CY62167EV18 MoBL®

16 Mbit (1M x 16) Static RAM

Features

- Very high speed: 55 ns
- Wide voltage range: 1.65 V to 2.25 V
- Ultra low standby power
  - Typical standby current: 1.5 µA
  - Maximum standby current: 12 µA
- Ultra low active power
  - Typical active current: 2.2 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
- Offered in Pb-free 48-ball very fine ball grid array (VFBGA) packages

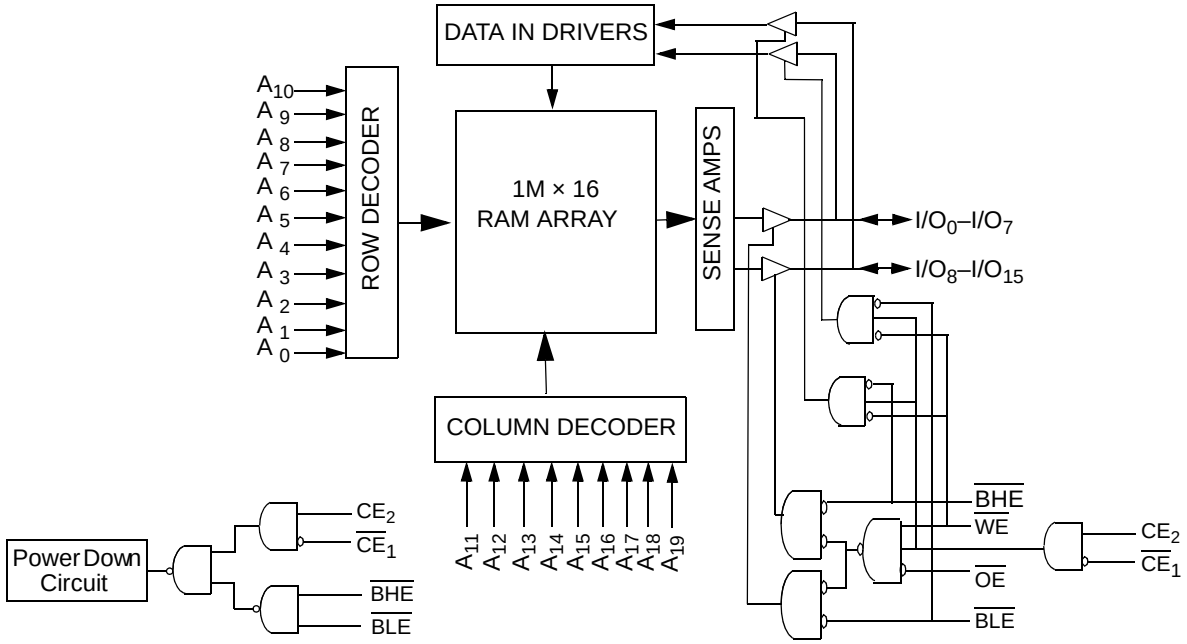
Functional Description

The CY62167EV18 is a high performance CMOS static RAM organized as 1M 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 reduces power consumption by 99 percent when addresses are not toggling. Place the device into standby mode when deselected ($\overline{CE}_1$ HIGH or CE_2 LOW or both $\overline{BHE}$ and $\overline{BLE}$ are HIGH). The input and 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); outputs are disabled ($\overline{OE}$ HIGH); both Byte High Enable and Byte Low Enable are disabled ($\overline{BHE}$, $\overline{BLE}$ HIGH); and a write operation is in progress ($\overline{CE}_1$ LOW, CE_2 HIGH and $\overline{WE}$ LOW).

To write to the device, take Chip Enables ($\overline{CE}_1$ LOW and CE_2 HIGH) and Write Enable ($\overline{WE}$) input 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_{19}). 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_{19}).

To read from the device, take Chip Enables ($\overline{CE}_1$ 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 appears 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.

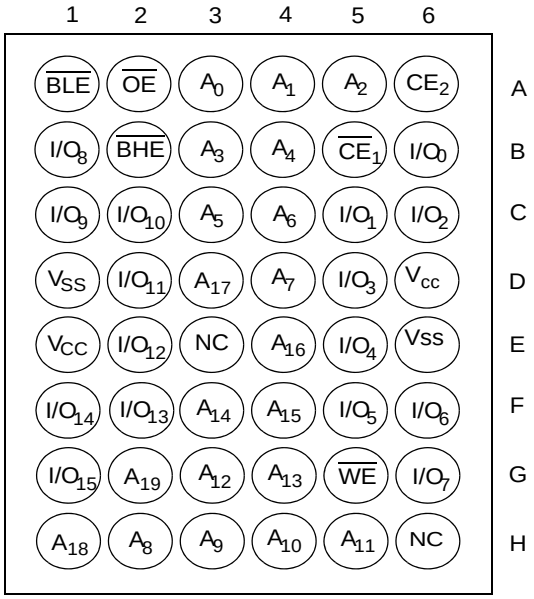
Logic Block Diagram



Contents

Pin Configuration

Figure 1. 48-Ball VFBGA (6 × 8 × 1 mm) Top View [1, 2]



Product Portfolio

Product	V_{CC} Range (V)			Speed (ns)	Power Dissipation					
					Operating I_{CC} (mA)				Standby I_{SB2} (µA)	
					f = 1 MHz		f = f_{max}			
	Min	Typ[3]	Max		Typ[3]	Max	Typ[3]	Max	Typ[3]	Max
CY62167EV18LL	1.65	1.8	2.25	55	2.2	4.0	25	30	1.5	12
CY62167EV30LL[4]										

Notes
1. NC pins are not connected on the die.
2. Ball H6 for the VFBGA package can be used to upgrade to a 32 M density.
3. 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.
4. This part can be operated in the V_{CC} range of 1.65 V–2.25 V at 55ns speed. It can also be operated in the V_{CC} range of 2.2 V–3.6 V at 45ns speed.

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 ..... –0.2 V to 2.45 V (V_{CC} (max) + 0.2 V)

DC voltage applied to outputs in High Z state[5, 6] ..... –0.2 V to 2.45 V (V_{CC} (max) + 0.2 V)

DC input voltage[5, 6]..... –0.2 V to 2.45 V (V_{CC}(max) + 0.2 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]
CY62167EV18LL	Industrial	–40 °C to +85 °C	1.65 V to 2.25 V

Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions		55 ns			Unit
				Min	Typ[8]	Max	
V_{OH}	Output HIGH voltage	I_{OH} = –0.1 mA		1.4	–	–	V
V_{OL}	Output LOW voltage	I_{OL} = 0.1 mA		–	–	0.2	V
V_{IH}	Input HIGH voltage	V_{CC} = 1.65 V to 2.25 V		1.4	–	V_{CC} + 0.2 V	V
V_{IL}	Input LOW voltage	V_{CC} = 1.65 V to 2.25 V		–0.2	–	0.4	V
I_{IX}	Input leakage current	GND ≤ V_I ≤ V_{CC}		–1	–	+1	µA
I_{OZ}	Output leakage current	GND ≤ V_O ≤ V_{CC}, Output Disabled		–1	–	+1	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	–	25	30	mA
		f = 1 MHz		–	2.2	4.0	mA
I_{SB1}[9]	Automatic power down current – CMOS inputs	$\overline{CE_1}$ ≥ V_{CC} – 0.2 V or CE_2 ≤ 0.2 V or (BHE and BLE) ≥ V_{CC} – 0.2 V, V_{IN} ≥ V_{CC} – 0.2V, V_{IN} ≤ 0.2 V) f = f_{max} (address and data only), f = 0 (OE, and WE), V_{CC} = V_{CC} (max)		–	1.5	12	µA
I_{SB2}[9]	Automatic power down current – CMOS inputs	$\overline{CE_1}$ ≥ V_{CC} – 0.2 V or CE_2 ≤ 0.2 V, V_{IN} ≥ V_{CC} – 0.2 V or V_{IN} ≤ 0.2 V, or (BHE and BLE) ≥ V_{CC} – 0.2 V, f = 0, V_{CC} = V_{CC} (max)		–	1.5	12	µA

Capacitance

Parameter[10]	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

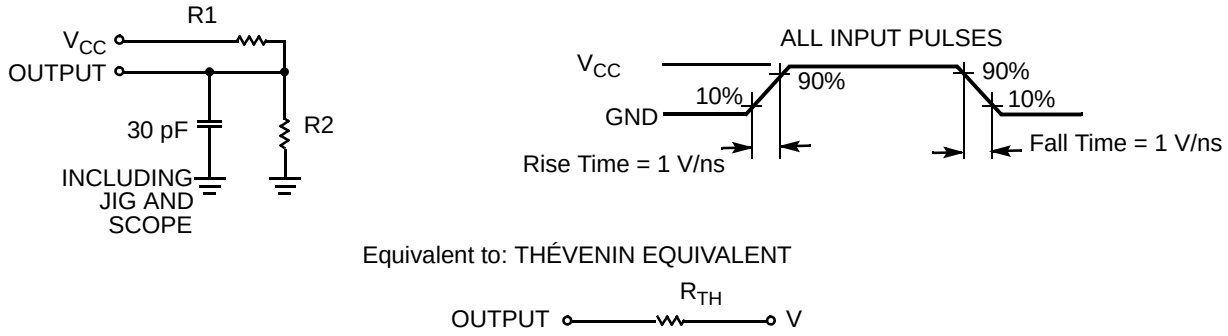
Notes

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 is based on a 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 enables ($\overline{CE_1}$ and CE_2), and byte enables ($\overline{BHE}$ and $\overline{BLE}$) must be tied to CMOS levels to meet the I_{SB1} /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

Parameter[11]	Description	Test Conditions	VFBGA (6 × 8 × 1mm)	Unit
Θ_{JA}	Thermal resistance (Junction to ambient)	Still air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	55	°C/W
Θ_{JC}	Thermal resistance (Junction to case)		16	°C/W

Figure 2. AC Test Loads and Waveforms



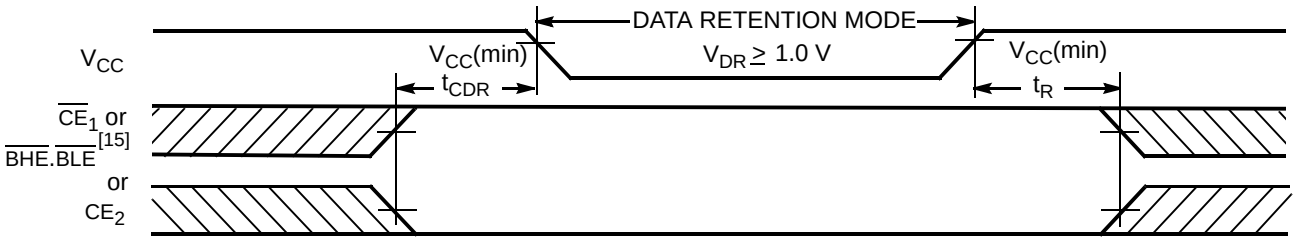
Parameters	1.8 V	Unit
R1	13500	Ω
R2	10800	Ω
R_{TH}	6000	Ω
V_{TH}	0.80	V

Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ[12]	Max	Unit
V_{DR}	V_{CC} for data retention		1.0	–	–	V
I_{CCDR}[13]	Data retention current	V_{CC} = 1.0 V, $\overline{CE_1} \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V or ($\overline{BHE}$ and $\overline{BLE}$) $\geq V_{CC} - 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V	–	–	10	µA
t_{CDR}[11]	Chip deselect to data retention time		0	–	–	ns
t_R[14]	Operation recovery time		55	–	–	ns

Figure 3. Data Retention Waveform



Notes

11. Tested initially and after any design or process changes that may affect these parameters.
12. 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.
13. Chip enables ($\overline{CE_1}$ and CE_2), and byte enables ($\overline{BHE}$ and $\overline{BLE}$) must be tied to CMOS levels to meet the I_{SB1} /I_{SB2} / I_{CCDR} spec. Other inputs can be left floating.
14. Full device operation requires linear V_{CC} ramp from V_{DR} to V_{CC}(min) ≥ 100 µs or stable at V_{CC}(min) ≥ 100 µs.
15. $\overline{BHE}$. $\overline{BLE}$ 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

Parameter[16, 17]	Description	55 ns		Unit
		Min	Max	
Read Cycle				
t_{RC}	Read cycle time	55	–	ns
t_{AA}	Address to data valid	–	55	ns
t_{OHA}	Data hold from address change	10	–	ns
t_{ACE}	$\overline{CE}_1$ LOW and CE_2 HIGH to data valid	–	55	ns
t_{DOE}	$\overline{OE}$ LOW to data valid	–	25	ns
t_{LZOE}	$\overline{OE}$ LOW to Low Z[18]	5	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z[18, 19]	–	18	ns
t_{LZCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Low Z[18]	10	–	ns
t_{HZCE}	$\overline{CE}_1$ HIGH and CE_2 LOW to High Z[18, 19]	–	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	–	55	ns
t_{DBE}	BLE/BHE LOW to data valid	–	55	ns
t_{LZBE}	$\overline{BLE}/\overline{BHE}$ LOW to Low Z[18]	10	–	ns
t_{HZBE}	$\overline{BLE}/\overline{BHE}$ HIGH to High Z[18, 19]	–	18	ns
Write Cycle[20]				
t_{WC}	Write cycle time	55	–	ns
t_{SCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to write end	40	–	ns
t_{AW}	Address setup to write end	40	–	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	40	–	ns
t_{BW}	$\overline{BLE}/\overline{BHE}$ LOW to write end	40	–	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[18, 19]	–	20	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low Z[18]	10	–	ns

Notes

16. Test conditions for all parameters other than tri-state parameters are based on signal transition time of 1 V/ns, 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 AC Test Loads and Waveforms on page 5.
17. 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.
18. At any given 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 given device.
19. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the output enters a high impedance state.
20. The internal memory write time is defined by the overlap of $\overline{WE}$, $\overline{CE}_1 = V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE} = V_{IL}$, 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).[21, 22]

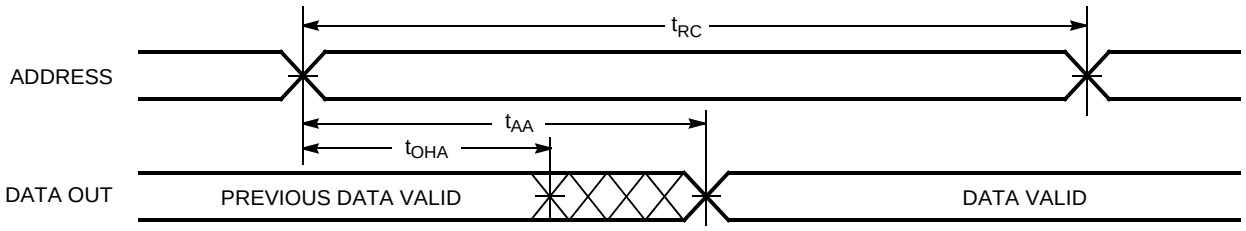
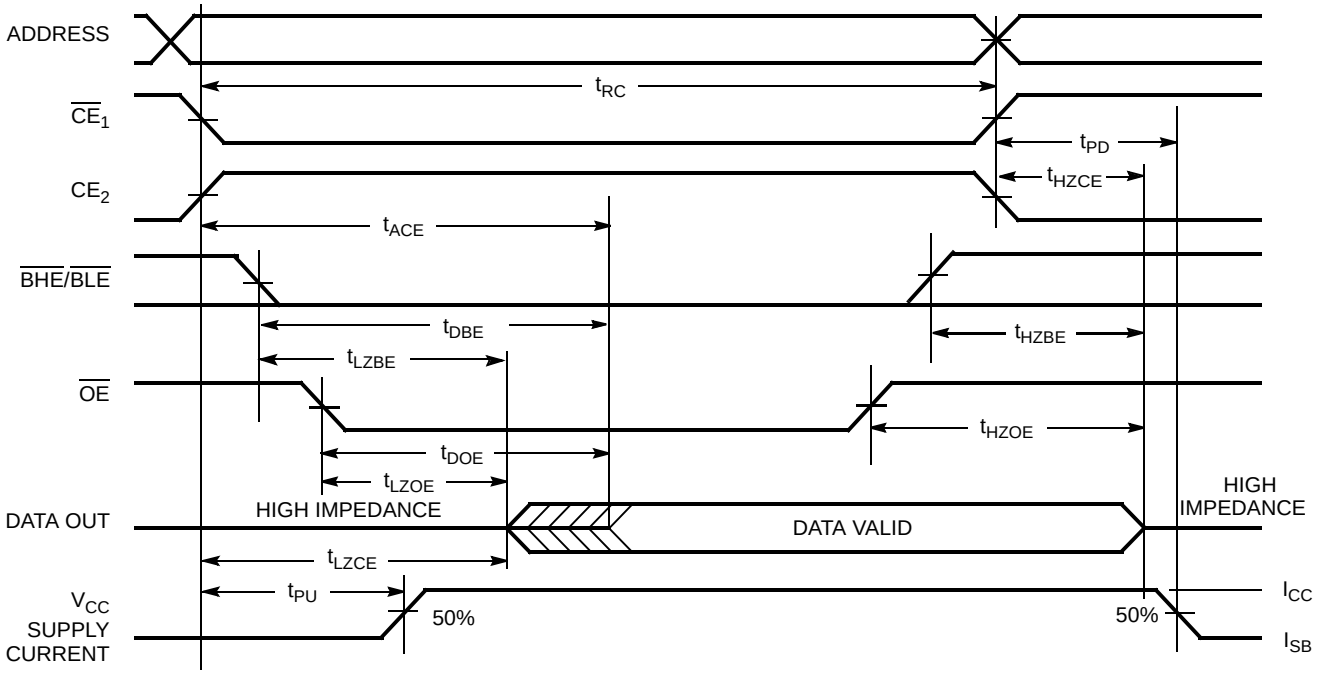


Figure 5. Read Cycle No. 2 ($\overline{OE}$ Controlled)[22, 23]



Notes
21. 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}.
22. $\overline{WE}$ is HIGH for read cycle.
23. 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)[24, 25, 26]

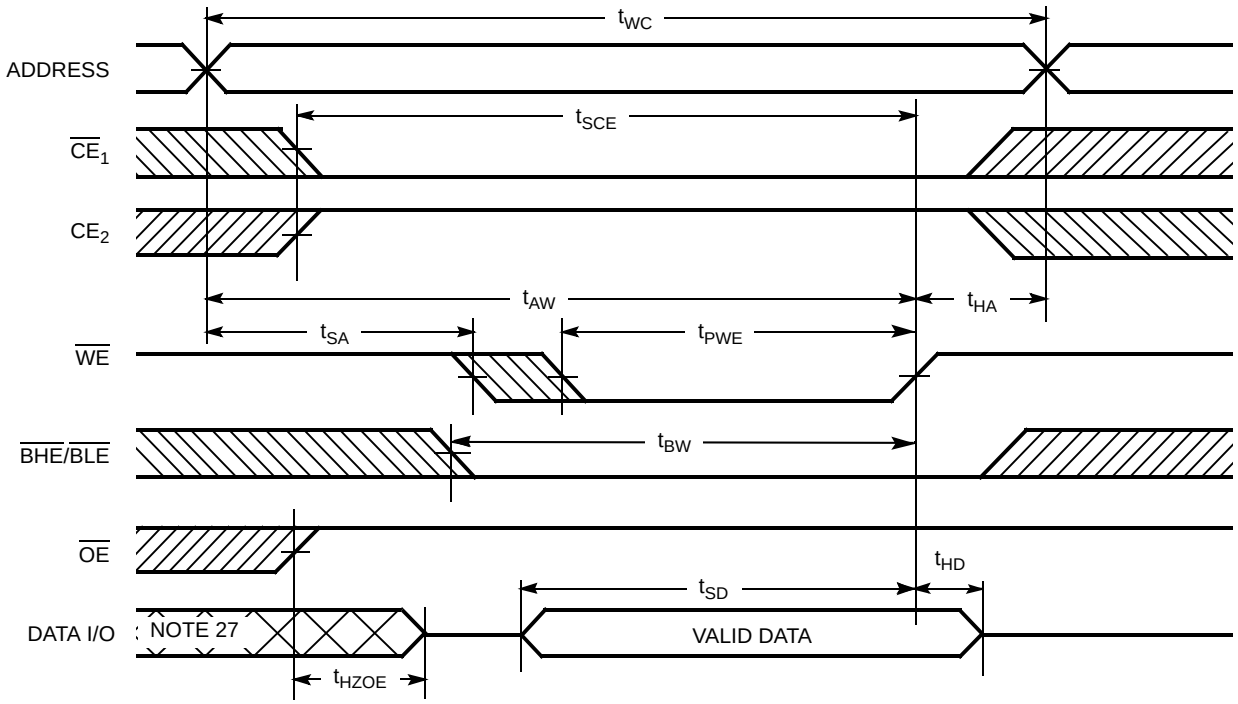
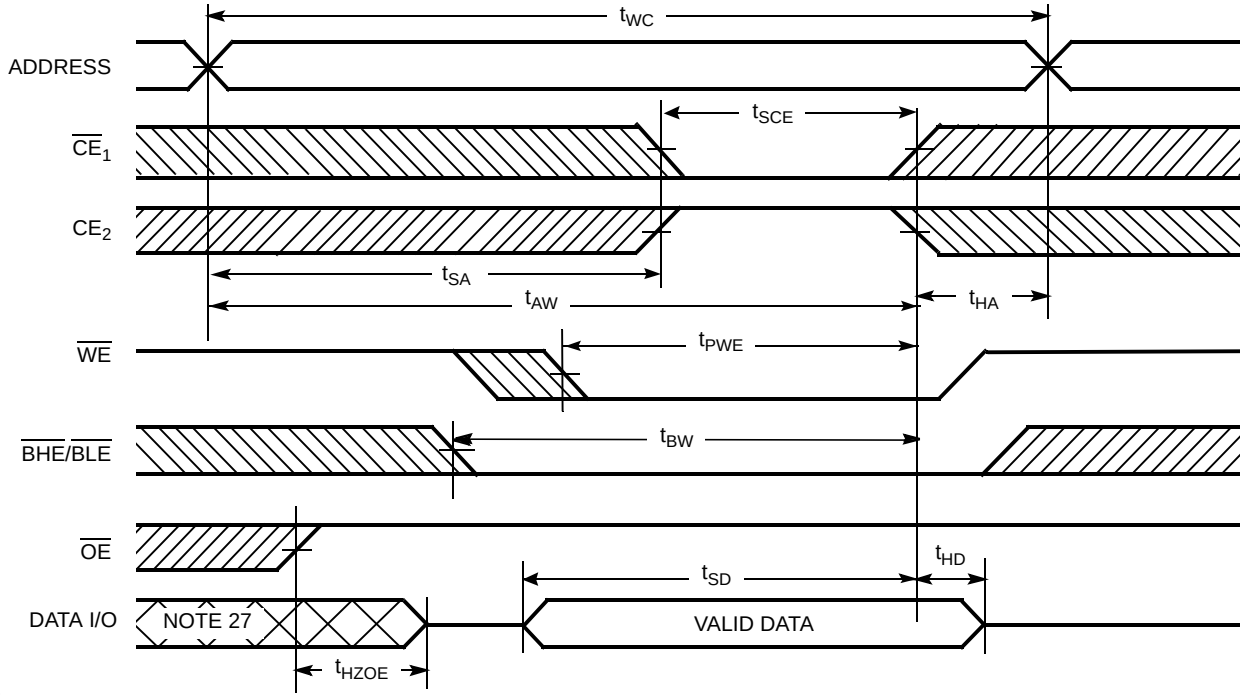


Figure 7. Write Cycle No. 2 ($\overline{CE_1}$ or CE_2 Controlled)[24, 25, 26]



Notes

24. The internal memory write time is defined by the overlap of $\overline{WE}$, $\overline{CE_1}$ = V_{IL}, $\overline{BHE}$ and/or $\overline{BLE}$ = 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
25. Data I/O is high impedance if $\overline{OE}$ = V_{IH}.
26. 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.
27. During this period the I/Os are in output state. Do not apply input signals.

Switching Waveforms (continued)

Figure 8. Write Cycle No. 3 ($\overline{WE}$ controlled, $\overline{OE}$ LOW)[28]

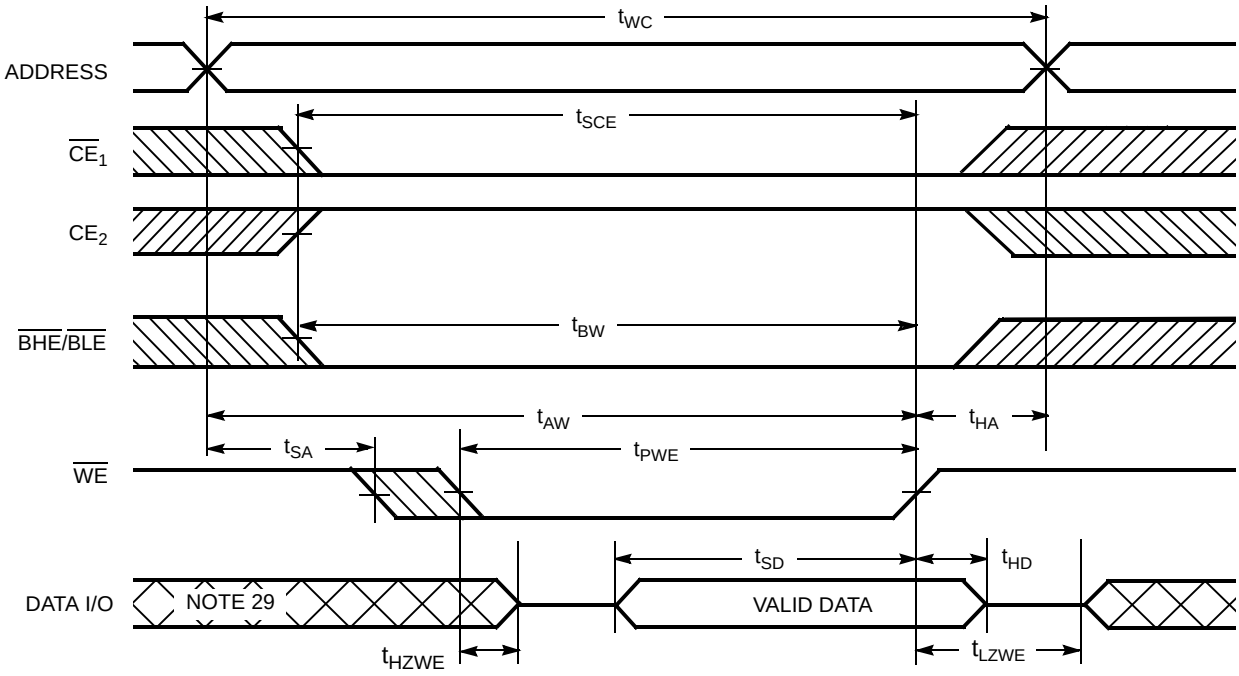
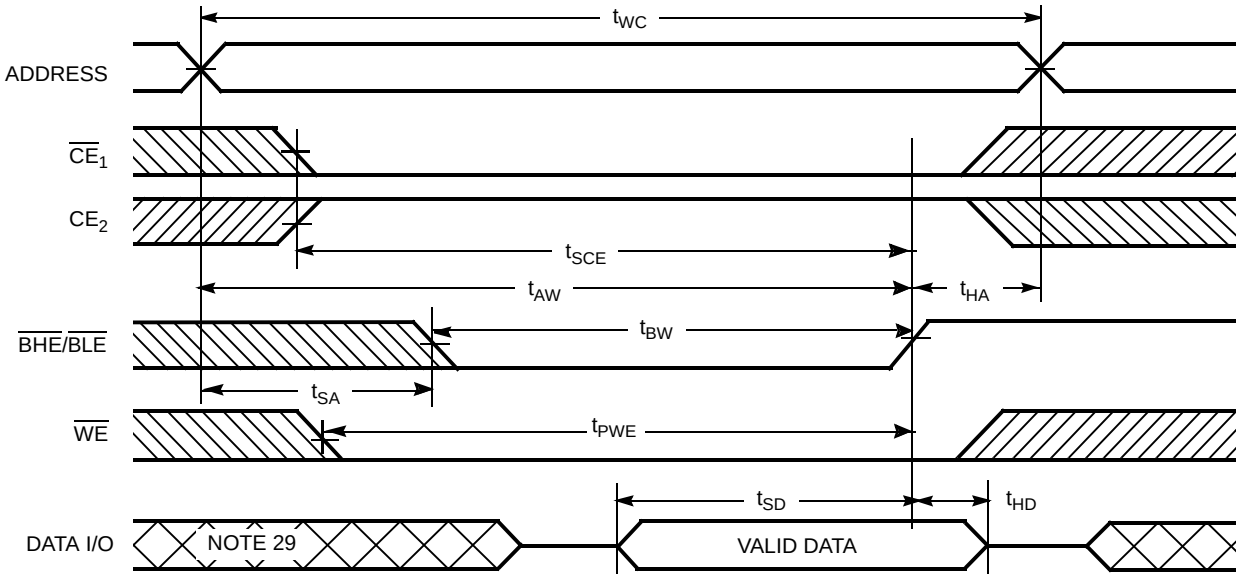


Figure 9. Write Cycle No. 4 ($\overline{BHE}$/$\overline{BLE}$ Controlled, $\overline{OE}$ Low)[28]



Notes
28. 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.
29. During this period the I/Os are in output state. Do not apply input signals.

Truth Table

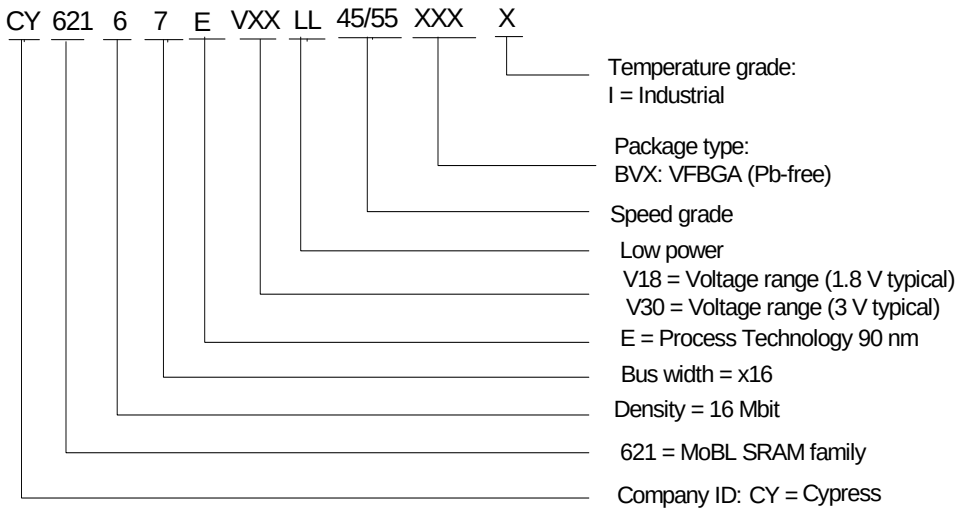
$\overline{CE_1}$	CE_2	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X[30]	X	X	X	X	High Z	Deselect/Power-down	Standby (I_{SB})
X[30]	L	X	X	X	X	High Z	Deselect/Power-down	Standby (I_{SB})
X[30]	X[30]	X	X	H	H	High Z	Deselect/Power-down	Standby (I_{SB})
L	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
30. 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
55	CY62167EV18LL-55BVI	51-85150	48-ball VFBGA (6 × 8 × 1 mm)	Industrial
	CY62167EV18LL-55BVXI		48-ball VFBGA (6 × 8 × 1 mm) (Pb-free)	
	CY62167EV30LL-45BVI [31]	51-85150	48-ball VFBGA (6 × 8 × 1 mm)	

Ordering Code Definition



Note
31. This part can be operated in the V_{CC} range of 1.65 V to 2.25 V at 55 ns speed. It can also be operated in the V_{CC} range of 2.2 V–3.6 V at 45ns speed.

Package Diagrams

Figure 10. 48-Ball VFBGA (6 × 8 × 1 mm), 51-85150

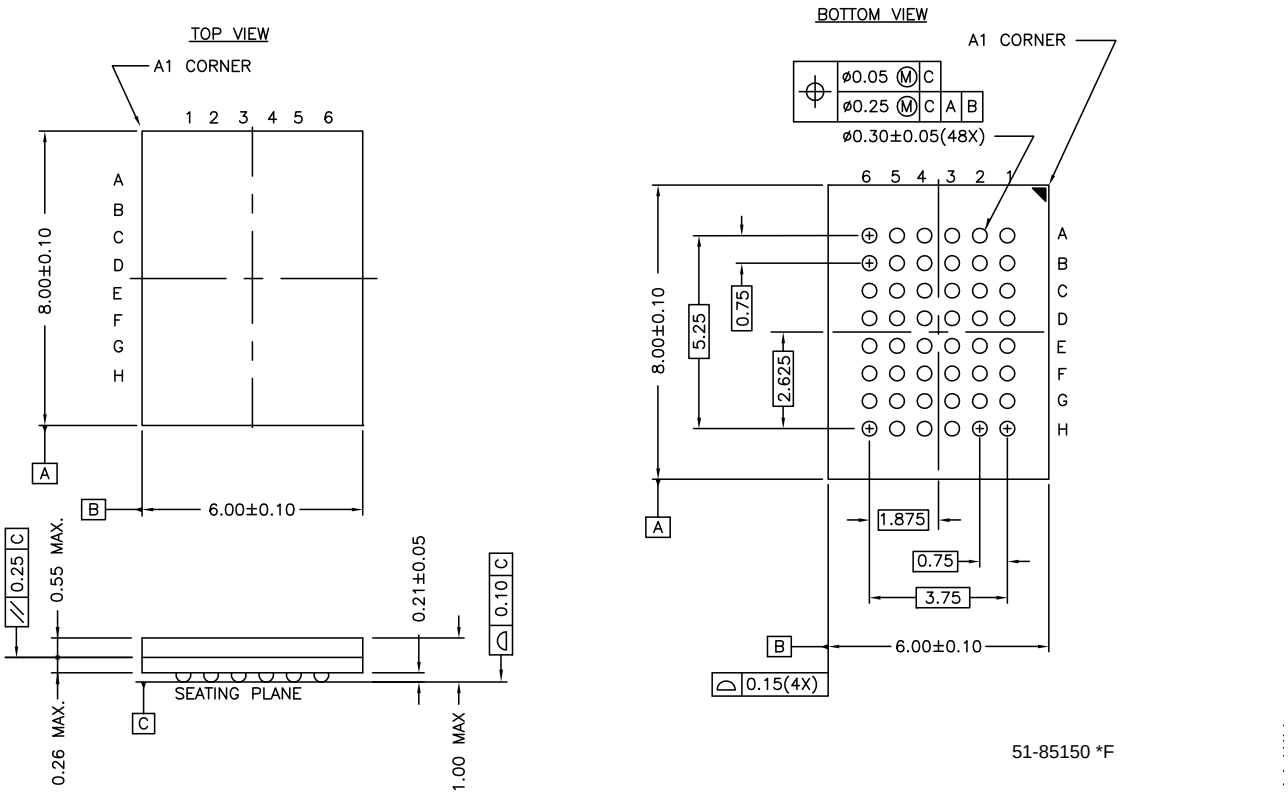
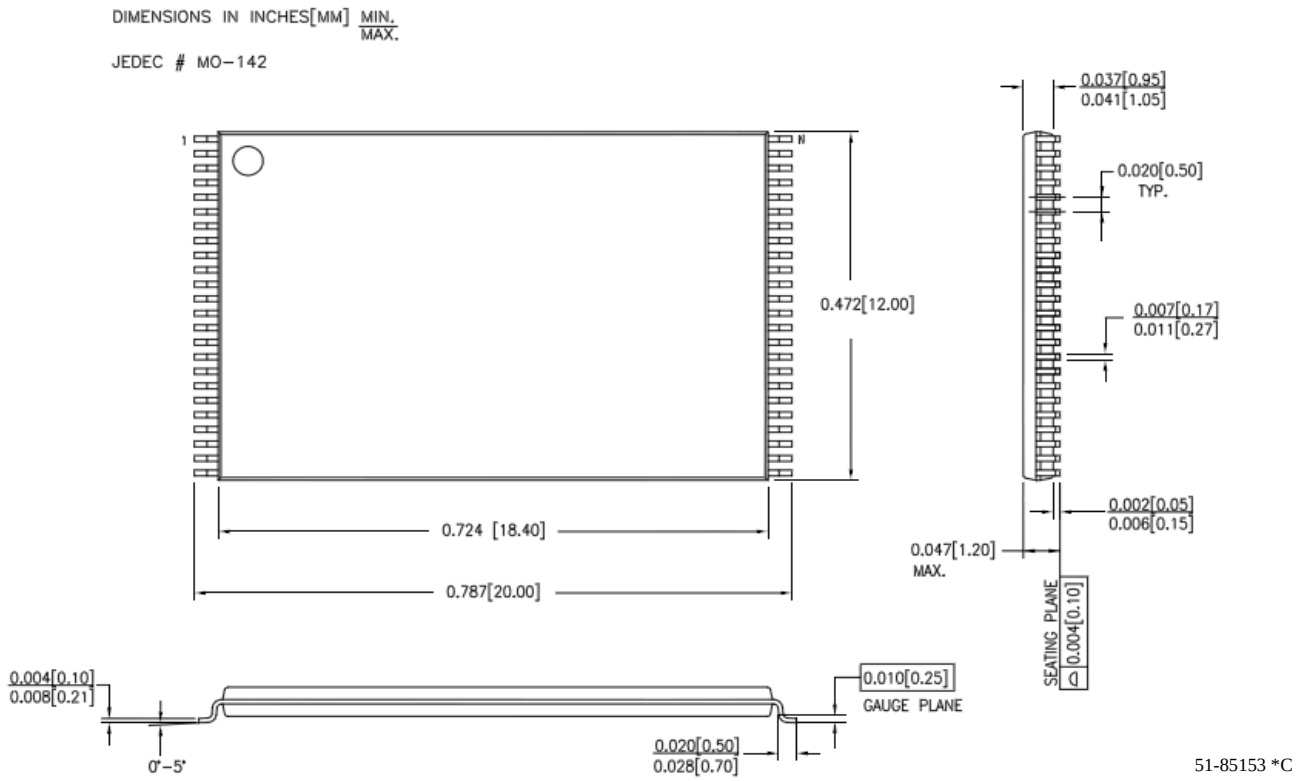


Figure 11. 48-Pin TSOP I (12 mm x 18.4 mm x 1.0 mm), 51-85183



Acronyms

Acronym	Description
$\overline{\text{BHE}}$	byte high enable
$\overline{\text{BLE}}$	byte low enable
$\overline{\text{CE}}$	chip enable
CMOS	complementary metal oxide semiconductor
I/O	input/output
$\overline{\text{OE}}$	output enable
SRAM	static random access memory
TSOP	thin small outline package
VFBGA	very fine ball grid array
$\overline{\text{WE}}$	write enable

Document Conventions

Units of Measure

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

Document History Page

Document Title: CY62167EV18 MoBL® 16 Mbit (1M x 16) Static RAM Document Number: 38-05447				
Rev.	**ECN No.**	**Orig. of Change**	**Submission date**	**Description of Change**
**	202600	AJU	01/23/2004	New Data Sheet
*A	463674	NXR	See ECN	Converted from Advance Information to Preliminary Changed $V_{CC(max)}$ from 2.20 V to 2.25 V Removed 'L' bin and 35 ns speed bin from product offering Changed ball E3 from DNU to NC Removed redundant foot note on DNU Changed the $I_{SB2(typ)}$ value from 1.3 µA to 1.5 µA Changed the $I_{CC(max)}$ value from 40 mA to 25 mA Changed the AC Test Load Capacitance value from 50 pF to 30 pF Corrected typo in Data Retention Characteristics (t_R) from 100 µs to t_{RC} ns Changed the I_{CCDR} Value from 8 µA to 5 µA Changed t_{OHA}, t_{LZCE}, t_{LZBE}, and t_{LZWE} from 6 ns to 10 ns Changed t_{LZOE} from 3 ns to 5 ns Changed t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} from 15 ns to 18 ns Changed t_{SCE}, t_{AW}, and t_{BW} from 40 ns to 35 ns Changed t_{PE} from 30 ns to 35 ns Changed t_{SD} from 20 ns to 25 ns Updated 48 ball FBGA Package Information Updated the Ordering Information table
*B	469182	NSI	See ECN	Minor Change: Moved to external web
*C	619122	NXR	See ECN	Replaced 45 ns speed bin with 55 ns speed bin
*D	1130323	VKN	See ECN	Converted from preliminary to final Added footnote# 8 related I_{SB2} and I_{CCDR} Changed I_{SB1} and I_{SB2} spec from 10 µA to 12 µA Changed I_{CCDR} spec from 8 µA to 10 µA Added footnote# 13 related AC timing parameters Changed t_{WC} spec from 45 ns to 55 ns Changed t_{SCE}, t_{AW}, t_{PWE}, t_{BW} spec from 35 ns to 40 ns Changed t_{HZWE} spec from 18 ns to 20 ns
*E	1388287	VKN	See ECN	Added 48-Ball VFBGA (6 x 7 x 1mm) package Added footnote# 1 related to FBGA package Updated Ordering Information table
*F	1664843	VKN/AESA	See ECN	Added CY62167EV30LL-45BVI part in the Ordering Information table Added footnote# 5 related to CY62167EV30LL-45BVI part
*G	2675375	VKN/PYRS	03/17/2009	Added CY62167EV18LL-55BVI part in the Ordering Information table
*H	2904565	AJU	04/05/2010	Removed inactive part from the ordering information table.Updated package diagrams.
*I	2934396	VKN	06/03/10	Added footnote #24 related to chip enable Updated template
*J	3006301	RAME	08/12/2010	Included $\overline{BHE}$ and $\overline{BLE}$ in I_{SB1}, I_{SB2}, and I_{CCDR} test conditions to reflect Byte power down feature. Removed 48-Ball VFBGA (6 x 7 x 1 mm) package related information. Added Acronyms and Ordering code definition. Format updates to match template.
*K	3113908	PRAS	12/17/2010	Updated Figure 1 and Package Diagram.
*L	3295175	RAME	06/29/2011	Updated Package Diagrams. Added Document Conventions. Removed reference to AN1064 SRAM system guidelines. Added I_{SB1} to footnotes 9 and 13. Modified Ordering Code Definition. Updated Table of Contents.

Sales, Solutions, and Legal Information

Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at Cypress Locations.

Products	
Automotive	cypress.com/go/automotive
Clocks & Buffers	cypress.com/go/clocks
Interface	cypress.com/go/interface
Lighting & Power Control	cypress.com/go/powerpsoc
	cypress.com/go/plc
Memory	cypress.com/go/memory
Optical & Image Sensing	cypress.com/go/image
PSoC	cypress.com/go/psoc
Touch Sensing	cypress.com/go/touch
USB Controllers	cypress.com/go/USB
Wireless/RF	cypress.com/go/wireless

PSoC Solutions

psoc.cypress.com/solutions

PSoC 1 | PSoC 3 | PSoC 5