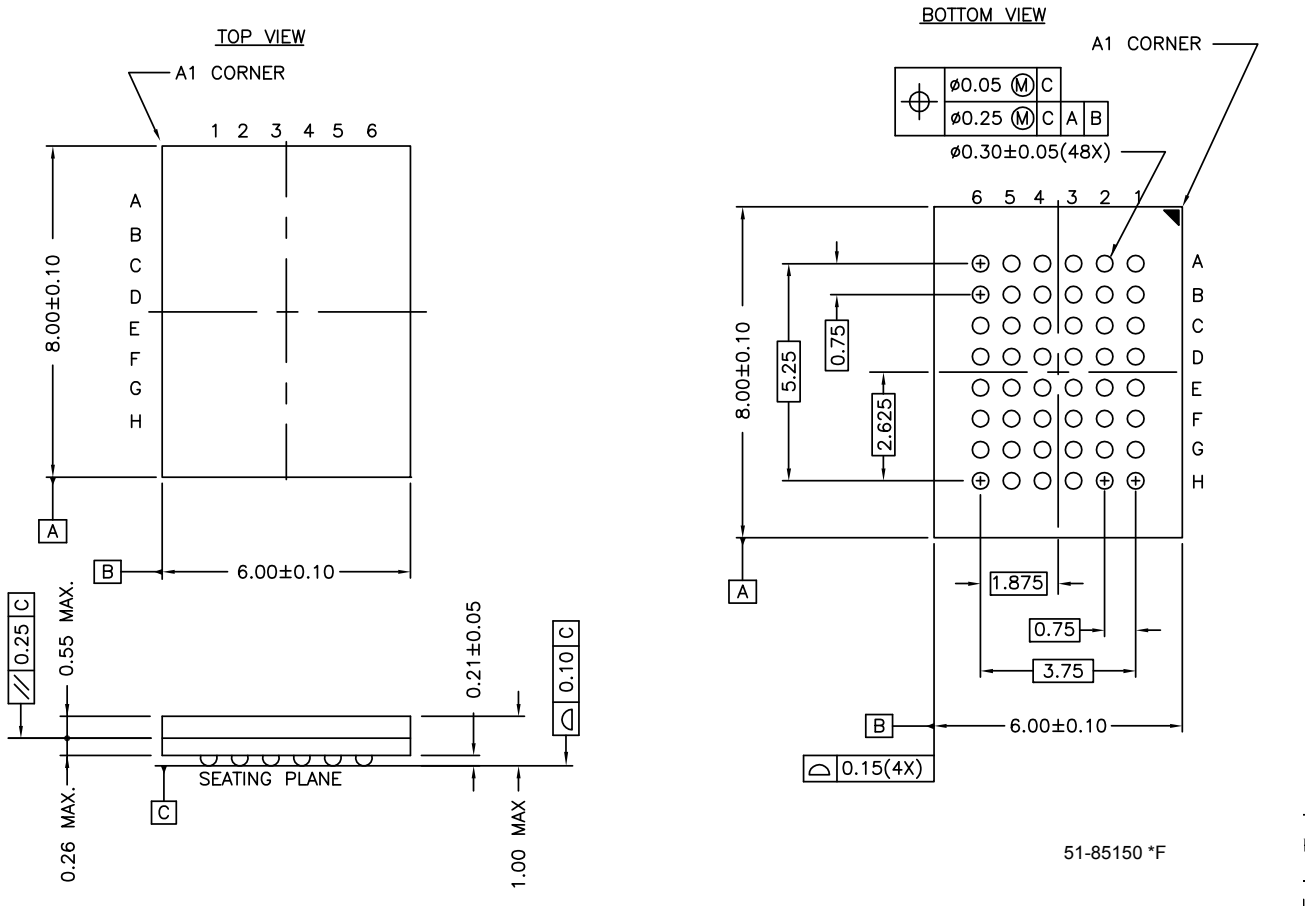
Ordering Code Definitions



Notes
36. This BGA package is offered with single chip enable.
37. This BGA package is offered with dual chip enable.

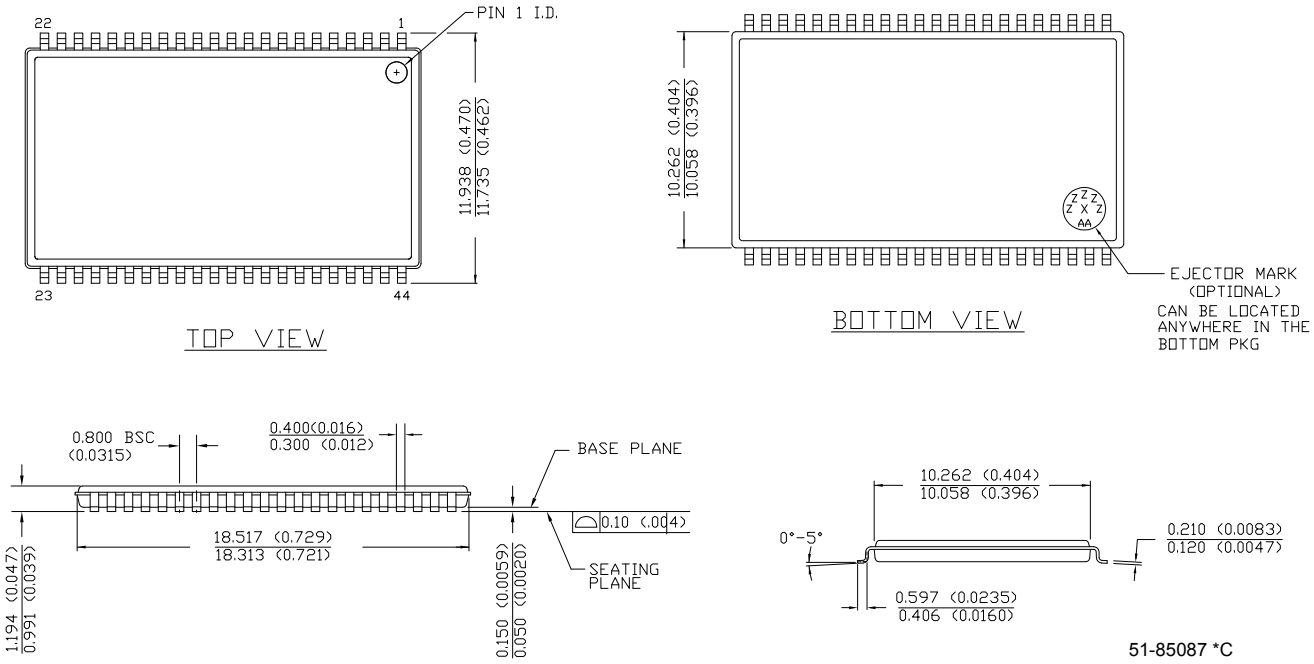
Package Diagrams

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



Package Diagrams (continued)

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



Acronyms

Acronym	Description
CMOS	complementary metal oxide semiconductor
I/O	input/output
SRAM	static random access memory
VFBGA	very fine ball grid array
TSOP	thin small outline package

Document Conventions

Units of Measure

Symbol	Unit of Measure
°C	degrees Celsius
µA	microamperes
mA	milliampere
MHz	megahertz
ns	nanoseconds
pF	picofarads
V	volts
Ω	ohms
W	watts

Document History Page

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