

## Features

- Thin small outline package (TSOP-I) configurable as 1 M × 16 or as 2 M × 8 SRAM
- Wide voltage range: 2.2 V–3.6 V
- Ultra-low active power:  
Typical active current: 2 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
- Complementary metal oxide semiconductor (CMOS) for optimum speed / power
- Available in Pb-free and non Pb-free 48-ball very fine-pitch ball grid array (VFBGA) and 48-pin TSOP I package

## Functional Description

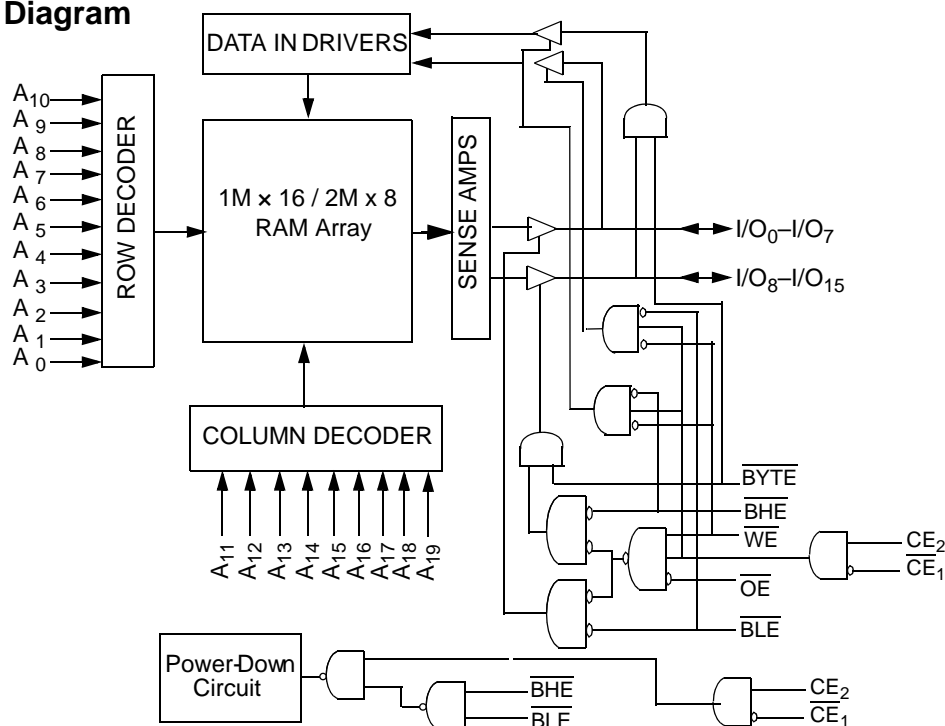
The CY62167DV30 is a high-performance CMOS static RAM organized as 1M words by 16-bits. This device features advanced circuit design to provide ultra-low active current. This is ideal for providing More Battery Life™ (MoBL®) in portable applications such as cellular telephones. The device also has an

automatic power-down feature that significantly reduces power consumption by 99% when addresses are not toggling. The device can also be put into standby mode when deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW or both  $\overline{BHE}$  and  $\overline{BLE}$  are HIGH). The input/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), or during a Write operation ( $CE_1$  LOW,  $CE_2$  HIGH and  $\overline{WE}$  LOW).

Writing to the device is accomplished by taking 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  $A_{19}$ ).

Reading from the device is accomplished by taking 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 appear on  $I/O_0$  to  $I/O_7$ . If Byte High Enable ( $\overline{BHE}$ ) is LOW, then data from memory appear on  $I/O_8$  to  $I/O_{15}$ . See the truth table at the back of this data sheet for a complete description of Read and Write modes.

## Logic Block Diagram



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## 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>[1]</sup>	Max		Typ <sup>[1]</sup>	Max	Typ <sup>[1]</sup>	Max	Typ <sup>[1]</sup>	Max
CY62167DV30LL	2.2	3.0	3.6	55	2	4	15	30	2.5	22
				70			12	25		

## Pin Configurations

Figure 1. 48-ball VFBGA pinout (Top View) [2, 3]

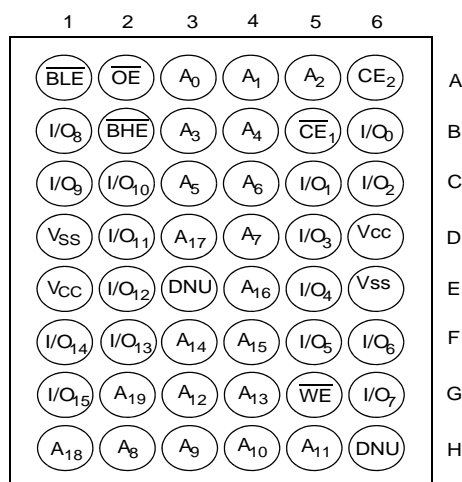


Figure 2. 48-pin TSOP I pinout (Top View) [4]



### Notes

- 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.
- NC pins are not connected on the die.
- DNU pins have to be left floating.
- The BYTE pin in the 48-TSOP I package has to be tied to V<sub>CC</sub> to use the device as a 1M x 16 SRAM. The 48-TSOP I package can also be used as a 2 M x 8 SRAM by tying the BYTE signal to V<sub>SS</sub>. In the 2 M x 8 configuration, Pin 45 is A20, while BHE, BLE and I/O8 to I/O14 pins are not used (DNU).

## 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  $V_{CC} + 0.3$  V

DC voltage applied to outputs in High-Z state <sup>[5, 6]</sup> ..... -0.2 V to  $V_{CC} + 0.3$  V

DC input voltage <sup>[5, 6]</sup> ..... -0.2 V to  $V_{CC} + 0.3$  V

Output current into outputs (LOW) ..... 20 mA

Static discharge voltage

(per MIL-STD-883, Method 3015) ..... > 2001 V

Latch-up current ..... > 200 mA

## Operating Range

Device	Range	Ambient Temperature	$V_{CC}$ <sup>[7]</sup>
CY62167DV30LL	Industrial	-40 °C to +85 °C	2.20 V to 3.60 V

## Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	CY62167DV30-55			CY62167DV30-70			Unit
			Min	Typ <sup>[8]</sup>	Max	Min	Typ <sup>[8]</sup>	Max	
$V_{OH}$	Output HIGH voltage	$I_{OH} = -0.1$ mA $V_{CC} = 2.20$ V	2.0	—	—	2.0	—	—	V
		$I_{OH} = -1.0$ mA $V_{CC} = 2.70$ V	2.4			2.4			
$V_{OL}$	Output LOW voltage	$I_{OL} = 0.1$ mA $V_{CC} = 2.20$ V	—	—	0.4	—	—	0.4	V
		$I_{OL} = 2.1$ mA $V_{CC} = 2.70$ 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			2.2			
$V_{IL}$	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			0.8			0.8	
$I_{IX}$	Input leakage current	$GND \leq V_I \leq V_{CC}$	-1	—	+1	-1	—	+1	μA
$I_{OZ}$	Output leakage current	$GND \leq V_O \leq V_{CC}$ , output disabled	-1	—	+1	-1	—	+1	μA
$I_{CC}$	$V_{CC}$ operating supply current	$V_{CC} = V_{CC(max)}$ $I_{OUT} = 0$ mA CMOS levels	—	$f = f_{Max} = 1/t_{RC}$ 15	30	—	12	25	mA
		$f = 1$ MHz		2	4		2	4	
$I_{SB1}$	Automatic power-down current – CMOS inputs	$\overline{CE}_1 \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V, $V_{IN} \leq 0.2$ V, $f = f_{Max}$ (address and data only), $f = 0$ ( $\overline{OE}$ , $\overline{WE}$ ), $V_{CC} = 3.60$ V	—	2.5	22	—	2.5	22	μA
$I_{SB2}$	Automatic power-down current – CMOS Inputs	$\overline{CE}_1 \geq V_{CC} - 0.2$ V or $CE_2 \leq 0.2$ V $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V, $f = 0$ , $V_{CC} = 3.60$ V	—	2.5	22	—	2.5	22	μA

### 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 requires linear  $V_{CC}$  ramp from 0 to  $V_{CC(min)}$  and  $V_{CC}$  must be stable at  $V_{CC(min)}$  for 500 μs.

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.

## Capacitance

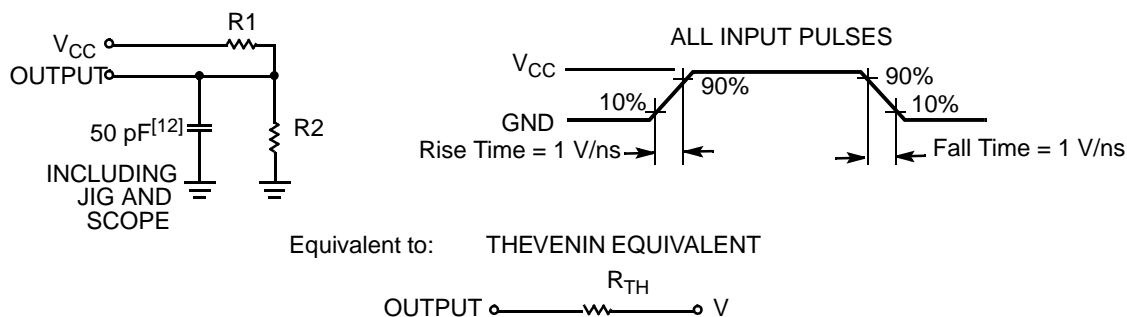
Parameter <sup>[10]</sup>	Description	Test Conditions	Max	Unit
$C_{IN}$	Input capacitance	$T_A = 25\text{ }^{\circ}\text{C}$ , $f = 1\text{ MHz}$ , $V_{CC} = V_{CC(typ)}$	8	pF
$C_{OUT}$	Output capacitance		10	pF

## Thermal Resistance

Parameter <sup>[10]</sup>	Description	Test Conditions	VFBGA	TSOP I	Unit
$\theta_{JA}$	Thermal resistance (junction to ambient)	Still air, soldered on a 3 x 4.5 inch, 2-layer printed circuit board	55	60	$^{\circ}\text{C/W}$
$\theta_{JC}$	Thermal resistance (junction to case)		16	4.3	$^{\circ}\text{C/W}$

## AC Test Loads and Waveforms

Figure 3. AC Test Loads and Waveforms



Parameters	2.5 V	3.0 V	Unit
R1	16667	1103	$\Omega$
R2	15385	1554	$\Omega$
$R_{TH}$	8000	645	$\Omega$
$V_{TH}$	1.20	1.75	V

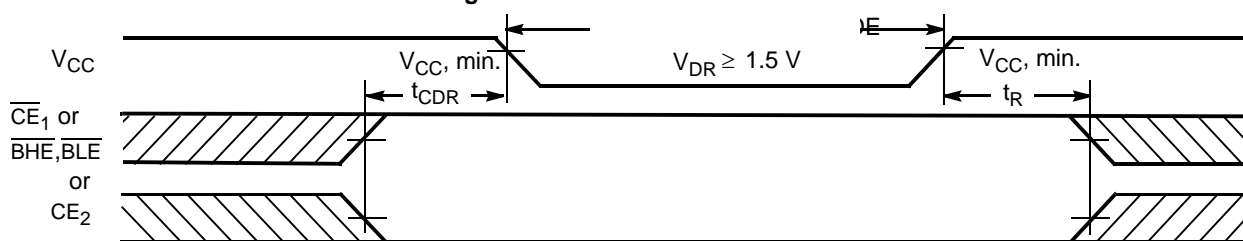
## Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions	Min	Typ <sup>[9]</sup>	Max	Unit
$V_{DR}$	$V_{CC}$ for data retention		1.5	–	–	V
$I_{CCDR}$	Data retention current	$V_{CC} = 1.5\text{ V}$ , $\overline{CE}_1 \leq V_{CC} - 0.2\text{ V}$ or $\overline{CE}_2 \leq V_{CC} - 0.2\text{ V}$ , $V_{IN} \leq V_{CC} - 0.2\text{ V}$ or $V_{IN} \leq V_{CC} - 0.2\text{ V}$	–	–	10	$\mu\text{A}$
$t_{CDR}^{[10]}$	Chip deselect to data retention time		0	–	–	ns
$t_R^{[11]}$	Operation recovery time	CY62167DV30LL-55	55	–	–	ns
		CY62167DV30LL-70	70			

## Data Retention Waveform

Figure 4. Data Retention Waveform<sup>[12]</sup>



### Notes

9. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at  $V_{CC} = V_{CC(typ)}$ ,  $T_A = 25^\circ\text{C}$ .

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

11. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(min.)} \geq 100\text{ }\mu\text{s}$  or stable at  $V_{CC(min.)} \geq 100\text{ }\mu\text{s}$ .

12.  $\overline{BHE}.\overline{BLE}$  is the AND of both  $\overline{BHE}$  and  $\overline{BLE}$ . Chip can be deselected by either disabling the chip enable signals or by disabling both  $\overline{BHE}$  and  $\overline{BLE}$ .

## Switching Characteristics

Over the Operating Range

Parameter <sup>[13]</sup>	Description	55 ns		70 ns		Unit
		Min	Max	Min	Max	
Read Cycle						
t <sub>RC</sub>	Read cycle time	55	–	70	–	ns
t <sub>AA</sub>	Address to data valid	–	55	–	70	ns
t <sub>OHA</sub>	Data hold from address change	10	–	10	–	ns
t <sub>ACE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to data valid	–	55	–	70	ns
t <sub>DOE</sub>	$\overline{OE}$ LOW to data valid	–	25	–	35	ns
t <sub>LZOE</sub>	$\overline{OE}$ LOW to low Z <sup>[14]</sup>	5	–	5	–	ns
t <sub>HZOE</sub>	$\overline{OE}$ HIGH to high Z <sup>[14, 15]</sup>	–	20	–	25	ns
t <sub>LZCE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to low Z <sup>[14]</sup>	10	–	10	–	ns
t <sub>HZCE</sub>	$\overline{CE}_1$ HIGH and CE <sub>2</sub> LOW to high Z <sup>[14, 15]</sup>	–	20	–	25	ns
t <sub>PU</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to power-up	0	–	0	–	ns
t <sub>PD</sub>	$\overline{CE}_1$ HIGH and CE <sub>2</sub> LOW to power-down	–	55	–	70	ns
t <sub>DBE</sub>	BLE/BHE LOW to data valid	–	55	–	70	ns
t <sub>LZBE</sub>	$\overline{BLE/BHE}$ LOW to low Z <sup>[14]</sup>	10	–	10	–	ns
t <sub>HZBE</sub>	$\overline{BLE/BHE}$ HIGH to high Z <sup>[14, 15]</sup>	–	20	–	25	ns
Write Cycle <sup>[16]</sup>						
t <sub>WC</sub>	Write cycle time	55	–	70	–	ns
t <sub>SCE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to write end	40	–	60	–	ns
t <sub>AW</sub>	Address setup to write end	40	–	60	–	ns
t <sub>HA</sub>	Address hold from write end	0	–	0	–	ns
t <sub>SA</sub>	Address setup to write start	0	–	0	–	ns
t <sub>PWE</sub>	$\overline{WE}$ pulse width	40	–	45	–	ns
t <sub>BW</sub>	BLE/BHE LOW to write end	40	–	60	–	ns
t <sub>SD</sub>	Data setup to write end	25	–	30	–	ns
t <sub>HD</sub>	Data hold from write end	0	–	0	–	ns
t <sub>HZWE</sub>	$\overline{WE}$ LOW to high-Z <sup>[14, 15]</sup>	–	20	–	25	ns
t <sub>LZWE</sub>	$\overline{WE}$ HIGH to low-Z <sup>[14]</sup>	10	–	10	–	ns

### Notes

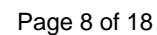
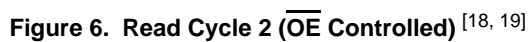
13. Test conditions for all parameters other than Tri-state parameters assume signal transition time of 1 ns/V, timing reference levels of  $V_{CC(typ)}/2$ , input pulse levels of 0 to  $V_{CC(typ)}$ , and output loading of the specified  $I_{OL}/I_{OH}$  as shown in the "AC Test Loads and Waveforms" section.

14. At any temperature and voltage condition, t<sub>HZCE</sub> is less than t<sub>LZCE</sub>, t<sub>HZBE</sub> is less than t<sub>LZBE</sub>, t<sub>HZOE</sub> is less than t<sub>LZOE</sub>, and t<sub>HZWE</sub> is less than t<sub>LZWE</sub> for any device.

15. t<sub>HZOE</sub>, t<sub>HZCE</sub>, t<sub>HZBE</sub>, and t<sub>HZWE</sub> transitions are measured when the outputs enter a high impedance state.

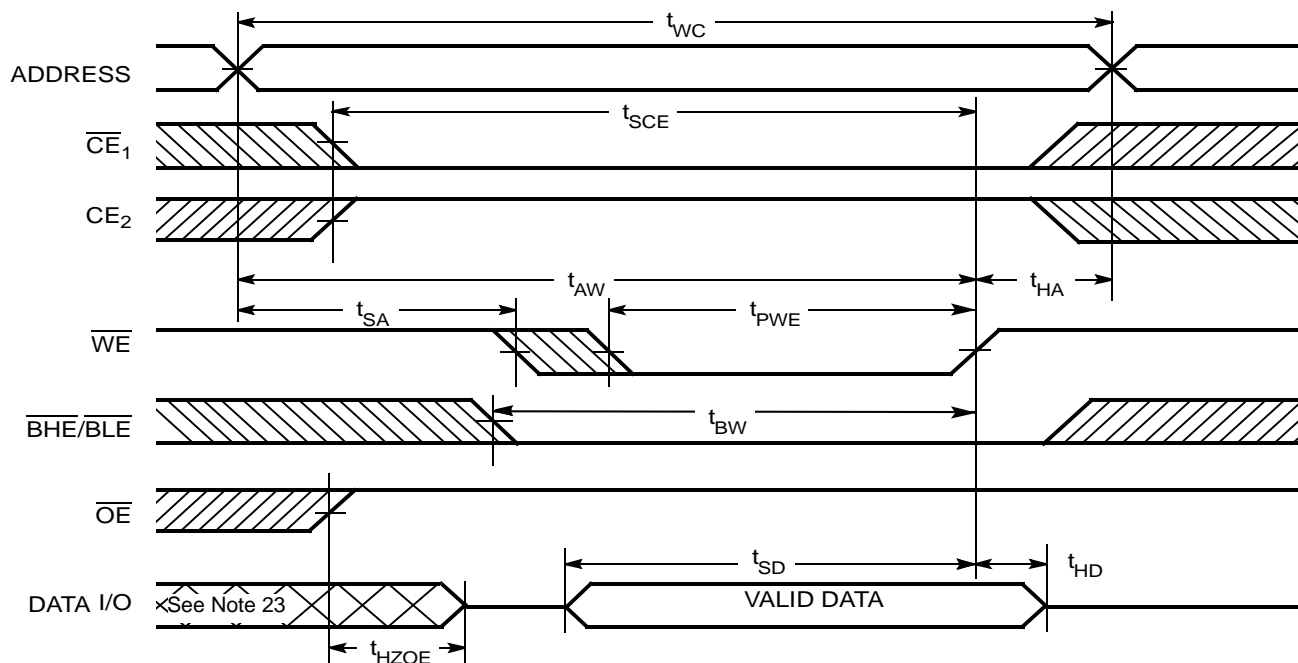
16. The internal Write time of the memory is defined by the overlap of WE,  $\overline{CE}_1 = V_{IL}$ , BHE and/or BLE =  $V_{IL}$ , and CE<sub>2</sub> =  $V_{IH}$ . All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input setup and hold timing should be referenced to the edge of the signal that terminates the Write.

**Figure 5. Read Cycle 1 (Address Transition Controlled)** <sup>[17, 18]</sup>





**Switching Waveforms** (continued)

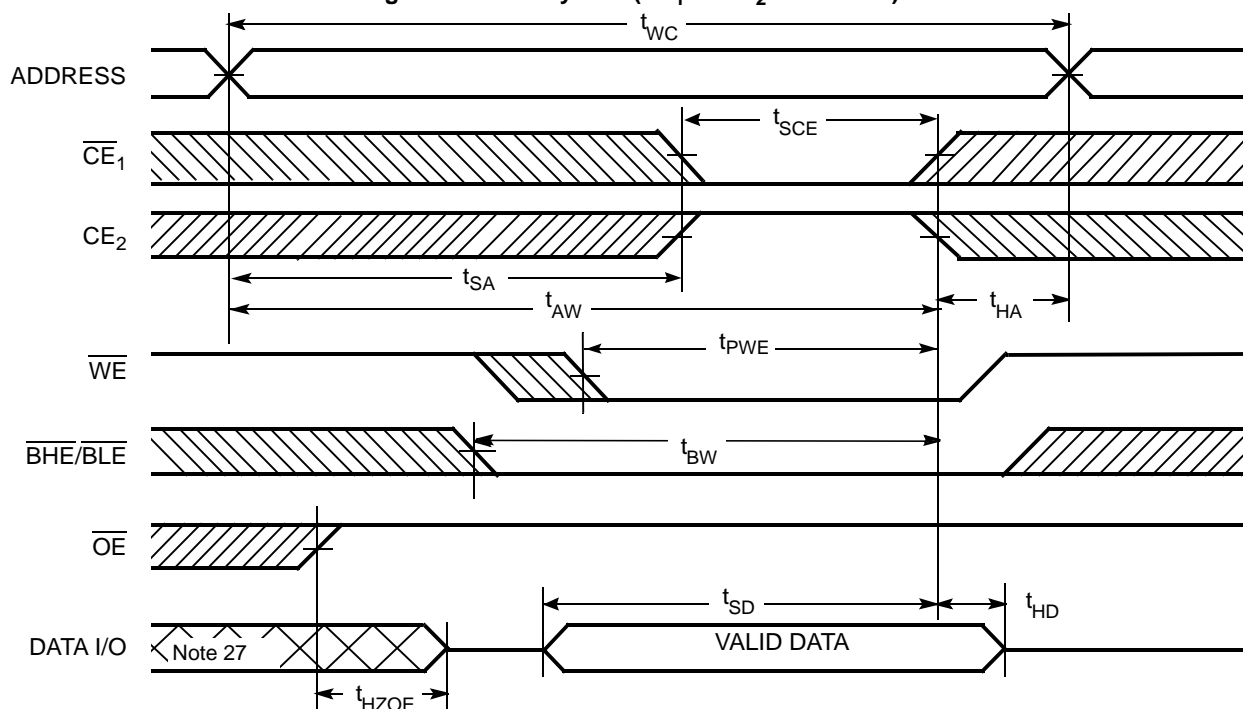
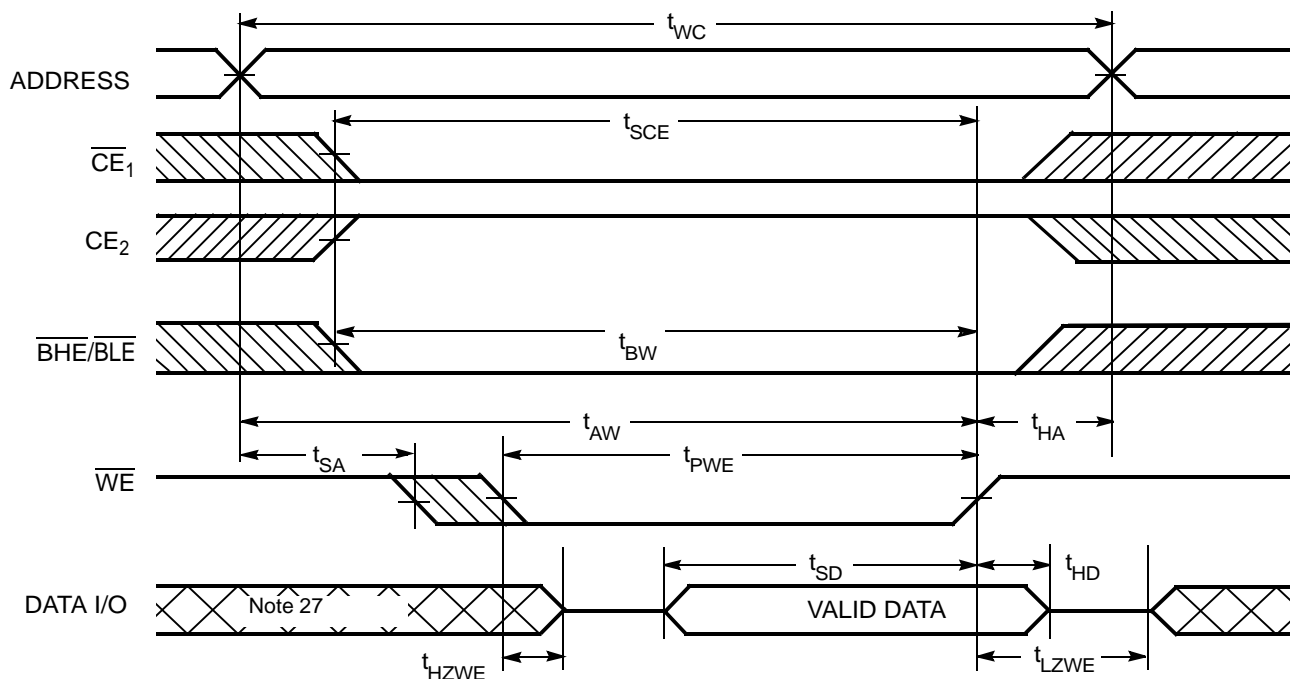
**Figure 7. Write Cycle 1 ( $\overline{WE}$  Controlled)** [20, 21, 22]

**Notes**

20. The internal Write time of the memory 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 should be referenced to the edge of the signal that terminates the Write.

21. Data I/O is high-impedance if  $\overline{OE} = V_{IH}$ .

22. 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.

23. During this period, the I/Os are in output state and input signals should not be applied.

**Switching Waveforms (continued)**
**Figure 8. Write Cycle 2 ( $\overline{CE}_1$  or  $CE_2$  Controlled) [24, 25, 26]**

**Figure 9. Write Cycle 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW) [26]**

**Notes**

24. The internal Write time of the memory 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 should be referenced to the edge of the signal that terminates the Write.

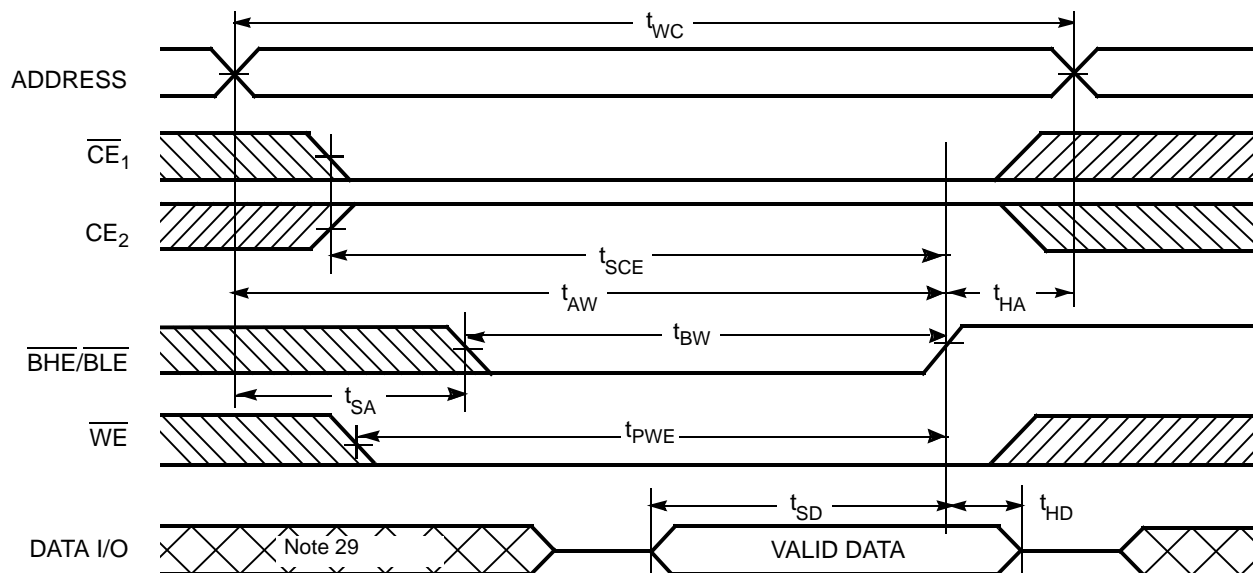
25. Data I/O is high-impedance if  $\overline{OE} = V_{IH}$ .

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 and input signals should not be applied.

## Switching Waveforms (continued)

**Figure 10. Write Cycle 4 ( $\overline{\text{BHE}}/\overline{\text{BLE}}$  Controlled,  $\overline{\text{OE}}$  LOW) <sup>[28]</sup>**



### Notes

28. If  $\overline{\text{CE}}_1$  goes HIGH and  $\text{CE}_2$  goes LOW simultaneously with  $\overline{\text{WE}} = V_{IH}$ , the output remains in a high-impedance state.  
 29. During this period, the I/Os are in output state and input signals should not be applied.

**Truth Table**

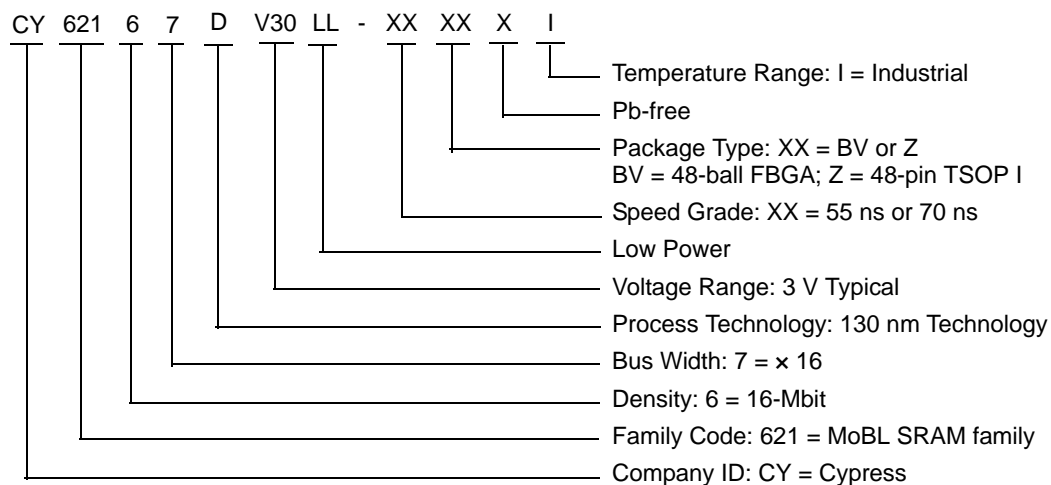
$\overline{CE}_1$	$CE_2$	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect/Power-down	Standby ( $I_{SB}$ )
X	L	X	X	X	X	High Z	Deselect/Power-down	Standby ( $I_{SB}$ )
X	X	X	X	H	H	High Z	Deselect/Power-down	Standby ( $I_{SB}$ )
L	H	H	L	L	L	Data out ( $I/O_0$ – $I/O_{15}$ )	Read	Active ( $I_{CC}$ )
L	H	H	L	H	L	High Z ( $I/O_8$ – $I/O_{15}$ ); Data out ( $I/O_0$ – $I/O_7$ )	Read	Active ( $I_{CC}$ )
L	H	H	L	L	H	Data out ( $I/O_8$ – $I/O_{15}$ ); High Z ( $I/O_0$ – $I/O_7$ )	Read	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	High Z ( $I/O_8$ – $I/O_{15}$ ); Data in ( $I/O_0$ – $I/O_7$ )	Write	Active ( $I_{CC}$ )
L	H	L	X	L	H	Data in ( $I/O_8$ – $I/O_{15}$ ); High Z ( $I/O_0$ – $I/O_7$ )	Write	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 ( $I_{CC}$ )

## Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
55	CY62167DV30LL-55BVI	51-85178	48-ball FBGA (8 × 9.5 × 1 mm)	Industrial
	CY62167DV30LL-55BVXI		48-ball FBGA (8 × 9.5 × 1 mm) Pb-free	
	CY62167DV30LL-55ZXI	51-85183	48-pin TSOP I (12 × 18.4 × 1 mm) Pb-free	
70	CY62167DV30LL-70BVI	51-85178	48-ball FBGA (8 × 9.5 × 1 mm)	

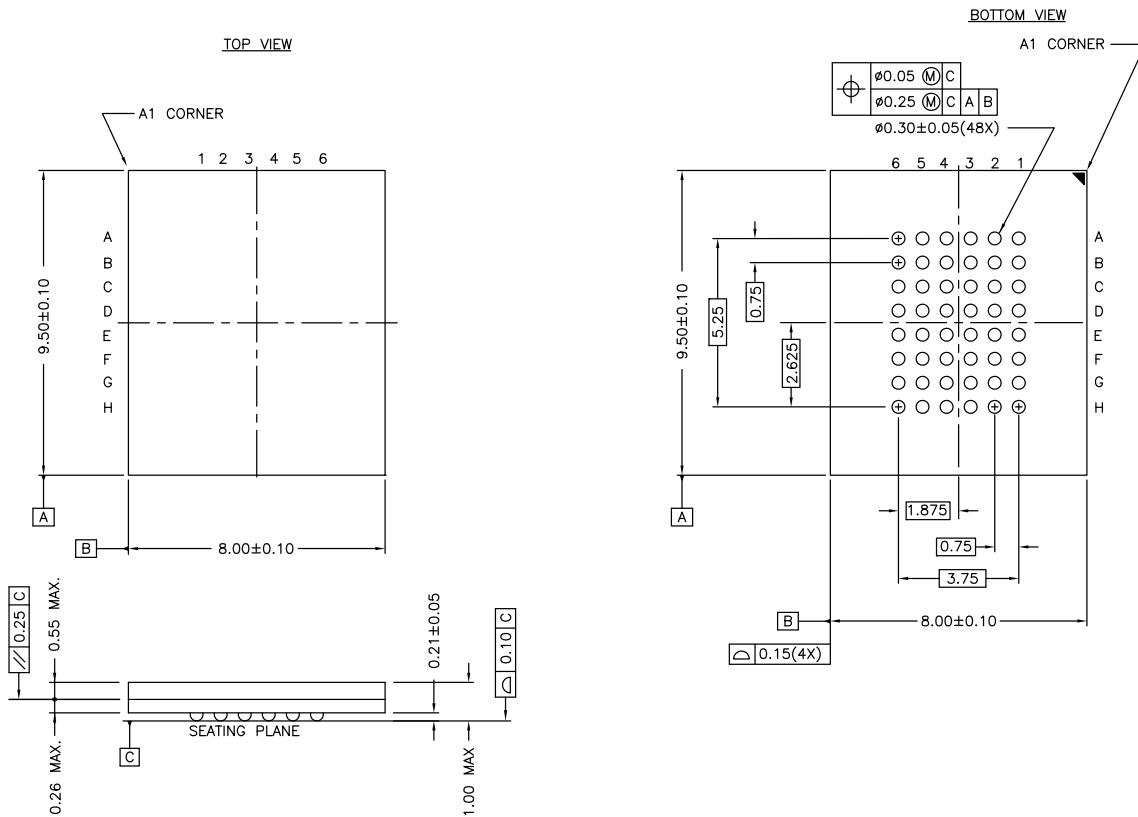
Please contact your local Cypress sales representative for availability of these parts

## Ordering Code Definitions



## Package Diagrams

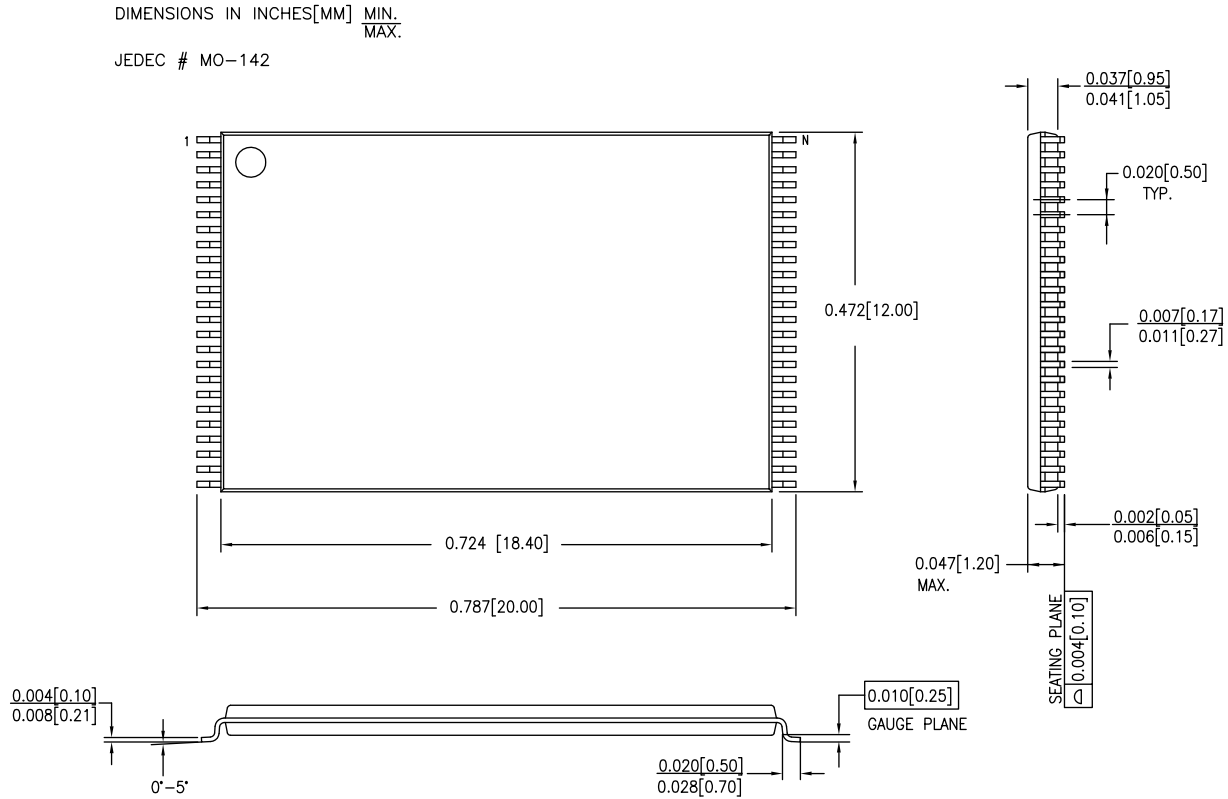
Figure 11. 48-ball VFBGA (8 × 9.5 × 1 mm) BV48B Package Outline, 51-85178



51-85178 \*C

Package Diagrams (continued)

Figure 12. 48-pin TSOP I (12 × 18.4 × 1 mm) Z48A Package Outline, 51-85183



51-85183 °C

## Acronyms

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
I/O	Input/Output
SRAM	Static Random Access Memory
TSOP	Thin Small Outline Package
VFBGA	Very Fine-Pitch Ball Grid Array

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
°C	degrees Celsius
MHz	megahertz
μA	microampere
mA	milliampere
ns	nanosecond
Ω	ohm
pF	picofarad
V	volt
W	watt



## Document History Page

Document Title: CY62167DV30 MoBL®, 16-Mbit (1 M × 16) Static RAM Document Number: 38-05328				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	118408	GUG	09/30/02	New data sheet.
*A	123692	DPM	02/11/03	Changed status from Advanced to Preliminary. Added package diagram
*B	126555	DPM	04/25/03	Minor change: Changed Sunset Owner from DPM to HRT
*C	127841	XRJ	09/10/03	Added 48 TSOP I package
*D	205701	AJU	See ECN	Changed BYTE pin usage description for 48 TSOP I package
*E	238050	KKV/AJU	See ECN	Replaced 48-ball VFBGA package diagram; Modified Package Name in Ordering Information table from BV48A to BV48B
*F	304054	PCI	See ECN	Added 45-ns Speed Bin in AC, DC and Ordering Information tables Added Footnote #12 on page #4 Added Pb-free packages on page # 10
*G	492895	VKN	See ECN	Modified datasheet to explain x8 configurability. Removed L power bin from the product offering Updated Ordering Information Table
*H	2896036	AJU	03/19/10	Removed 45-ns. Removed inactive parts from Ordering Information. Updated Packaging Information Updated links in Sales, Solutions, and Legal Information.
*I	3067267	RAME	11/08/10	Updated datasheet as per new template Added <a href="#">Ordering Code Definitions</a> . Added <a href="#">Acronyms</a> and <a href="#">Units of Measure</a> . Updated all table notes to footnote. Package diagram updated 51-85178 from ** to *A
*J	3329789	RAME	07/27/11	Removed references to AN1064 SRAM system guidelines. Updated template according to current CY standards.
*K	4108382	AJU	08/29/2013	Updated <a href="#">Pin Configurations</a> : Removed the note "Ball H6 for the FBGA package can be used to upgrade to a 32M density" and its reference in <a href="#">Figure 1</a> .  Updated <a href="#">Package Diagrams</a> : spec 51-85178 – Changed revision from *A to *C.  Updated in new template.
*L	4192919	VINI	11/15/2013	No technical updates.  Completing Sunset Review.

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