



**CY62167DV30**

**MoBL<sup>®</sup>**

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

## Features

- **Very high speed: 55 ns**
- **Wide voltage range: 2.20V – 3.60V**
- **Ultra-low active power**
  - Typical active current: 2 mA @ f = 1 MHz
  - Typical active current: 15 mA @ f = f<sub>max</sub>
- **Ultra-low standby power**
- **Easy memory expansion with  $\overline{CE}_1$ ,  $CE_2$ , and  $\overline{OE}$  features**
- **Automatic power-down when deselected**
- **CMOS for optimum speed/power**
- **Packages offered in a 48-ball BGA and 48-pin TSOPI**

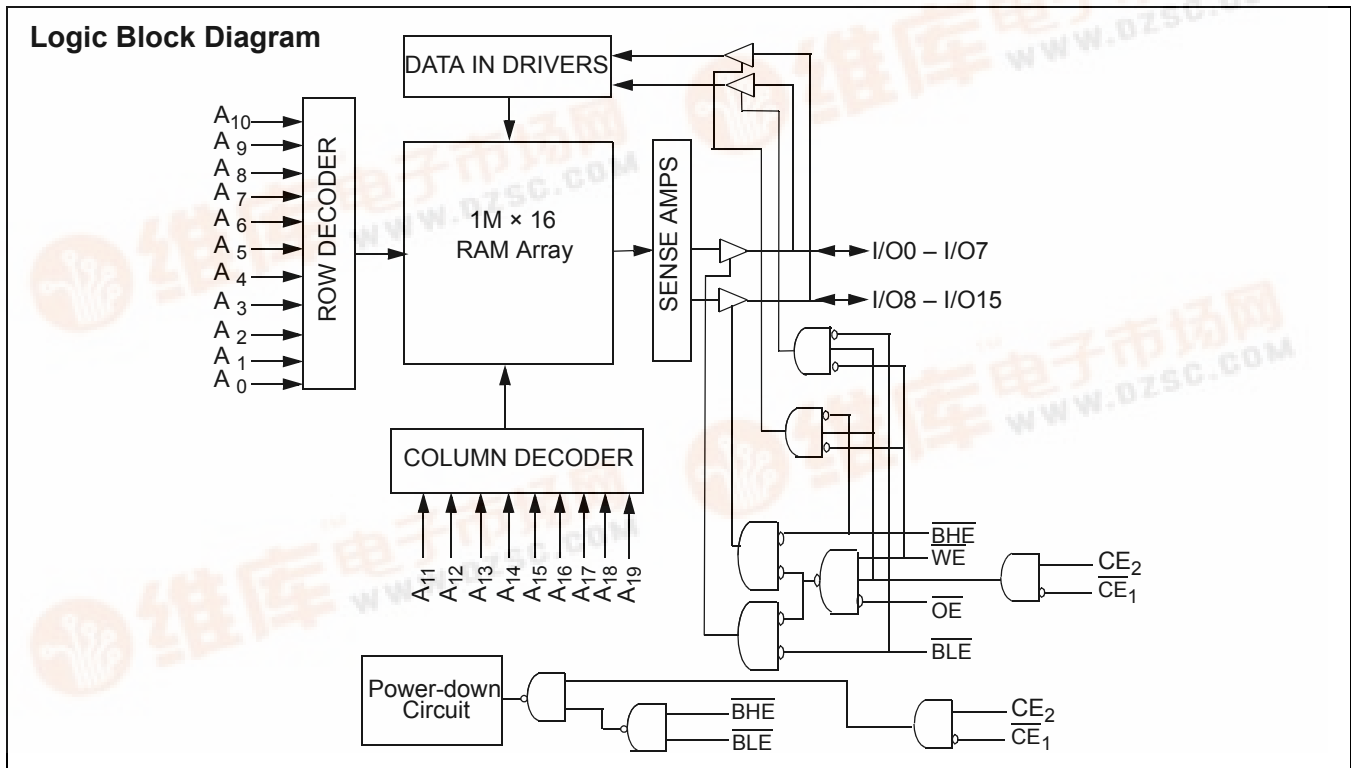
## Functional Description<sup>[1]</sup>

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<sup>®</sup>) in portable applications such as cellular telephones. The device also has an automatic power-down feature that significantly

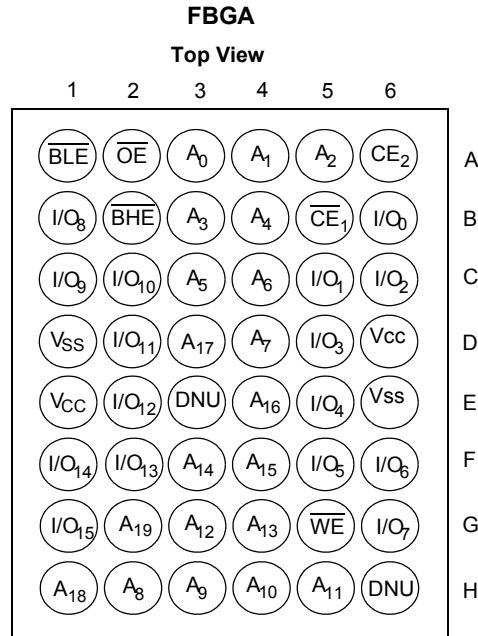
reduces power consumption by 99% when addresses are not toggling. The device can also be put into standby mode when deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW or both BHE and BLE are HIGH). The input/output pins (I/O<sub>0</sub> through I/O<sub>15</sub>) are placed in a high-impedance state 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 (BHE, BLE HIGH), or during a Write operation ( $\overline{CE}_1$  LOW,  $CE_2$  HIGH and WE LOW).

Writing to the device is accomplished by taking 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 I/O pins (I/O<sub>0</sub> through I/O<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 I/O pins (I/O<sub>8</sub> through I/O<sub>15</sub>) is written into the location specified on the address pins (A<sub>0</sub> through A<sub>19</sub>).

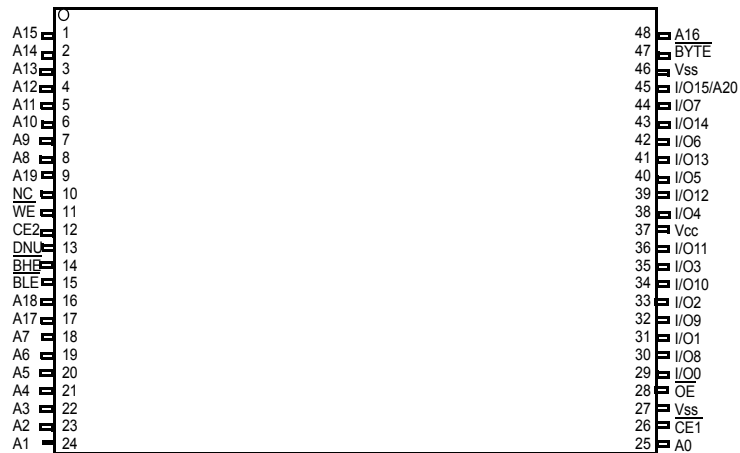
Reading from the device is accomplished by taking Chip Enables ( $\overline{CE}_1$  LOW and  $CE_2$  HIGH) and Output Enable ( $\overline{OE}$ ) LOW while forcing the Write Enable (WE) HIGH. If Byte Low Enable (BLE) is LOW, then data from the memory location specified by the address pins will appear on I/O<sub>0</sub> to I/O<sub>7</sub>. If Byte High Enable (BHE) is LOW, then data from memory will appear on I/O<sub>8</sub> to I/O<sub>15</sub>. See the truth table at the back of this data sheet for a complete description of Read and Write modes.



Note:  
1. For best practice recommendations, please refer to the Cypress application note "System Design Guidelines" on <http://www.cypress.com>.

**Pin Configuration**<sup>[2, 3, 4, 5]</sup>


**48TSOPI (Forward)**  
**Top View**


**Notes:**

2. NC pins are not connected on the die.
3. DNU pins have to be left floating.
4. The BYTE pin in the 48-TSOPI package has to be tied HIGH to use the device as a 1M × 16 SRAM. The 48-TSOPI package can also be used as a 2M × 8 SRAM by tying the BYTE signal LOW. For 2M × 8 Functionality, please refer to the CY62168DV30 datasheet. In the 2M × 8 configuration, Pin 45 is A20.
5. Ball H6 for the FBGA package can be used to upgrade to a 32M density.



**Maximum Ratings**

(Above which the useful life may be impaired. For user guidelines, 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 V<sub>CC</sub> + 0.3V
- DC Voltage Applied to Outputs in High-Z State<sup>[6, 7]</sup> ..... -0.2V to V<sub>CC</sub> + 0.3V
- DC Input Voltage<sup>[6, 7]</sup> ..... -0.2V to V<sub>CC</sub> + 0.3V

- Output Current into Outputs (LOW) ..... 20 mA
- Static Discharge Voltage ..... > 2001V (per MIL-STD-883, Method 3015)
- Latch-up Current ..... > 200 mA

**Operating Range**

Device	Range	Ambient Temperature	V <sub>CC</sub> <sup>[8]</sup>
CY62167DV30L	Industrial	-40°C to +85°C	2.20V to 3.60V
CY62167DV30LL			3.60V

**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)	
	Min.	Typ. <sup>[9]</sup>	Max.		f = 1MHz		f = f <sub>max</sub>			
					Typ. <sup>[9]</sup>	Max.	Typ. <sup>[9]</sup>	Max.	Typ. <sup>[9]</sup>	Max.
CY62167DV30L	2.20	3.0	3.60	55	2	4	15	30	2.5	30
				70			12	25		
CY62167DV30LL				55	2	4	15	30	2.5	22
				70			12	25		

**Electrical Characteristics** Over the Operating Range

Parameter	Description	Test Conditions	CY62167DV30-55			CY62167DV30-70			Unit
			Min.	Typ. <sup>[9]</sup>	Max.	Min.	Typ. <sup>[9]</sup>	Max.	
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -0.1 mA, V <sub>CC</sub> = 2.20V	2.0			2.0			V
		I <sub>OH</sub> = -1.0 mA, V <sub>CC</sub> = 2.70V	2.4			2.4			V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 0.1 mA, V <sub>CC</sub> = 2.20V			0.4			0.4	V
		I <sub>OL</sub> = 2.1mA, V <sub>CC</sub> = 2.70V			0.4			0.4	V
V <sub>IH</sub>	Input HIGH Voltage	V <sub>CC</sub> = 2.2V to 2.7V	1.8		V <sub>CC</sub> + 0.3V	1.8		V <sub>CC</sub> + 0.3V	V
		V <sub>CC</sub> = 2.7V to 3.6V	2.2		V <sub>CC</sub> + 0.3V	2.2		V <sub>CC</sub> + 0.3V	V
V <sub>IL</sub>	Input LOW Voltage	V <sub>CC</sub> = 2.2V to 2.7V	-0.3		0.6	-0.3		0.6	V
		V <sub>CC</sub> = 2.7V to 3.6V	-0.3		0.8	-0.3		0.8	V
I <sub>IX</sub>	Input Leakage Current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-1		+1	-1		+1	µA
I <sub>OZ</sub>	Output Leakage Current	GND ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , Output Disabled	-1		+1	-1		+1	µA
I <sub>CC</sub>	V <sub>CC</sub> Operating Supply Current	f = f <sub>MAX</sub> = 1/t <sub>RC</sub> , V <sub>CC</sub> = V <sub>CCmax</sub> , I <sub>OUT</sub> = 0 mA, CMOS levels		15	30		12	25	mA
		f = 1 MHz		2	4		2	4	mA
I <sub>SB1</sub>	Automatic CE Power-down Current — CMOS Inputs	CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2V or CE <sub>2</sub> ≤ 0.2V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V, V <sub>IN</sub> ≤ 0.2V, f = f <sub>MAX</sub> (Address and Data Only), f = 0 (OE, WE, BHE, BLE), V <sub>CC</sub> = 3.60V	L	2.5	30		2.5	25	µA
			LL	2.5	22		2.5	22	
I <sub>SB2</sub>	Automatic CE Power-down Current — CMOS Inputs	CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2V or CE <sub>2</sub> ≤ 0.2V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ 0.2V, f = 0, V <sub>CC</sub> = 3.60V	L	2.5	30		2.5	30	µA
			LL	2.5	22		2.5	22	

**Notes:**

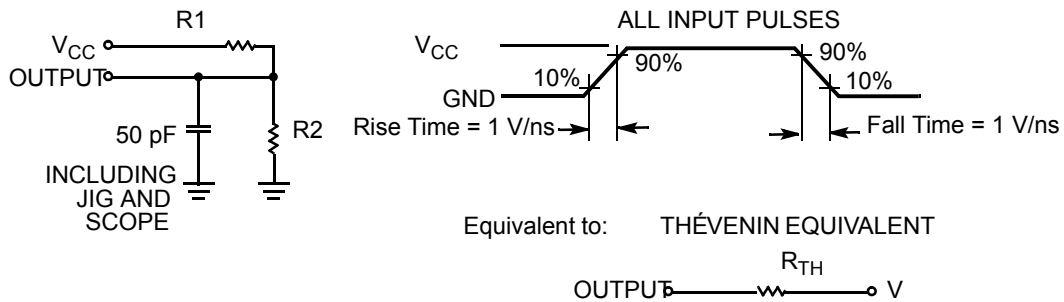
- 6. V<sub>IL(min.)</sub> = -2.0V for pulse durations less than 20 ns.
- 7. V<sub>IH(Max)</sub> = V<sub>CC</sub> + 0.75V for pulse durations less than 20 ns.
- 8. Full Device AC operation requires linear V<sub>CC</sub> ramp from 0 to V<sub>CC(min.)</sub> >= 500 µs.
- 9. Typical values are included for 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.

**Capacitance<sup>[10, 11]</sup>**

Parameter	Description	Test Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	T <sub>A</sub> = 25°C, f = 1 MHz, V <sub>CC</sub> = V <sub>CC(typ)</sub>	8	pF
C <sub>OUT</sub>	Output Capacitance		10	pF

**Thermal Resistance**

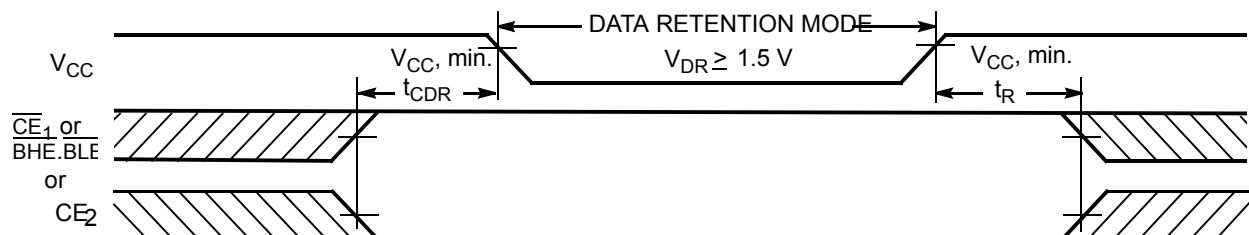
Parameter	Description	Test Conditions	BGA	TSOP I	Unit
Θ <sub>JA</sub>	Thermal Resistance (Junction to Ambient) <sup>[10]</sup>	Still Air, soldered on a 3 × 4.5 inch, two-layer printed circuit board	55	60	°C/W
Θ <sub>JC</sub>	Thermal Resistance (Junction to Case) <sup>[10]</sup>		16	4.3	°C/W

**AC Test Loads and Waveforms**


Parameters	2.50V	3.0V	Unit
R1	16667	1103	Ω
R2	15385	1554	Ω
R <sub>TH</sub>	8000	645	Ω
V <sub>TH</sub>	1.20	1.75	V

**Data Retention Characteristics (Over the Operating Range)**

Parameter	Description	Conditions	Min.	Typ. <sup>[9]</sup>	Max.	Unit
V <sub>DR</sub>	V <sub>CC</sub> for Data Retention		1.5			V
I <sub>CCDR</sub>	Data Retention Current	V <sub>CC</sub> = 1.5V CE <sub>1</sub> ≥ V <sub>CC</sub> - 0.2V, CE <sub>2</sub> ≤ 0.2V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ 0.2V	L		15	μA
			LL		10	
t <sub>CDR</sub> <sup>[10]</sup>	Chip Deselect to Data Retention Time		0			ns
t <sub>R</sub> <sup>[12]</sup>	Operation Recovery Time		t <sub>RC</sub>			ns

**Data Retention Waveform<sup>[13]</sup>**

**Notes:**

10. Tested initially and after any design or process changes that may affect these parameters.
11. This applies for all packages.
12. Full device operation requires linear V<sub>CC</sub> ramp from V<sub>DR</sub> to V<sub>CC(min.)</sub> ≥ 100 μs or stable at V<sub>CC(min.)</sub> ≥ 100 μs.
13. BHE.BLE is the AND of both BHE and BLE. Chip can be deselected by either disabling the chip enable signals or by disabling both BHE and BLE.

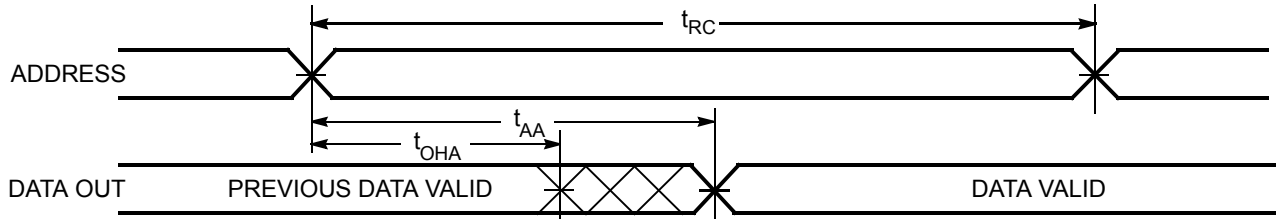
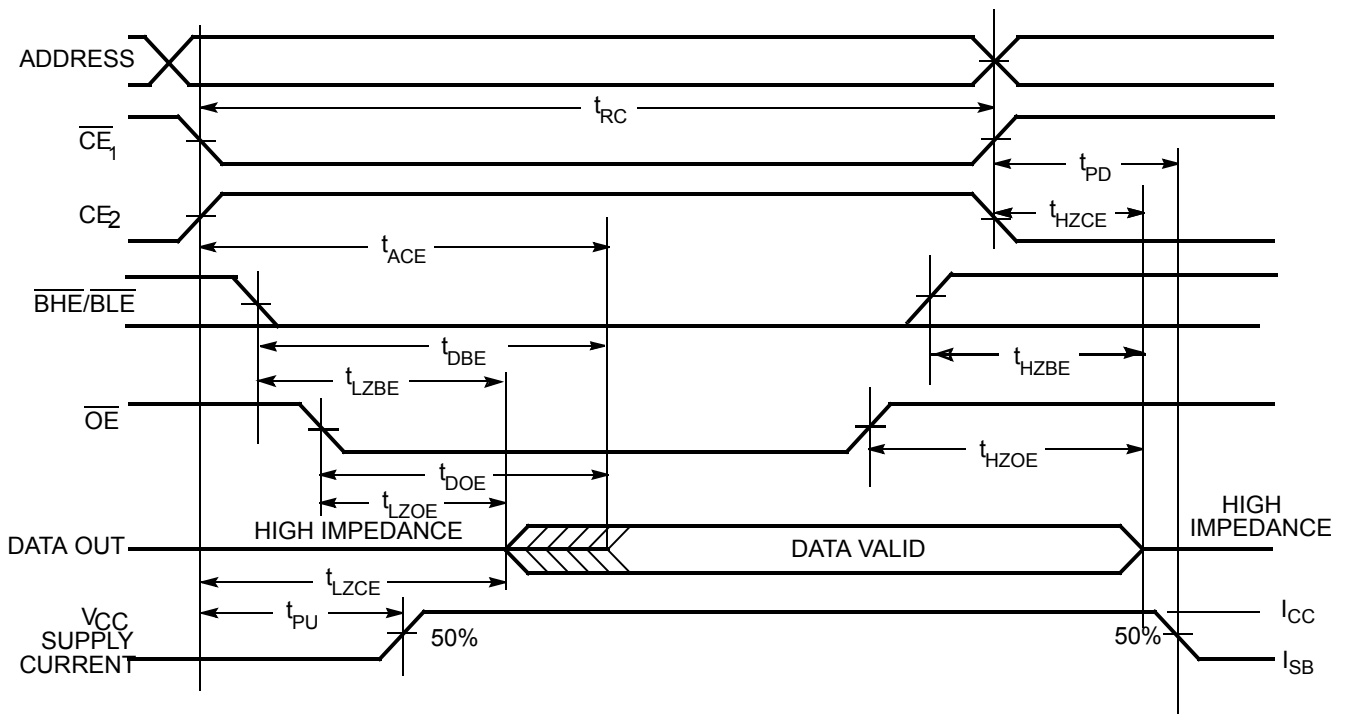


Switching Characteristics Over the Operating Range<sup>[14]</sup>

Parameter	Description	55 ns		70 ns		Unit
		Min.	Max.	Min.	Max.	
<b>Read Cycle</b>						
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>[15]</sup>	5		5		ns
t <sub>HZOE</sub>	$\overline{OE}$ HIGH to High Z <sup>[15, 16]</sup>		20		25	ns
t <sub>LZCE</sub>	$\overline{CE}_1$ LOW and CE <sub>2</sub> HIGH to Low Z <sup>[15]</sup>	10		10		ns
t <sub>HZCE</sub>	$\overline{CE}_1$ HIGH and CE <sub>2</sub> LOW to High Z <sup>[15, 16]</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>	$\overline{BLE}/\overline{BHE}$ LOW to Low Z <sup>[15]</sup>	10		10		ns
t <sub>HZBE</sub>	$\overline{BLE}/\overline{BHE}$ HIGH to HIGH Z <sup>[15, 16]</sup>		20		25	ns
<b>Write Cycle</b> <sup>[17]</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 Set-Up to Write End	40		60		ns
t <sub>HA</sub>	Address Hold from Write End	0		0		ns
t <sub>SA</sub>	Address Set-Up to Write Start	0		0		ns
t <sub>PWE</sub>	$\overline{WE}$ Pulse Width	40		45		ns
t <sub>BW</sub>	$\overline{BLE} / \overline{BHE}$ LOW to Write End	40		60		ns
t <sub>SD</sub>	Data Set-Up 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>[15, 16]</sup>		20		25	ns
t <sub>LZWE</sub>	$\overline{WE}$ HIGH to Low-Z <sup>[15]</sup>	10		10		ns

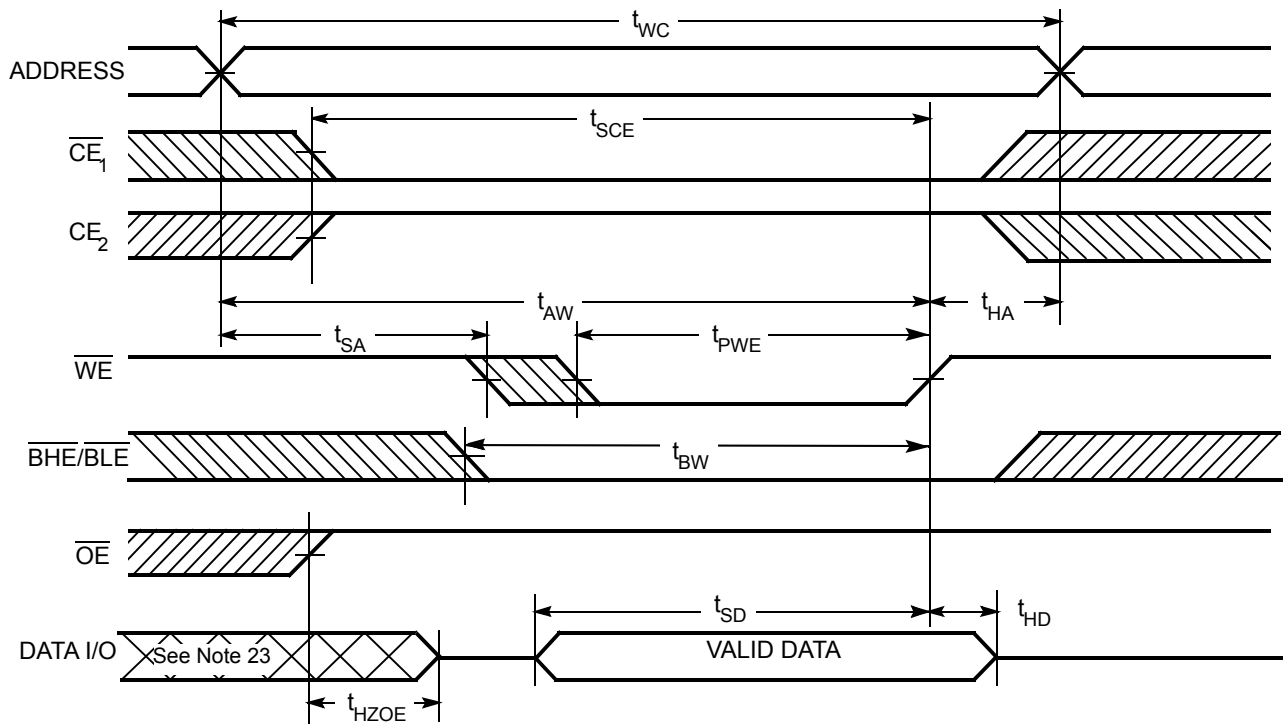
Notes:

- 14. Test conditions for all parameters other than three-state parameters assume signal transition time of 1 ns/V, timing reference levels of V<sub>CC(typ)</sub>/2, input pulse levels of 0 to V<sub>CC(typ)</sub>, and output loading of the specified I<sub>OL</sub>/I<sub>OH</sub> as shown in the "AC Test Loads and Waveforms" section.
- 15. At any given 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 given device.
- 16. 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.
- 17. The internal Write time of the memory is defined by the overlap of  $\overline{WE}$ ,  $\overline{CE}_1 = V_{IL}$ , BHE and/or  $\overline{BLE} = V_{IL}$ , and CE<sub>2</sub> = V<sub>IH</sub>. All signals must be ACTIVE to initiate a write and any of these signals can terminate a write by going INACTIVE. The data input set-up and hold timing should be referenced to the edge of the signal that terminates the Write.

**Switching Waveforms**
**Read Cycle 1 (Address Transition Controlled)<sup>[18, 19]</sup>**

**Read Cycle 2 (OE Controlled)<sup>[19, 20]</sup>**

**Notes:**

18. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}_1 = V_{IL}$ ,  $\overline{BHE}$  and/or  $\overline{BLE} = V_{IL}$ , and  $\overline{CE}_2 = V_{IH}$ .

19.  $\overline{WE}$  is HIGH for read cycle.

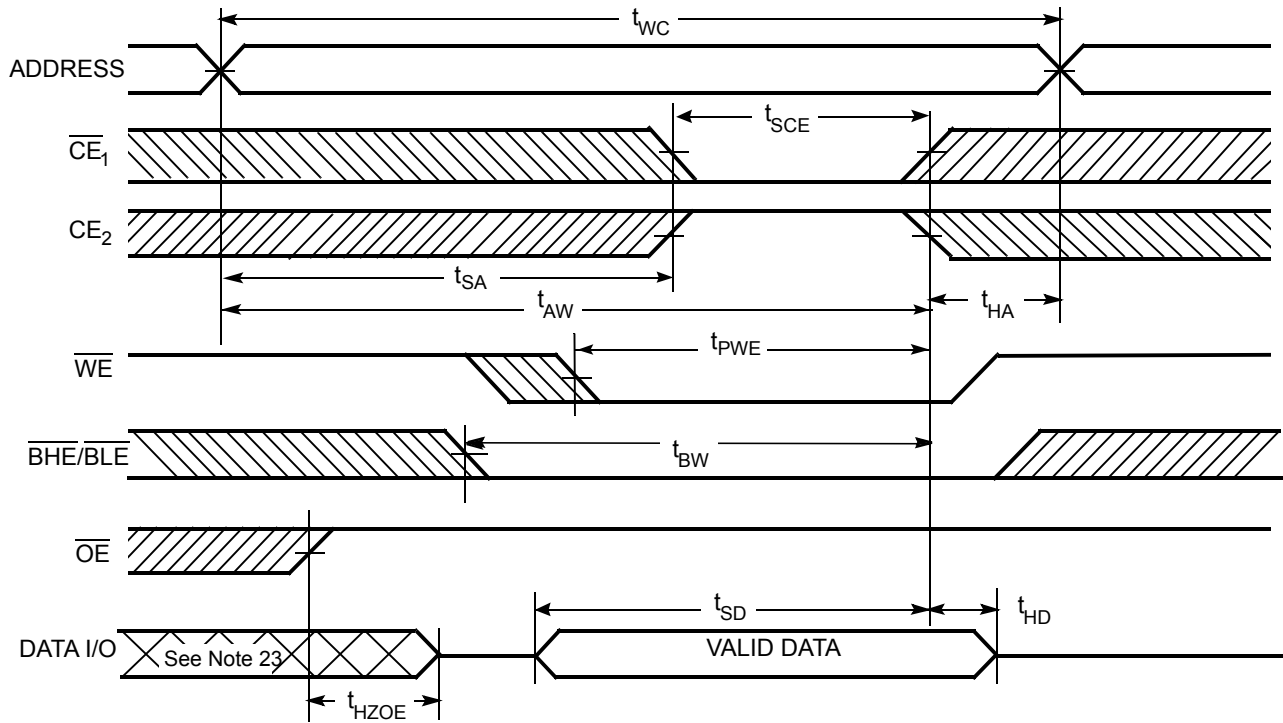
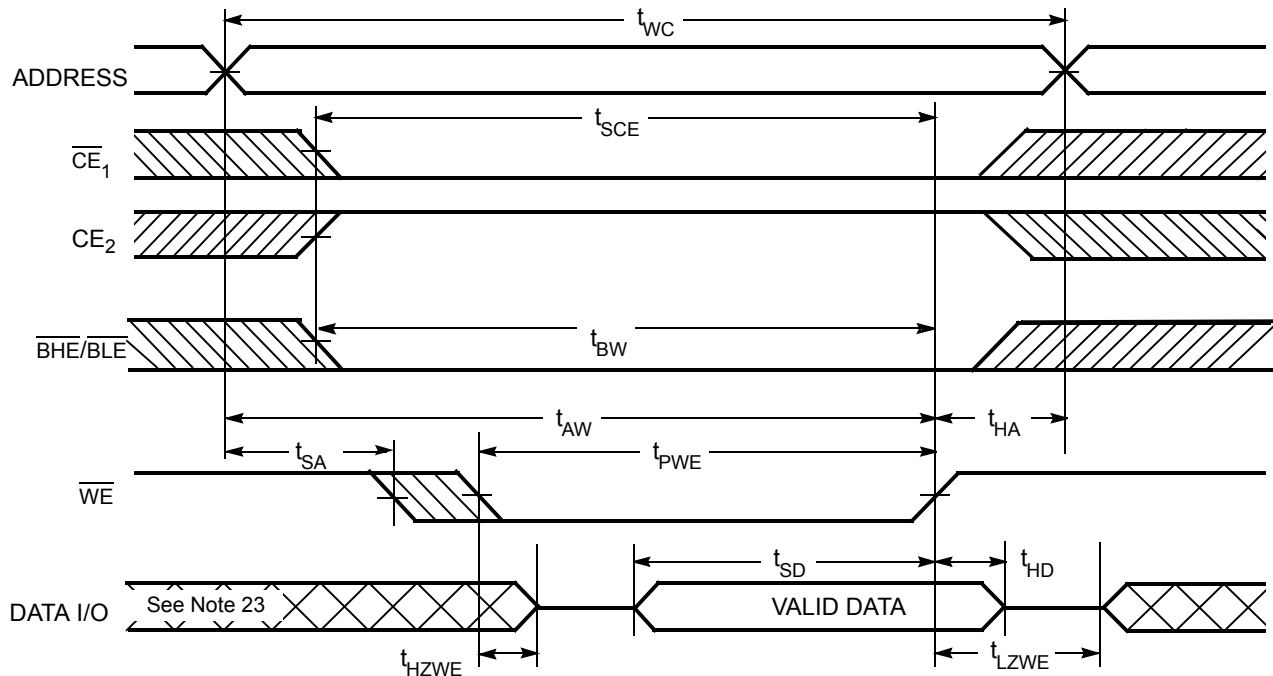
**Switching Waveforms (continued)**
**Write Cycle 1 ( $\overline{\text{WE}}$  Controlled)<sup>[17, 21, 22, 23]</sup>**

**Notes:**

20. Address valid prior to or coincident with  $\overline{\text{CE}}_1$ ,  $\overline{\text{BHE}}$ ,  $\overline{\text{BLE}}$  transition LOW and  $\text{CE}_2$  transition HIGH.

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

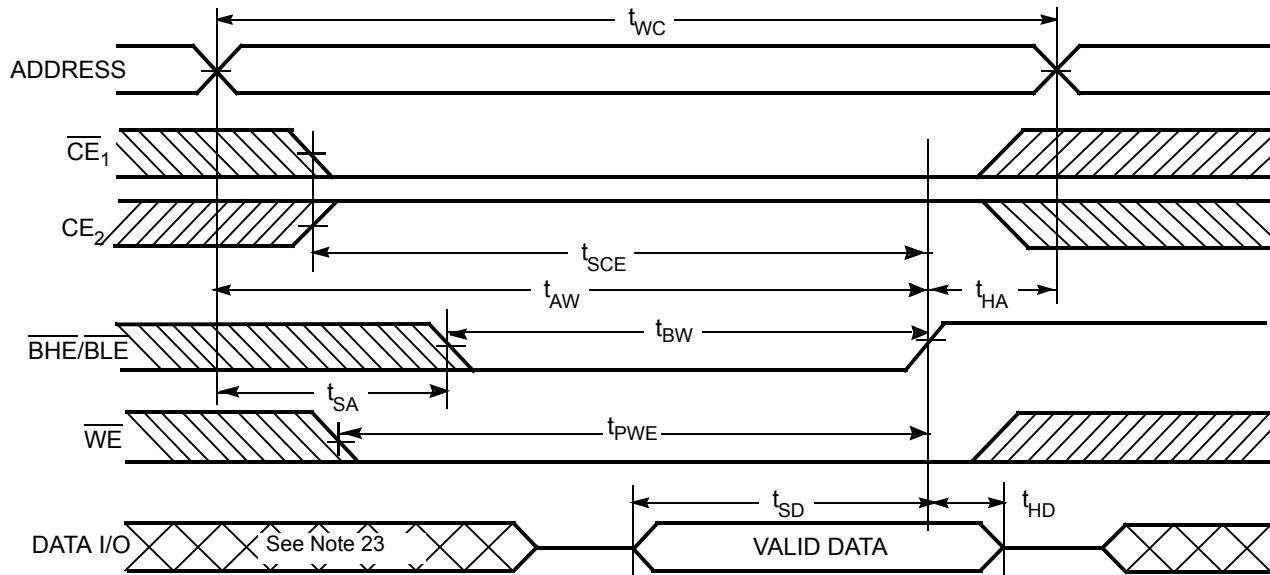
22. If  $\overline{\text{CE}}_1$  goes HIGH and  $\text{CE}_2$  goes LOW simultaneously with  $\overline{\text{WE}} = V_{\text{IH}}$ , the output remains in a high-impedance state.

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

**Switching Waveforms (continued)**
**Write Cycle 2 ( $\overline{CE}_1$  or  $\overline{CE}_2$  Controlled)<sup>[17, 21, 22, 23]</sup>**

**Write Cycle 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)<sup>[22, 23]</sup>**




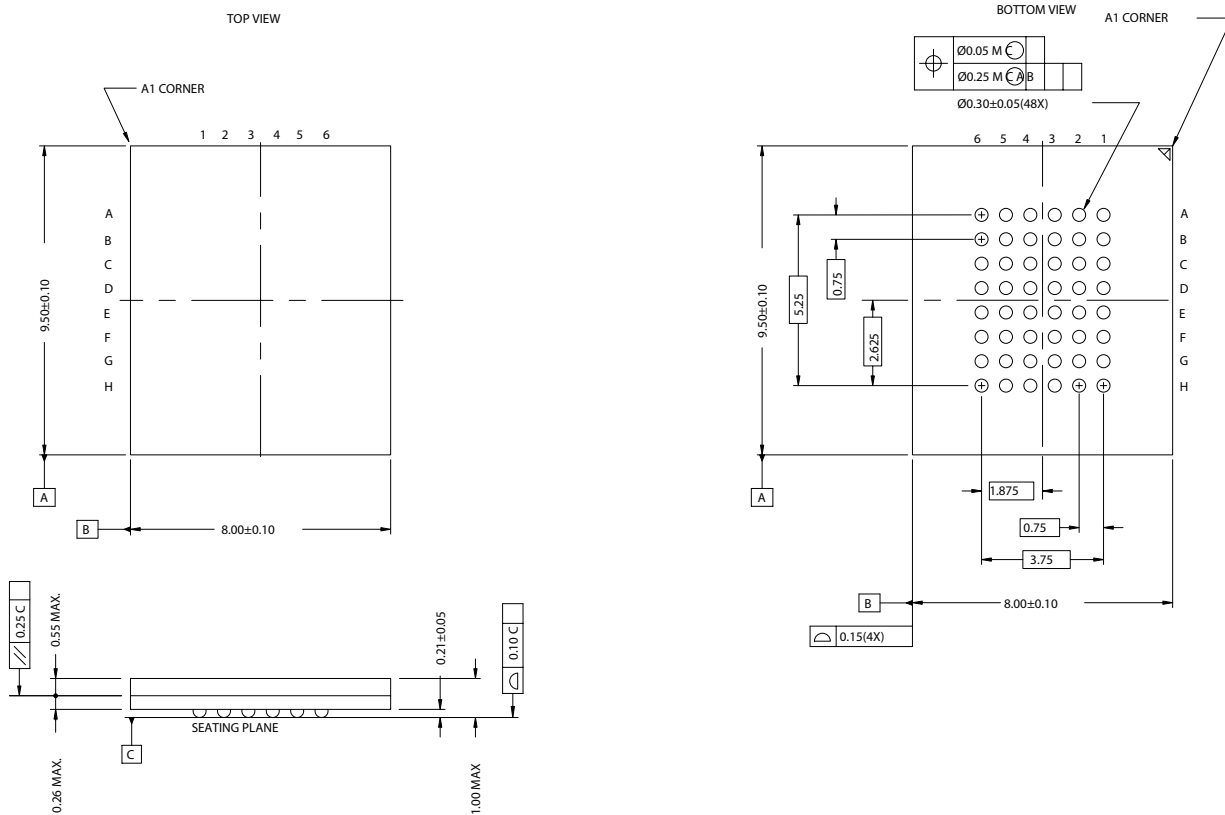
**Switching Waveforms** (continued)

**Write Cycle 4 (BHE/BLE Controlled, OE LOW)<sup>[22, 23]</sup>**

**Truth Table**

$\overline{CE}_1$	$\overline{CE}_2$	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	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	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 ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
55	CY62167DV30L-55BVI	BV48B	48-ball Fine Pitch BGA (8 mm × 9.5mm × 1 mm)	Industrial
	CY62167DV30LL-55BVI			
55	CY62167DV30L-55ZI	Z48A	48 Pin TSOP I	Industrial
	CY62167DV30LL-55ZI			
70	CY62167DV30L-70BVI	BV48B	48-ball Fine Pitch BGA (8 mm × 9.5mm × 1 mm)	Industrial
	CY62167DV30LL-70BVI			
70	CY62167DV30L-70ZI	Z48A	48-pin TSOP I	Industrial
	CY62167DV30LL-70ZI			

**Package Diagrams**
**48-Lead VFBGA (8 x 9.5 x 1 mm) BV48B**


51-85178-\*\*

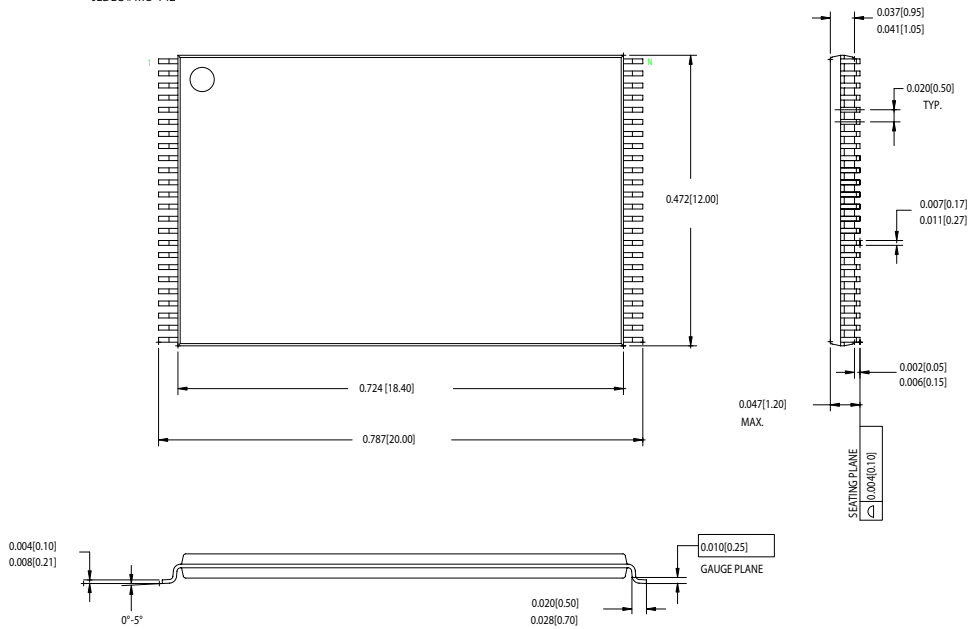
Package Diagrams

48-Lead TSOP I (12 mm x 18.4 mm x 1.0 mm) Z48A

DIMENSIONS IN INCHES(MM) MIN.

MAX.

JEDEC # MO-142



51-85183-A

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**Document History Page**

<b>Document Title:CY62167DV30 MoBL<sup>®</sup> 16-Mbit (1M x 16) Static RAM</b>				
<b>Document Number: 38-05328</b>				
<b>REV.</b>	<b>ECN NO.</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
**	118408	09/30/02	GUG	New Data Sheet
*A	123692	02/11/03	DPM	Changed Advanced to Preliminary Added package diagram
*B	126555	04/25/03	DPM	Minor change: Changed Sunset Owner from DPM to HRT
*C	127841	09/10/03	XRJ	Added 48 TSOP I package
*D	205701		AJU	Changed BYTE pin usage description for 48 TSOP I package
*E	238050	See ECN	KKV/AJU	Replaced 48-lead VFBGA package diagram; Modified Package Name in Ordering Information table from BV48A to BV48B