



## CY62167EV18 MoBL<sup>®</sup>

### 16-Mbit (1M x 16) Static RAM

#### Features

- Very high speed: 55 ns
- Wide voltage range: 1.65V – 2.25V
- Ultra low standby power
  - Typical standby current: 1.5  $\mu$ A
  - Maximum standby current: 12  $\mu$ A
- Ultra low active power
  - Typical active current: 2.2 mA @ 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 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<sup>™</sup> (MoBL<sup>®</sup>) in portable applications such as cellular telephones. The device also has an automatic power down feature that reduces power consumption

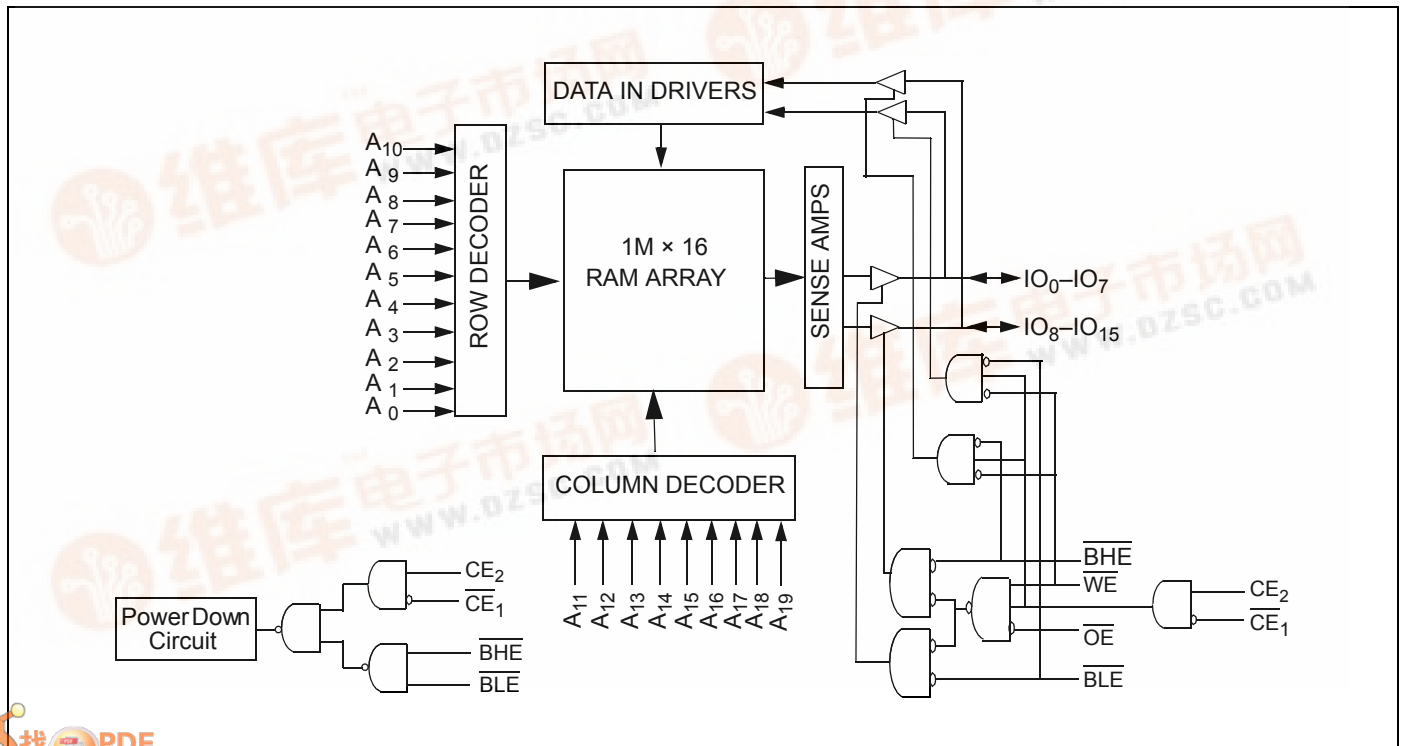
by 99% when addresses are not toggling. Place the device into standby mode when deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW or both BHE and BLE are HIGH). The input and output pins (IO<sub>0</sub> through IO<sub>15</sub>) are placed in a high impedance state when: the device is deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW); outputs are disabled ( $\overline{OE}$  HIGH); both Byte High Enable and Byte Low Enable are disabled ( $\overline{BHE}$ , BLE HIGH); and a write operation is in progress ( $\overline{CE}_1$  LOW,  $CE_2$  HIGH and WE LOW).

To write to the device, take Chip Enables ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH) and Write Enable (WE) input LOW. If Byte Low Enable (BLE) is LOW, then data from IO pins (IO<sub>0</sub> through IO<sub>7</sub>) is written into the location specified on the address pins (A<sub>0</sub> through A<sub>19</sub>). If Byte High Enable (BHE) is LOW, then data from IO pins (IO<sub>8</sub> through IO<sub>15</sub>) is written into the location specified on the address pins (A<sub>0</sub> through A<sub>19</sub>).

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 (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by the address pins appears on IO<sub>0</sub> to IO<sub>7</sub>. If Byte High Enable (BHE) is LOW, then data from memory appears on IO<sub>8</sub> to IO<sub>15</sub>. See the [Truth Table on page 9](#) for a complete description of read and write modes.

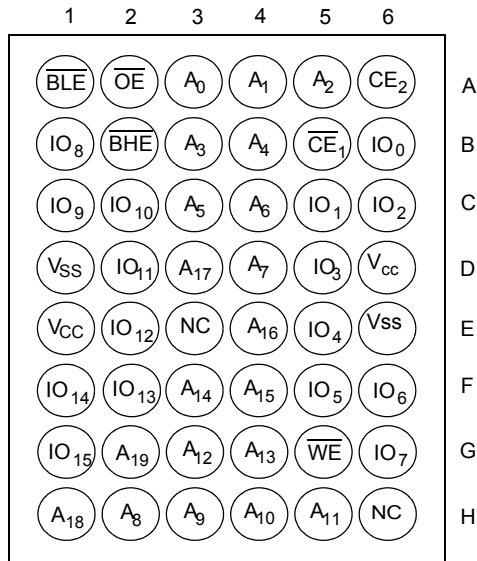
For best practice recommendations, refer to the Cypress application note [AN1064, SRAM System Guidelines](#).

#### Logic Block Diagram



## Pin Configuration

Figure 1. 48-Ball VFBGA (6 x 7 x 1mm) / (6 x 8 x 1mm) Top View [1, 2, 3]



## Product Portfolio

Product	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>[4]</sup>	Max	Typ <sup>[4]</sup>	Max	Typ <sup>[4]</sup>	Max	Typ <sup>[4]</sup>	Max		
CY62167EV18LL	1.65	1.8	2.25	55	2.2	4.0	25	30	1.5	12

### Notes

1. The information related to 6 x 7 x 1 mm VFBGA package is preliminary.
2. NC pins are not connected on the die.
3. Ball H6 for the VFBGA package can be used to upgrade to a 32M density.
4. 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.

## Maximum Ratings

Exceeding the maximum ratings may impair the useful life of the device. These 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 .....	-0.2V to 2.45V ( $V_{CC(max)} + 0.2V$ )
DC Voltage Applied to Outputs in High Z State <sup>[5, 6]</sup> .....	-0.2V to 2.45V ( $V_{CC(max)} + 0.2V$ )

DC Input Voltage <sup>[5, 6]</sup> .....	-0.2V to 2.45V ( $V_{CC(max)} + 0.2V$ )
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	$V_{CC}$ <sup>[7]</sup>
CY62167EV18LL	Industrial	-40°C to +85°C	1.65V to 2.25V

## Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	55 ns			Unit
			Min	Typ <sup>[4]</sup>	Max	
$V_{OH}$	Output HIGH Voltage	$I_{OH} = -0.1 \text{ mA}$	1.4			V
$V_{OL}$	Output LOW Voltage	$I_{OL} = 0.1 \text{ mA}$			0.2	V
$V_{IH}$	Input HIGH Voltage	$V_{CC} = 1.65V \text{ to } 2.25V$	1.4		$V_{CC} + 0.2V$	V
$V_{IL}$	Input LOW Voltage	$V_{CC} = 1.65V \text{ to } 2.25V$	-0.2		0.4	V
$I_{IX}$	Input Leakage Current	$GND \leq V_I \leq V_{CC}$	-1		+1	$\mu\text{A}$
$I_{OZ}$	Output Leakage Current	$GND \leq V_O \leq V_{CC}$ , Output Disabled	-1		+1	$\mu\text{A}$
$I_{CC}$	$V_{CC}$ Operating Supply Current	$f = f_{max} = 1/t_{RC}$		25	30	mA
		$f = 1 \text{ MHz}$				
$I_{SB1}$	Automatic CE Power Down Current – CMOS Inputs	$\overline{CE}_1 \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$ $V_{IN} \geq V_{CC} - 0.2V$ , $V_{IN} \leq 0.2V$ $f = f_{max}$ (Address and Data Only), $f = 0$ ( $\overline{OE}$ , $\overline{WE}$ , $\overline{BHE}$ and $\overline{BLE}$ ), $V_{CC} = V_{CC(max)}$		1.5	12	$\mu\text{A}$
$I_{SB2}$ <sup>[8]</sup>	Automatic CE Power Down Current – CMOS Inputs	$\overline{CE}_1 \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$ , $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$ , $f = 0$ , $V_{CC} = V_{CC(max)}$		1.5	12	$\mu\text{A}$

## Capacitance

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

Parameter	Description	Test Conditions	Max	Unit
$C_{IN}$	Input Capacitance	$T_A = 25^\circ\text{C}$ , $f = 1 \text{ MHz}$ ,	10	pF
$C_{OUT}$	Output Capacitance	$V_{CC} = V_{CC(typ)}$	10	pF

### Notes

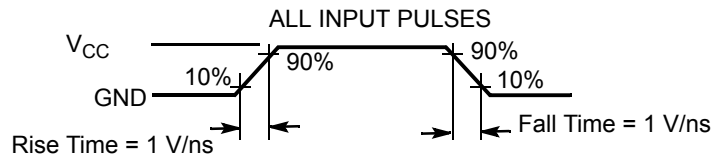
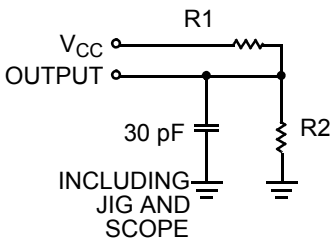
- $V_{IL(min)}$  = -2.0V for pulse durations less than 20 ns.
- $V_{IH(max)}$  =  $V_{CC} + 0.75V$  for pulse durations less than 20 ns.
- Full Device AC operation is based on a 100  $\mu\text{s}$  ramp time from 0 to  $V_{CC(min)}$  and 200  $\mu\text{s}$  wait time after  $V_{CC}$  stabilization.
- Only 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  $I_{SB2}$  /  $I_{CCDR}$  spec. Other inputs can be left floating.

### Thermal Resistance

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

Parameter	Description	Test Conditions	VFBGA (6 x 7 x 1mm)	VFBGA (6 x 8 x 1mm)	Unit
$\Theta_{JA}$	Thermal Resistance (Junction to Ambient)	Still air, soldered on a 3 x 4.5 inch, two-layer printed circuit board	27.74	55	°C/W
$\Theta_{JC}$	Thermal Resistance (Junction to Case)		9.84	16	°C/W

### AC Test Loads and Waveforms



Equivalent to: THÉVENIN EQUIVALENT



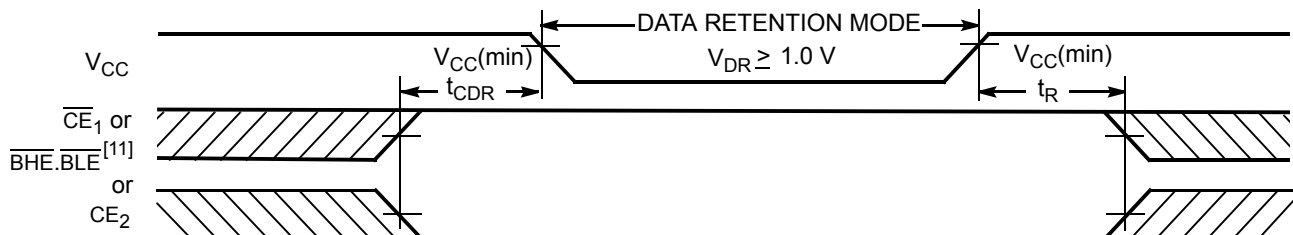
Parameters	1.8V	Unit
R1	13500	$\Omega$
R2	10800	$\Omega$
$R_{TH}$	6000	$\Omega$
$V_{TH}$	0.80	V

### Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ <sup>[4]</sup>	Max	Unit
$V_{DR}$	$V_{CC}$ for Data Retention		1.0			V
$I_{CCDR}$ <sup>[8]</sup>	Data Retention Current	$V_{CC} = 1.0V, CE_1 \geq V_{CC} - 0.2V, CE_2 \leq 0.2V, V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$			10	$\mu A$
$t_{CDR}$ <sup>[9]</sup>	Chip Deselect to Data Retention Time		0			ns
$t_R$ <sup>[10]</sup>	Operation Recovery Time		$t_{RC}$			ns

### Data Retention Waveform



**Notes**

- 9. Tested initially and after any design or process changes that may affect these parameters.
- 10. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC}(\text{min}) \geq 100 \mu s$  or stable at  $V_{CC}(\text{min}) \geq 100 \mu s$ .
- 11.  $\overline{BHE.BLE}$  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<sup>[12, 13]</sup>

Parameter	Description	55 ns		Unit
		Min	Max	
<b>Read Cycle</b>				
$t_{RC}$	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 <sup>[14]</sup>	5		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[14, 15]</sup>		18	ns
$t_{LZCE}$	$\overline{CE}_1$ LOW and $CE_2$ HIGH to Low-Z <sup>[14]</sup>	10		ns
$t_{HZCE}$	$\overline{CE}_1$ HIGH and $CE_2$ LOW to High-Z <sup>[14, 15]</sup>		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 <sup>[14]</sup>	10		ns
$t_{HZBE}$	$\overline{BLE}/\overline{BHE}$ HIGH to High-Z <sup>[14, 15]</sup>		18	ns
<b>Write Cycle<sup>[16]</sup></b>				
$t_{WC}$	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 <sup>[14, 15]</sup>		20	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[14]</sup>	10		ns

### Notes

- Test conditions for all parameters other than tri-state parameters are based on signal transition time of 1V/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 4](#).
- 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.
- 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.
- $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  transitions are measured when the output enters a high impedance state.
- The internal memory write time is defined by the overlap of  $\overline{WE}$ ,  $CE_1 = V_{IL}$ ,  $\overline{BHE}$  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 2 shows address transition controlled read cycle waveforms.<sup>[17, 18]</sup>

Figure 2. Read Cycle No. 1

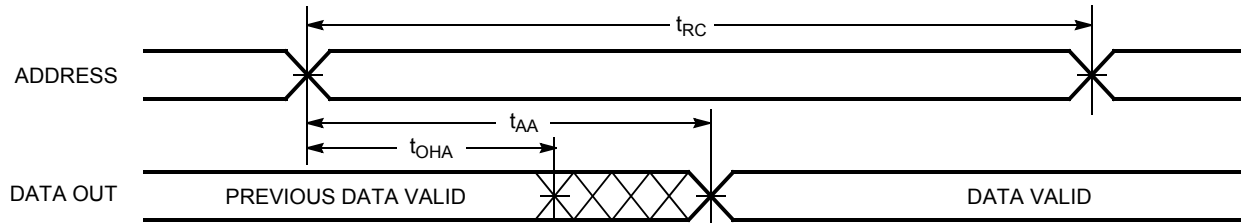
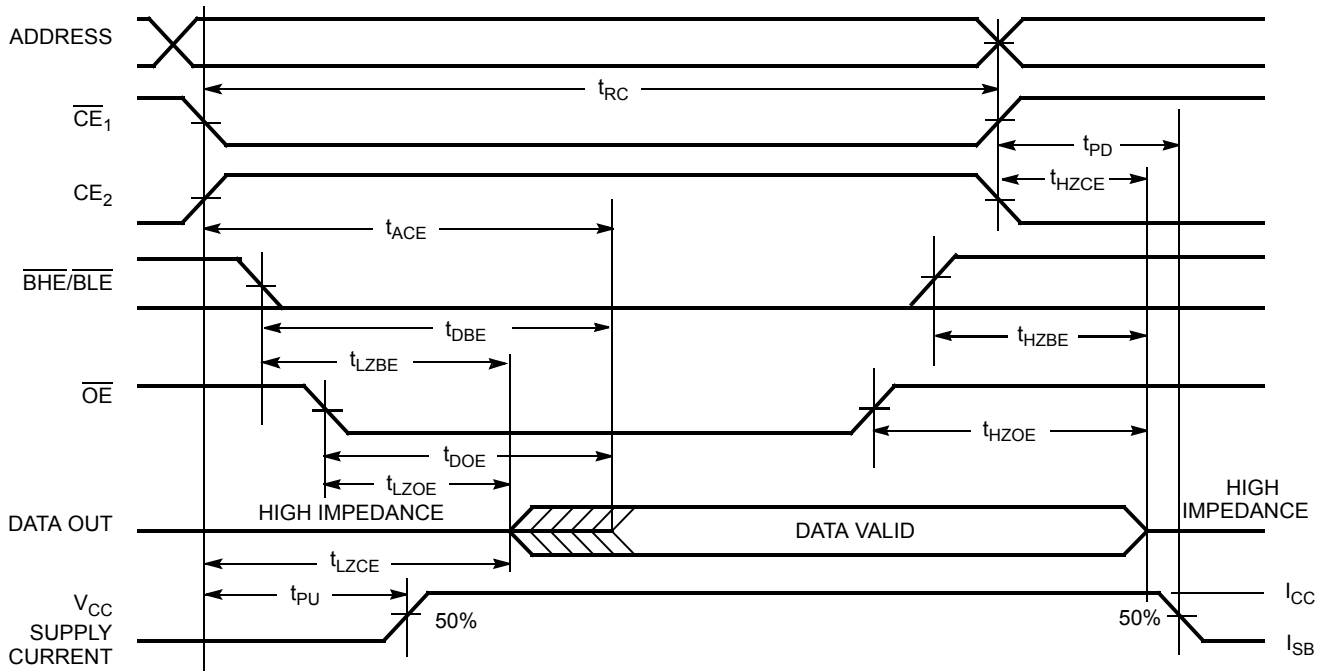


Figure 3 shows  $\overline{OE}$  controlled read cycle waveforms.<sup>[18, 19]</sup>

Figure 3. Read Cycle No. 2



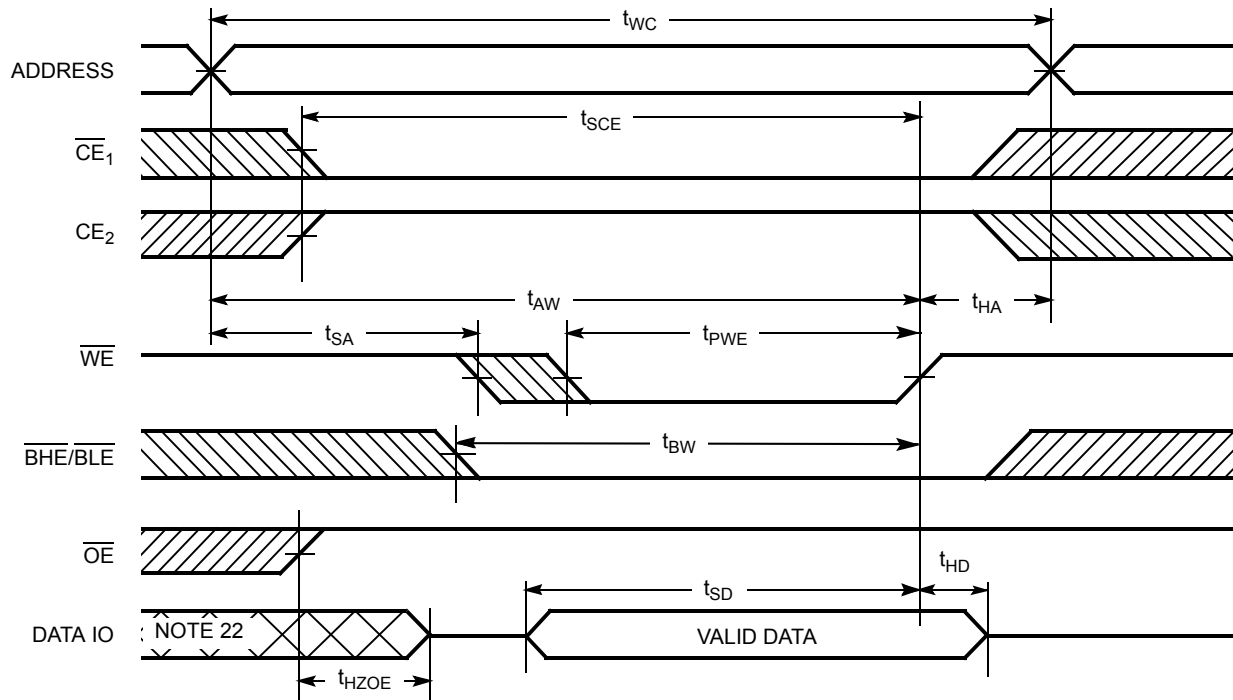
**Notes**

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

Switching Waveforms (continued)

Figure 4 shows  $\overline{WE}$  controlled write cycle waveforms.<sup>[16, 20, 21]</sup>

Figure 4. Write Cycle No. 1



Notes

- 20. Data IO is high impedance if  $\overline{OE} = V_{IH}$ .
- 21. If  $\overline{CE}_1$  goes HIGH and  $\overline{CE}_2$  goes LOW simultaneously with  $\overline{WE} = V_{IH}$ , the output remains in a high impedance state.
- 22. During this period the IOs are in output state. Do not apply input signals.

**Switching Waveforms** (continued)

Figure 5 shows  $\overline{CE}_1$  or  $CE_2$  controlled write cycle waveforms.<sup>[16, 20, 21]</sup>

**Figure 5. Write Cycle No. 2**

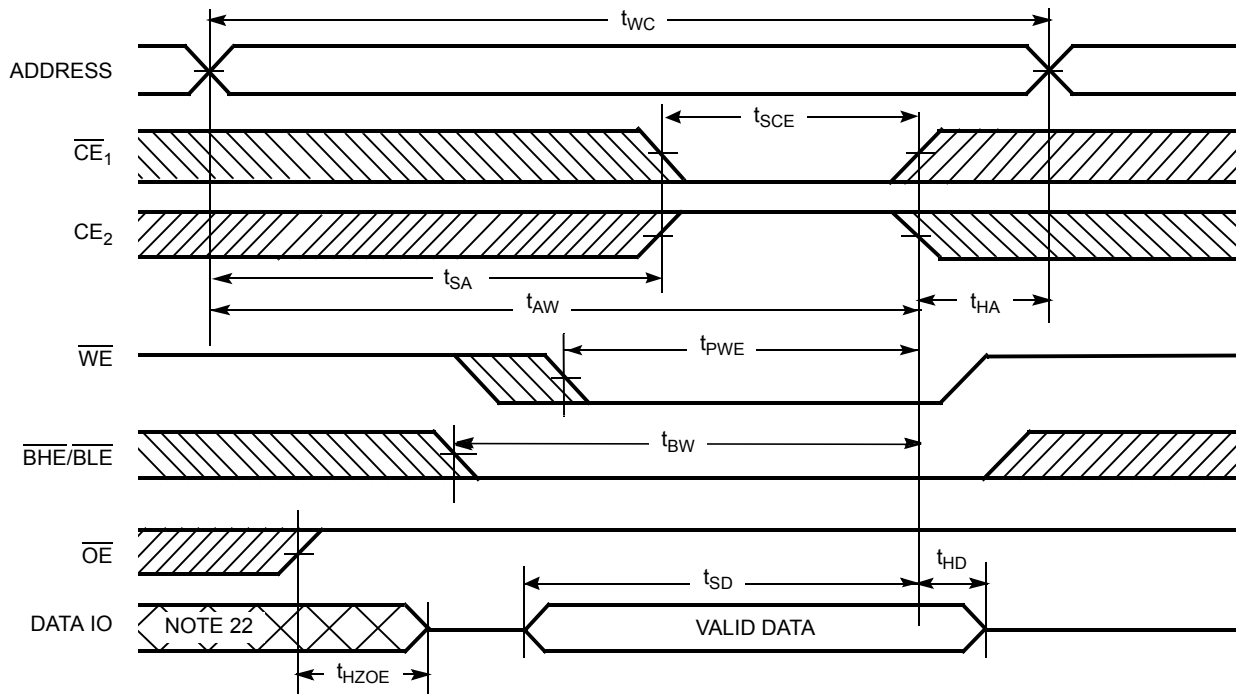
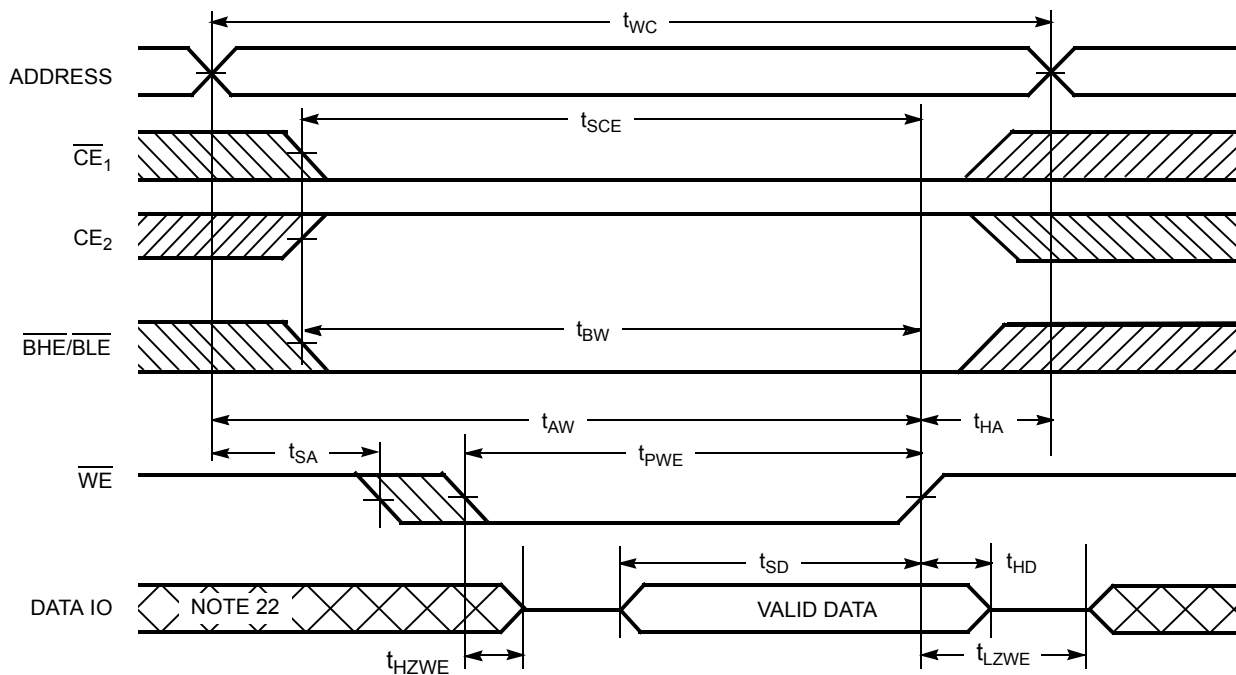


Figure 6 shows  $\overline{WE}$  controlled,  $\overline{OE}$  LOW write cycle waveforms.<sup>[21]</sup>

**Figure 6. Write Cycle No. 3**

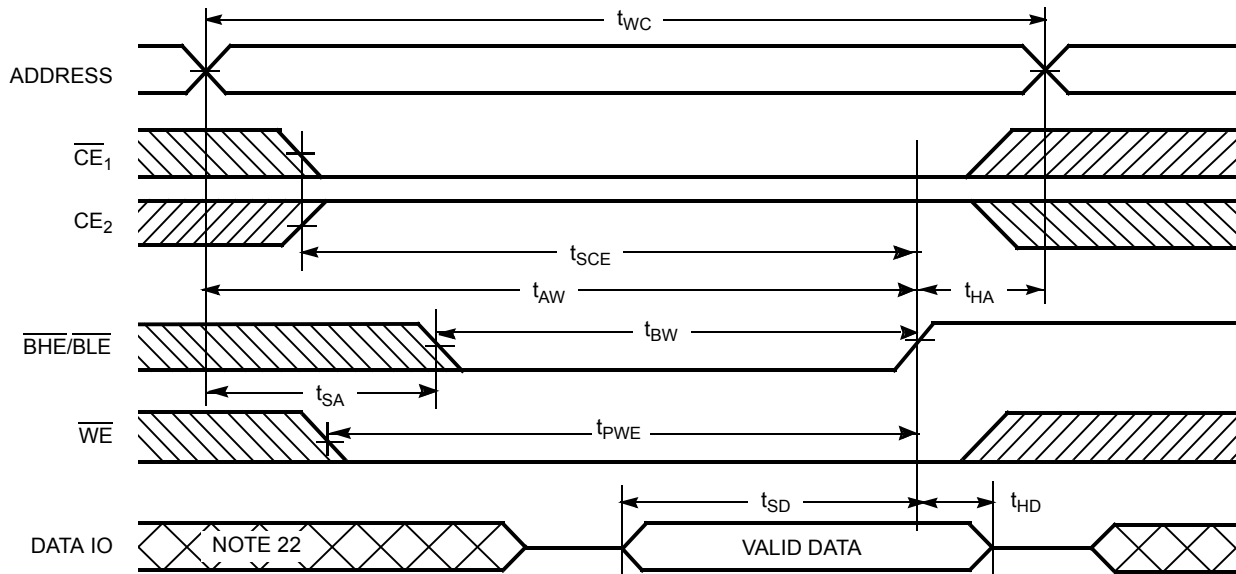




**Switching Waveforms** (continued)

Figure 7 shows  $\overline{\text{BHE}}/\overline{\text{BLE}}$  controlled,  $\overline{\text{OE}}$  LOW write cycle waveforms.<sup>[21]</sup>

**Figure 7. Write Cycle No. 4**



**Truth Table**

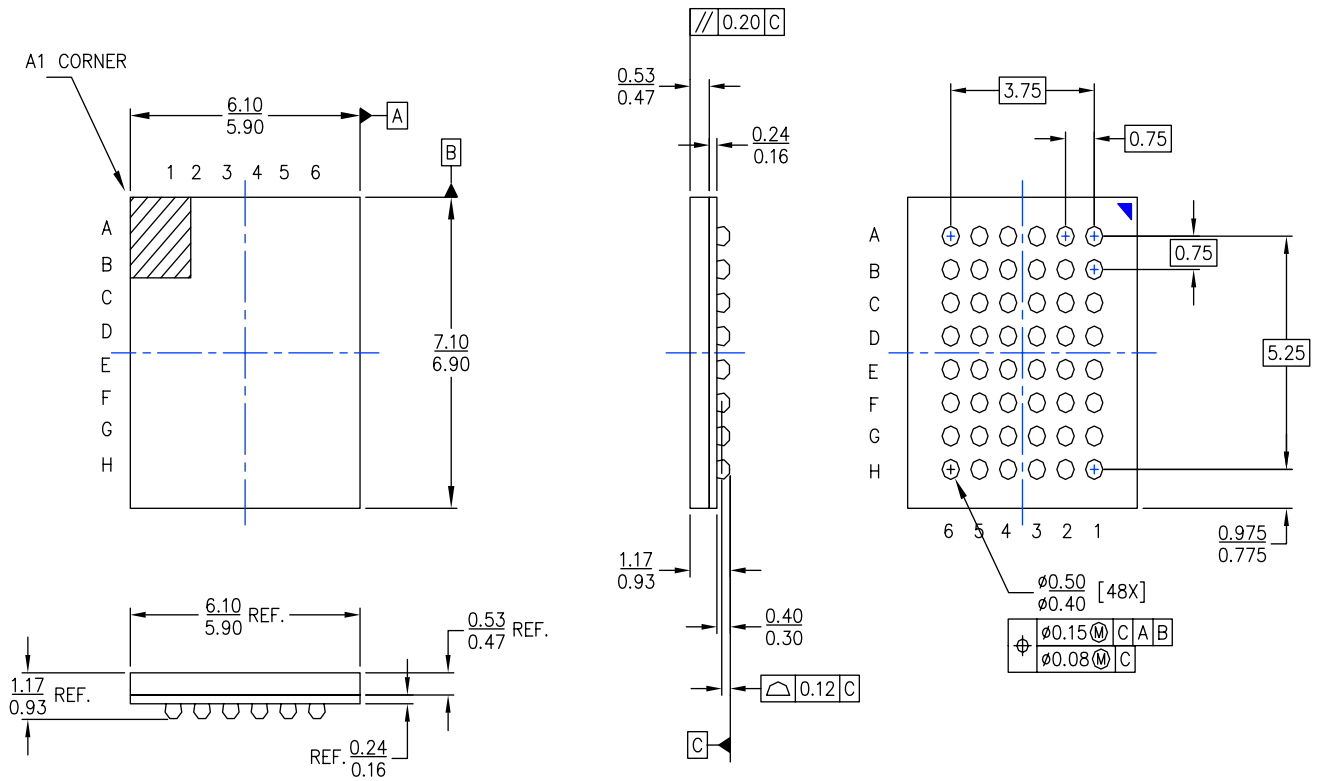
$\overline{\text{CE}}_1$	$\overline{\text{CE}}_2$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	$\overline{\text{BHE}}$	$\overline{\text{BLE}}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect / Power Down	Standby ( $I_{SB}$ )
X	L	X	X	X	X	High Z	Deselect / Power Down	Standby ( $I_{SB}$ )
X	X	X	X	H	H	High Z	Deselect / Power Down	Standby ( $I_{SB}$ )
L	H	H	L	L	L	Data Out ( $\text{IO}_0\text{--}\text{IO}_{15}$ )	Read	Active ( $I_{CC}$ )
L	H	H	L	H	L	Data Out ( $\text{IO}_0\text{--}\text{IO}_7$ ); High Z ( $\text{IO}_8\text{--}\text{IO}_{15}$ )	Read	Active ( $I_{CC}$ )
L	H	H	L	L	H	High Z ( $\text{IO}_0\text{--}\text{IO}_7$ ); Data Out ( $\text{IO}_8\text{--}\text{IO}_{15}$ )	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 ( $\text{IO}_0\text{--}\text{IO}_{15}$ )	Write	Active ( $I_{CC}$ )
L	H	L	X	H	L	Data In ( $\text{IO}_0\text{--}\text{IO}_7$ ); High Z ( $\text{IO}_8\text{--}\text{IO}_{15}$ )	Write	Active ( $I_{CC}$ )
L	H	L	X	L	H	High Z ( $\text{IO}_0\text{--}\text{IO}_7$ ); Data In ( $\text{IO}_8\text{--}\text{IO}_{15}$ )	Write	Active ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
55	CY62167EV18LL-55BAXI	001-13297	48-ball VFBGA (6 × 7 × 1 mm) (Pb-free)	Industrial
	CY62167EV18LL-55BVXI	51-85150	48-ball VFBGA (6 × 8 × 1 mm) (Pb-free)	

Package Diagram

Figure 8. 48-Ball VFBGA (6 x 7 x 1 mm), 001-13297

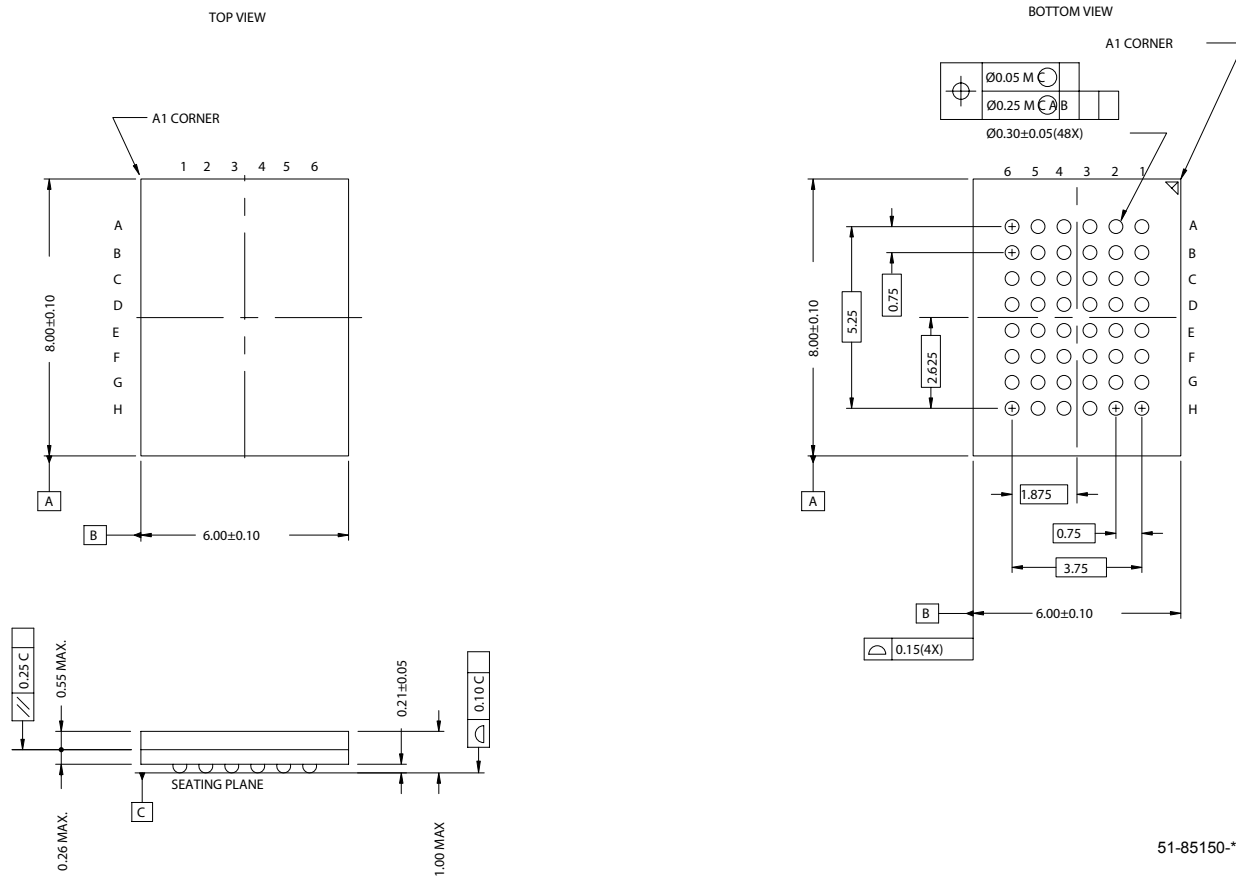


- NOTES:  
 1. ALL DIMENSION ARE IN MM [MAX/MIN]  
 2. JEDEC REFERENCE : MO-216  
 3. PACKAGE WEIGHT : 0.03g

001-13297-A

Package Diagram

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



51-85150-D

## Document History Page

Document Title: CY62167EV18 MoBL® 16-Mbit (1M x 16) Static RAM Document Number: 38-05447				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	202600	01/23/04	AJU	New Data Sheet
*A	463674	See ECN	NXR	Converted from Advance Information to Preliminary Changed $V_{CC(max)}$ from 2.20V to 2.25V 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 $\mu A$ to 1.5 $\mu A$ 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 $\mu s$ to $t_{RC}$ ns Changed the $I_{CCDR}$ Value from 8 $\mu A$ to 5 $\mu A$ 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	See ECN	NSI	Minor Change: Moved to external web
*C	619122	See ECN	NXR	Replaced 45 ns speed bin with 55 ns speed bin
*D	1130323	See ECN	VKN	Converted from preliminary to final Added footnote# 8 related $I_{SB2}$ and $I_{CCDR}$ Changed $I_{SB1}$ and $I_{SB2}$ spec from 10 $\mu A$ to 12 $\mu A$ Changed $I_{CCDR}$ spec from 8 $\mu A$ to 10 $\mu A$ 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	See ECN	VKN	Added 48-Ball VFBGA (6 x 7 x 1mm) package Added footnote# 1 related to FBGA package Updated Ordering Information table

© Cypress Semiconductor Corporation, 2004-2007. The information contained herein is subject to change without notice. Cypress Semiconductor Corporation assumes no responsibility for the use of any circuitry other than circuitry embodied in a Cypress product. Nor does it convey or imply any license under patent or other rights. Cypress products are not warranted nor intended to be used for medical, life support, life saving, critical control or safety applications, unless pursuant to an express written agreement with Cypress. Furthermore, Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress products in life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Any Source Code (software and/or firmware) is owned by Cypress Semiconductor Corporation (Cypress) and is protected by and subject to worldwide patent protection (United States and foreign), United States copyright laws and international treaty provisions. Cypress hereby grants to licensee a personal, non-exclusive, non-transferable license to copy, use, modify, create derivative works of, and compile the Cypress Source Code and derivative works for the sole purpose of creating custom software and or firmware in support of licensee product to be used only in conjunction with a Cypress integrated circuit as specified in the applicable agreement. Any reproduction, modification, translation, compilation, or representation of this Source Code except as specified above is prohibited without the express written permission of Cypress.

Disclaimer: CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Cypress reserves the right to make changes without further notice to the materials described herein. Cypress does not assume any liability arising out of the application or use of any product or circuit described herein. Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress' product in a life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Use may be limited by and subject to the applicable Cypress software license agreement.