



# 2M (128K x 16) Static RAM

## Features

- Very high speed: 55 ns and 70 ns
- Voltage range:
  - CY62136CV30: 2.7V–3.3V
  - CY62136CV33: 3.0V–3.6V
  - CY62136CV: 2.7V–3.6V
- Pin-compatible with the CY62136V
- Ultra-low active power
  - Typical active current: 1.5 mA @ f = 1 MHz
  - Typical active current: 5.5 mA @ f = f<sub>max</sub> (70-ns speed)
- Low standby power
- Easy memory expansion with  $\overline{CE}$  and  $\overline{OE}$  features
- Automatic power-down when deselected
- CMOS for optimum speed/power
- Packages offered in a 48-ball FBGA

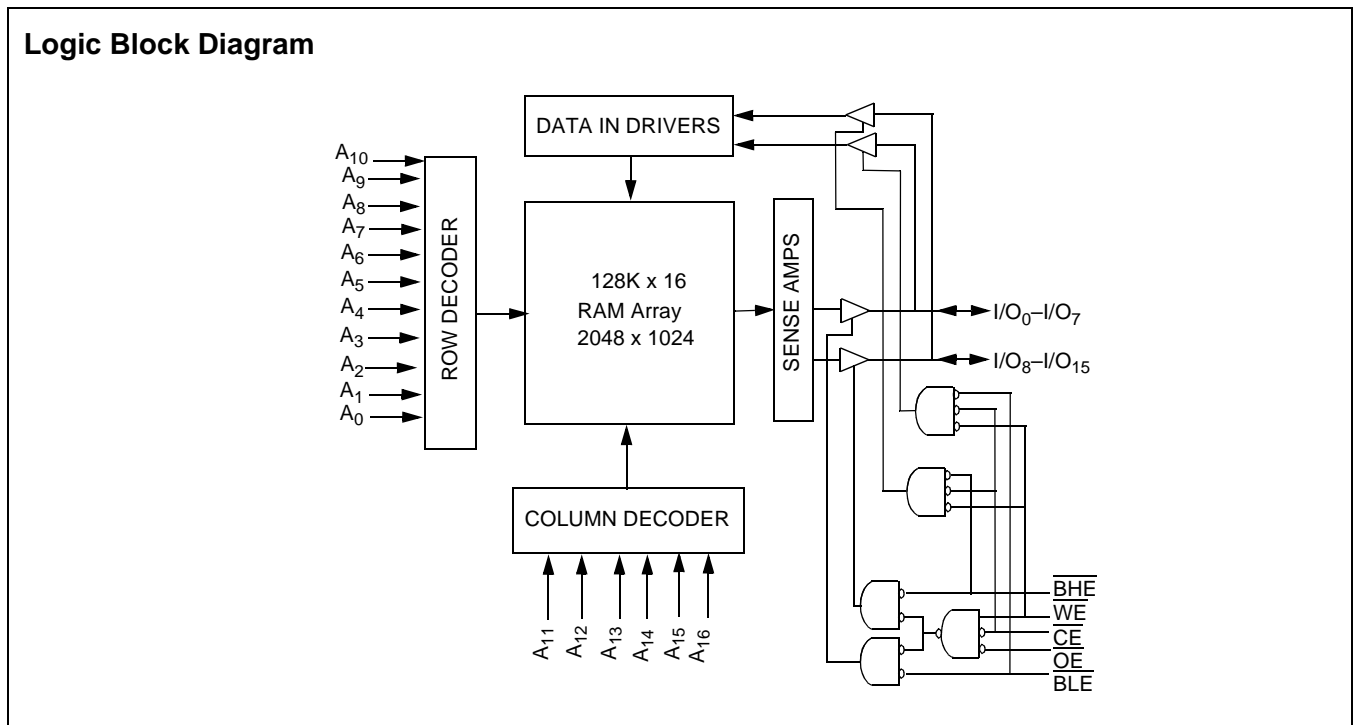
## Functional Description<sup>[1]</sup>

The  $\overline{CE}$  and CY62136CV are high-performance CMOS static RAM organized as 128K 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 80% when addresses are not toggling. The device can also be put into standby mode reducing power consumption by more than 99% when deselected ( $\overline{CE}$  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 ( $\overline{CE}$  HIGH), outputs are disabled ( $\overline{OE}$  HIGH), both Byte High Enable and Byte Low Enable are disabled ( $\overline{BHE}$ , BLE HIGH), or during a write operation ( $\overline{CE}$  LOW, and  $\overline{WE}$  LOW).

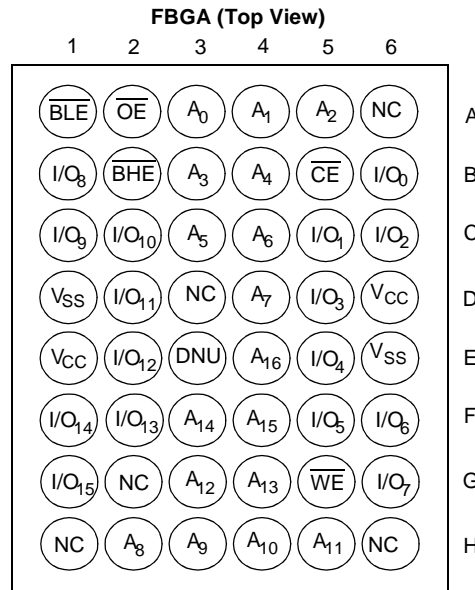
Writing to the device is accomplished by taking Chip Enable ( $\overline{CE}$ ) and Write Enable ( $\overline{WE}$ ) inputs LOW. If Byte Low Enable (BLE) is LOW, then data from I/O pins (I/O<sub>0</sub> through I/O<sub>7</sub>), is written into the location specified on the address pins (A<sub>0</sub> through A<sub>16</sub>). If Byte High Enable ( $\overline{BHE}$ ) 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>16</sub>).

Reading from the device is accomplished by taking Chip Enable ( $\overline{CE}$ ) and Output Enable ( $\overline{OE}$ ) LOW while forcing the Write Enable ( $\overline{WE}$ ) 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 ( $\overline{BHE}$ ) 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]</sup>**

**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 -0.5V to V<sub>CCMAX</sub> + 0.5V

DC Voltage Applied to Outputs in High-Z State<sup>[4]</sup> ..... -0.5V to V<sub>CC</sub> + 0.3V

DC Input Voltage<sup>[4]</sup> ..... -0.5V 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>
CY62136CV30	Industrial	-40°C to +85°C	2.7V to 3.3V
CY62136CV33			3.0V to 3.6V
CY62136CV			2.7V to 3.6V

**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)	
	V <sub>CC(min.)</sub>	V <sub>CC(typ.)</sub> <sup>[5]</sup>	V <sub>CC(max.)</sub>		f = 1 MHz		f = f <sub>max</sub>		Typ. <sup>[5]</sup>	Max.
					Typ. <sup>[5]</sup>	Max.	Typ. <sup>[5]</sup>	Max.		
CY62136CV30LL	2.7	3.0	3.3	55	1.5	3	7	15	2	10
				70	1.5	3	5.5	12		
CY62136CV33LL	3.0	3.3	3.6	55	1.5	3	7	15	5	15
				70	1.5	3	5.5	12		
CY62136CVLL	2.7	3.3	3.6	70	1.5	3	5.5	12	5	15

**Notes:**

2. NC pins are not connected to the die.
3. E3 (DNU) can be left as NC or V<sub>SS</sub> to ensure proper application.
4. V<sub>IL(min.)</sub> = -2.0V for pulse durations less than 20 ns.
5. 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.



**Electrical Characteristics** Over the Operating Range

Parameter	Description	Test Conditions		CY62136CV30-55			CY62136CV30-70			Unit
				Min.	Typ. <sup>[5]</sup>	Max.	Min.	Typ. <sup>[5]</sup>	Max.	
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -1.0 mA	V <sub>CC</sub> = 2.7V		2.4			2.4		V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 2.1 mA	V <sub>CC</sub> = 2.7V				0.4		0.4	V
V <sub>IH</sub>	Input HIGH Voltage			2.2		V <sub>CC</sub> + 0.3V	2.2		V <sub>CC</sub> + 0.3V	V
V <sub>IL</sub>	Input LOW Voltage			-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> = 3.3V I <sub>OUT</sub> = 0 mA CMOS Levels		7	15		5.5	12	mA
		f = 1 MHz			1.5	3		1.5	3	
I <sub>SB1</sub>	Automatic CE Power-down Current — CMOS Inputs	CE ≥ V <sub>CC</sub> - 0.2V V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ 0.2V, f = f <sub>max</sub> (Address and Data Only), f = 0 (OE, WE, BHE, and BLE)			2	10		2	10	μA
I <sub>SB2</sub>	Automatic CE Power-down Current — CMOS Inputs	CE ≥ V <sub>CC</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> = 3.3V								

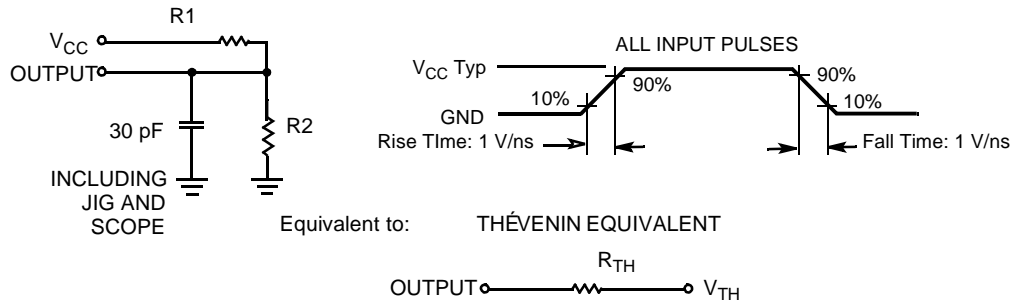
Parameter	Description	Test Conditions		CY62136CV33-55			CY62136CV33-70 CY62136CV-70			Unit
				Min.	Typ. <sup>[5]</sup>	Max.	Min.	Typ. <sup>[5]</sup>	Max.	
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -1.0 mA	V <sub>CC</sub> = 3.0V	2.4			2.4			V
			V <sub>CC</sub> = 2.7V				2.4			V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 2.1 mA	V <sub>CC</sub> = 3.0V			0.4			0.4	V
			V <sub>CC</sub> = 2.7V						0.4	V
V <sub>IH</sub>	Input HIGH Voltage			2.2		V <sub>CC</sub> + 0.3V	2.2		V <sub>CC</sub> + 0.3V	V
V <sub>IL</sub>	Input LOW Voltage			-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> = 3.6V I <sub>OUT</sub> = 0 mA CMOS Levels		7	15		5.5	12	mA
		f = 1 MHz			1.5	3		1.5	3	
I <sub>SB1</sub>	Automatic CE Power-down Current — CMOS Inputs	CE ≥ V <sub>CC</sub> - 0.2V V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V or V <sub>IN</sub> ≤ 0.2V, f = f <sub>max</sub> (Address and Data Only), f = 0 (OE, WE, BHE, and BLE)			5	15		5	15	μA
I <sub>SB2</sub>	Automatic CE Power-down Current — CMOS Inputs	CE ≥ V <sub>CC</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> = 3.6V								

**Capacitance<sup>[6]</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</sub> (typ.)	6	pF
C <sub>OUT</sub>	Output Capacitance		8	pF

**Thermal Resistance**

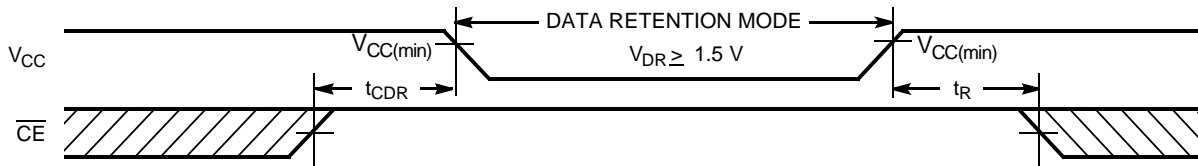
Parameter	Description	Test Conditions	BGA	Unit
$\Theta_{JA}$	Thermal Resistance (Junction to Ambient) <sup>[6]</sup>	Still Air, soldered on a 3 x 4.5 inch, two-layer printed circuit board	55	°C/W
$\Theta_{JC}$	Thermal Resistance (Junction to Case) <sup>[6]</sup>		16	°C/W

**AC Test Loads and Waveforms**


Parameters	3.0V	3.3V	Unit
R1	1105	1216	$\Omega$
R2	1550	1374	$\Omega$
R <sub>TH</sub>	645	645	$\Omega$
V <sub>TH</sub>	1.75	1.75	V

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

Parameter	Description	Conditions	Min.	Typ. <sup>[5]</sup>	Max.	Unit
V <sub>DR</sub>	V <sub>CC</sub> for Data Retention		1.5		V <sub>CCmax</sub>	V
I <sub>CCDR</sub>	Data Retention Current	V <sub>CC</sub> = 1.5V $\overline{CE} \geq V_{CC} - 0.2V$ , V <sub>IN</sub> $\geq V_{CC} - 0.2V$ or V <sub>IN</sub> $\leq 0.2V$		1	6	$\mu A$
t <sub>CDR</sub> <sup>[6]</sup>	Chip Deselect to Data Retention Time		0			ns
t <sub>R</sub> <sup>[7]</sup>	Operation Recovery Time		t <sub>RC</sub>			ns

**Data Retention Waveform**

**Notes:**

6. Tested initially and after any design or process changes that may affect these parameters.
7. Full Device AC operation requires linear V<sub>CC</sub> ramp from V<sub>DR</sub> to V<sub>CC(min.)</sub> > 100  $\mu s$  or stable at V<sub>CC(min.)</sub> > 100  $\mu s$ .

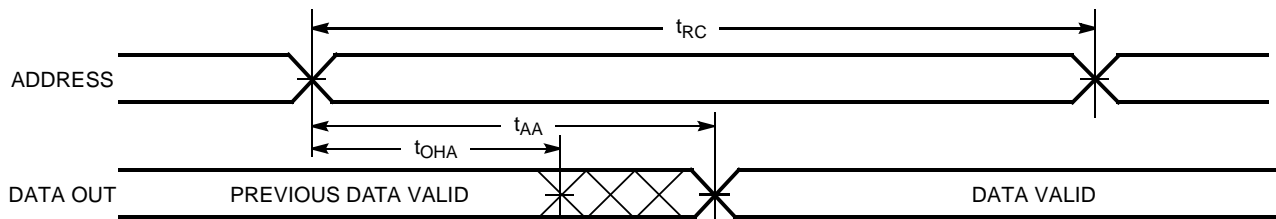


**Switching Characteristics** Over the Operating Range<sup>[8]</sup>

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>	CE LOW to Data Valid		55		70	ns
t <sub>DOE</sub>	OE LOW to Data Valid		25		35	ns
t <sub>LZOE</sub>	OE LOW to Low-Z <sup>[9]</sup>	5		5		ns
t <sub>HZOE</sub>	OE HIGH to High-Z <sup>[9, 10]</sup>		20		25	ns
t <sub>LZCE</sub>	CE LOW to Low-Z <sup>[9]</sup>	10		10		ns
t <sub>HZCE</sub>	CE HIGH to High-Z <sup>[9, 10]</sup>		20		25	ns
t <sub>PU</sub>	CE LOW to Power-up	0		0		ns
t <sub>PD</sub>	CE HIGH to Power-down		55		70	ns
t <sub>DBE</sub>	BHE/BL <sub>E</sub> LOW to Data Valid		25		35	ns
t <sub>LZBE</sub>	BHE/BL <sub>E</sub> LOW to Low-Z <sup>[9]</sup>	5		5		ns
t <sub>HZBE</sub>	BHE/BL <sub>E</sub> HIGH to High-Z <sup>[9, 10]</sup>		20		25	ns
<b>Write Cycle<sup>[11]</sup></b>						
t <sub>WC</sub>	Write Cycle Time	55		70		ns
t <sub>SCE</sub>	CE LOW to Write End	45		60		ns
t <sub>AW</sub>	Address Set-up to Write End	45		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>	WE Pulse Width	40		45		ns
t <sub>BW</sub>	BHE/BL <sub>E</sub> Pulse Width	50		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>	WE LOW to High-Z <sup>[9, 10]</sup>		20		25	ns
t <sub>LZWE</sub>	WE HIGH to Low-Z <sup>[9]</sup>	10		10		ns

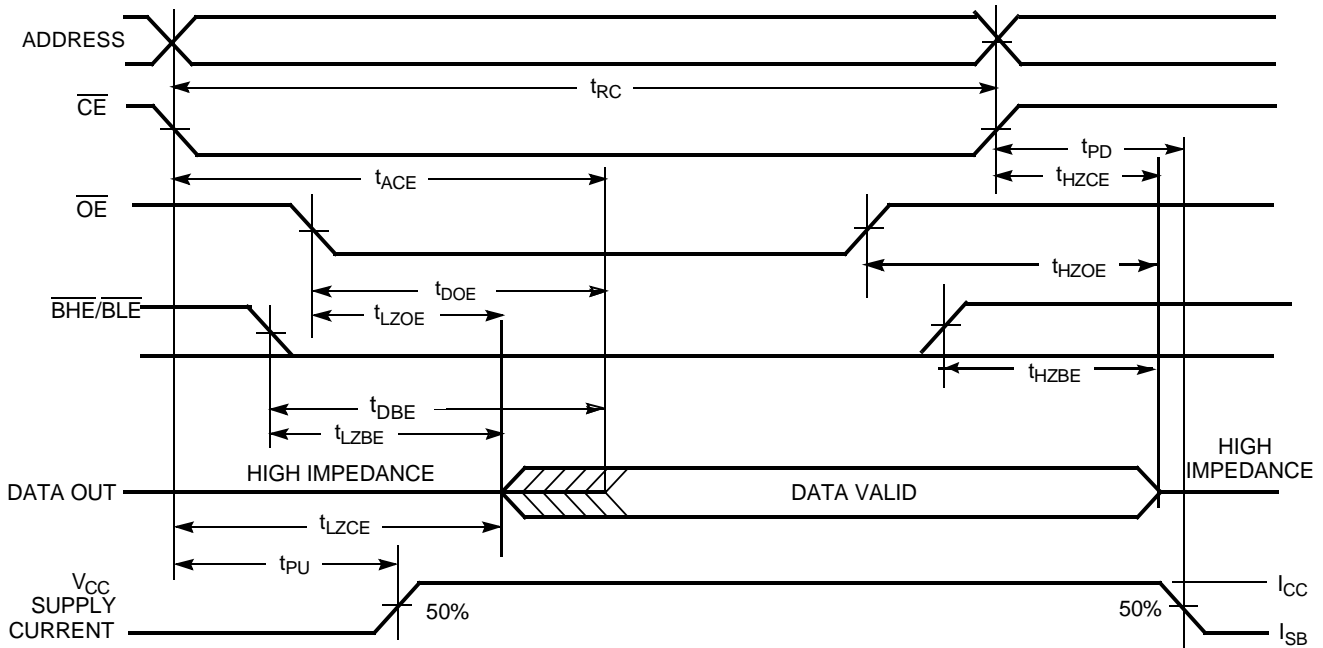
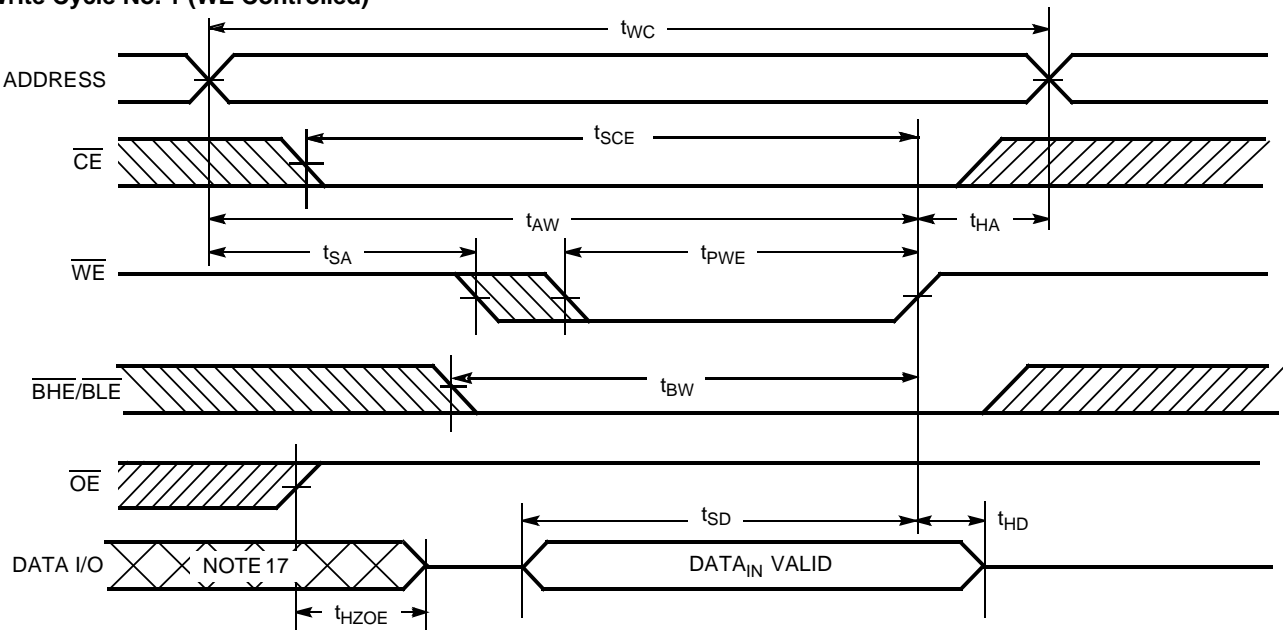
**Switching Waveforms**

**Read Cycle No. 1 (Address Transition Controlled)<sup>[12, 13]</sup>**

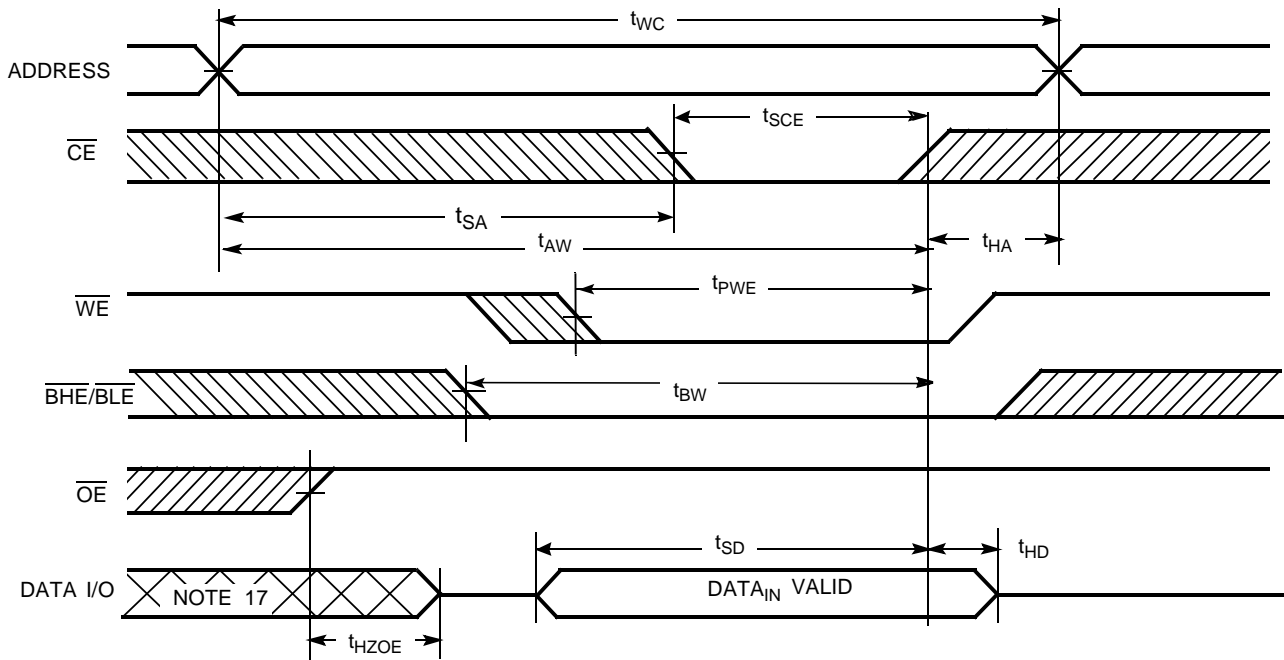
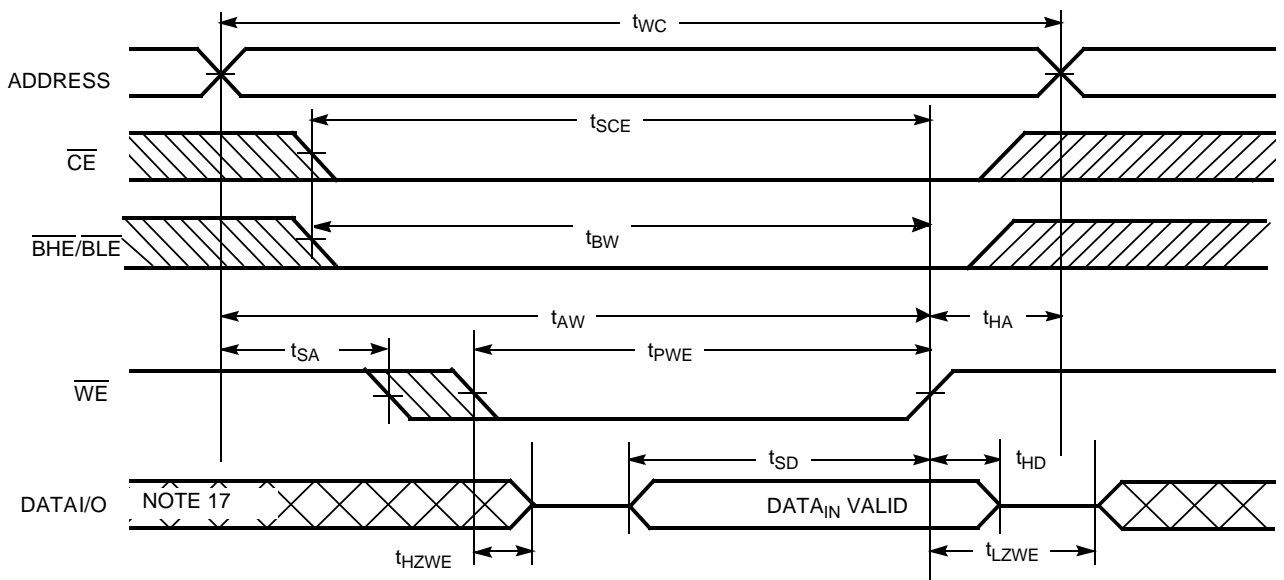


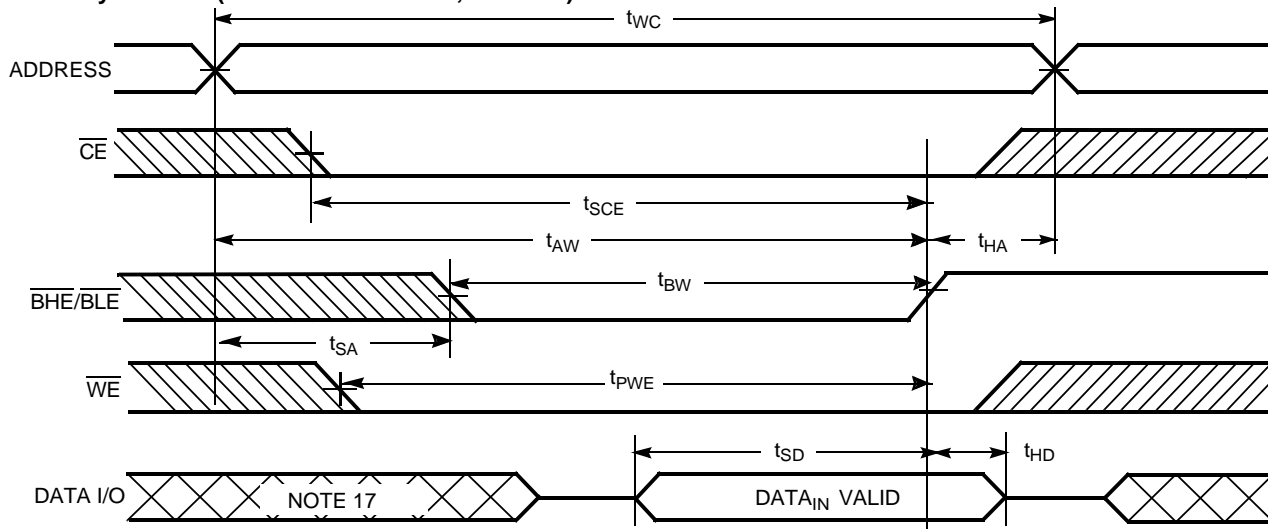
**Notes:**

- Test conditions assume signal transition time of 5 ns or less, 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> and 30-pF load capacitance.
- 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.
- 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.
- The internal write time of the memory is defined by the overlap of WE, CE = V<sub>IL</sub>, BHE and/or BLE = V<sub>IL</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.
- Device is continuously selected. OE, CE = V<sub>IL</sub>, BHE, BLE = V<sub>IL</sub>.
- WE is HIGH for read cycle.

**Switching Waveforms (continued)**
**Read Cycle No. 2 ( $\overline{OE}$  Controlled)** [13, 14]

**Write Cycle No. 1 ( $\overline{WE}$  Controlled)** [11, 15, 16]

**Notes:**

14. Address valid prior to or coincident with  $\overline{CE}$ ,  $\overline{BHE}$ ,  $\overline{BLE}$  transition LOW.
15. Data I/O is high-impedance if  $\overline{OE} = V_{IH}$ .
16. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE}$  HIGH, the output remains in a high-impedance state.
17. During this period, the I/Os are in output state and input signals should not be applied.

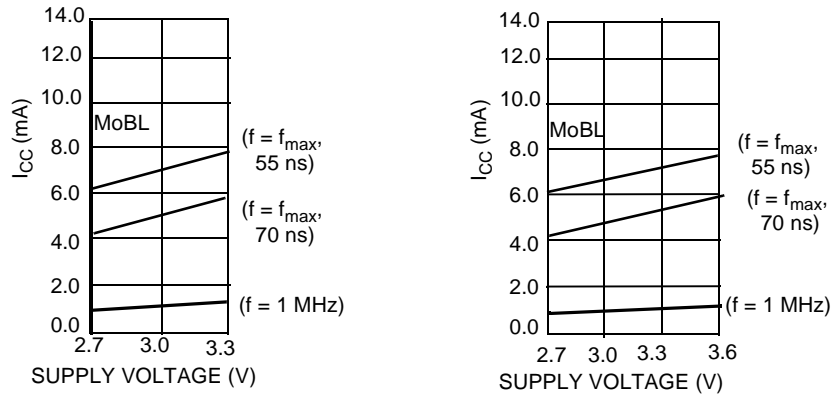
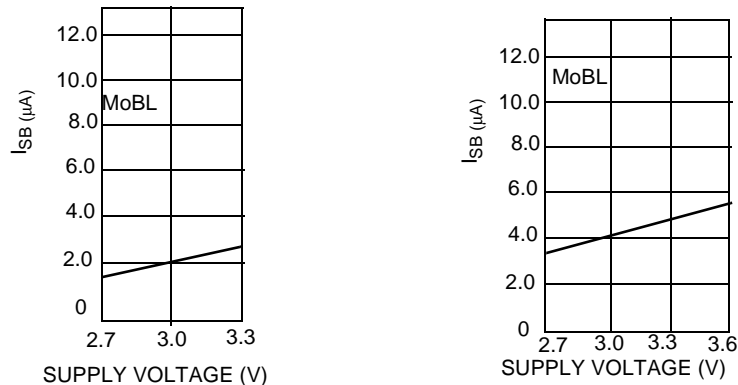
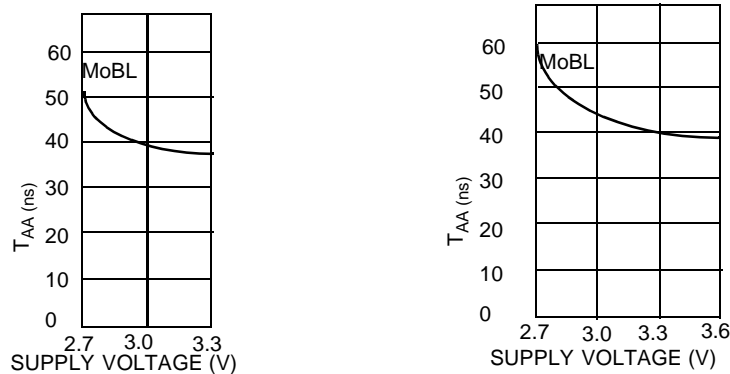
**Switching Waveforms (continued)**
**Write Cycle No. 2 ( $\overline{CE}$  Controlled)** <sup>[11, 15, 16]</sup>

**Write Cycle No. 3 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)** <sup>[16]</sup>


**Switching Waveforms (continued)**
**Write Cycle No. 4 ( $\overline{\text{BHE}}/\overline{\text{BLE}}$  Controlled,  $\overline{\text{OE}}$  LOW)<sup>[16]</sup>**




**Typical DC and AC Parameters**

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

**Operating Current vs. Supply Voltage**

**Standby Current vs. Supply Voltage**

**Access Time vs. Supply Voltage**

**Truth Table**

$\overline{\text{CE}}$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	$\overline{\text{BHE}}$	$\overline{\text{BLE}}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	High-Z	Deselect/Power-down	Standby ( $I_{SB}$ )
L	X	X	H	H	High-Z	Output Disabled	Active ( $I_{CC}$ )
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 ( $I_{CC}$ )



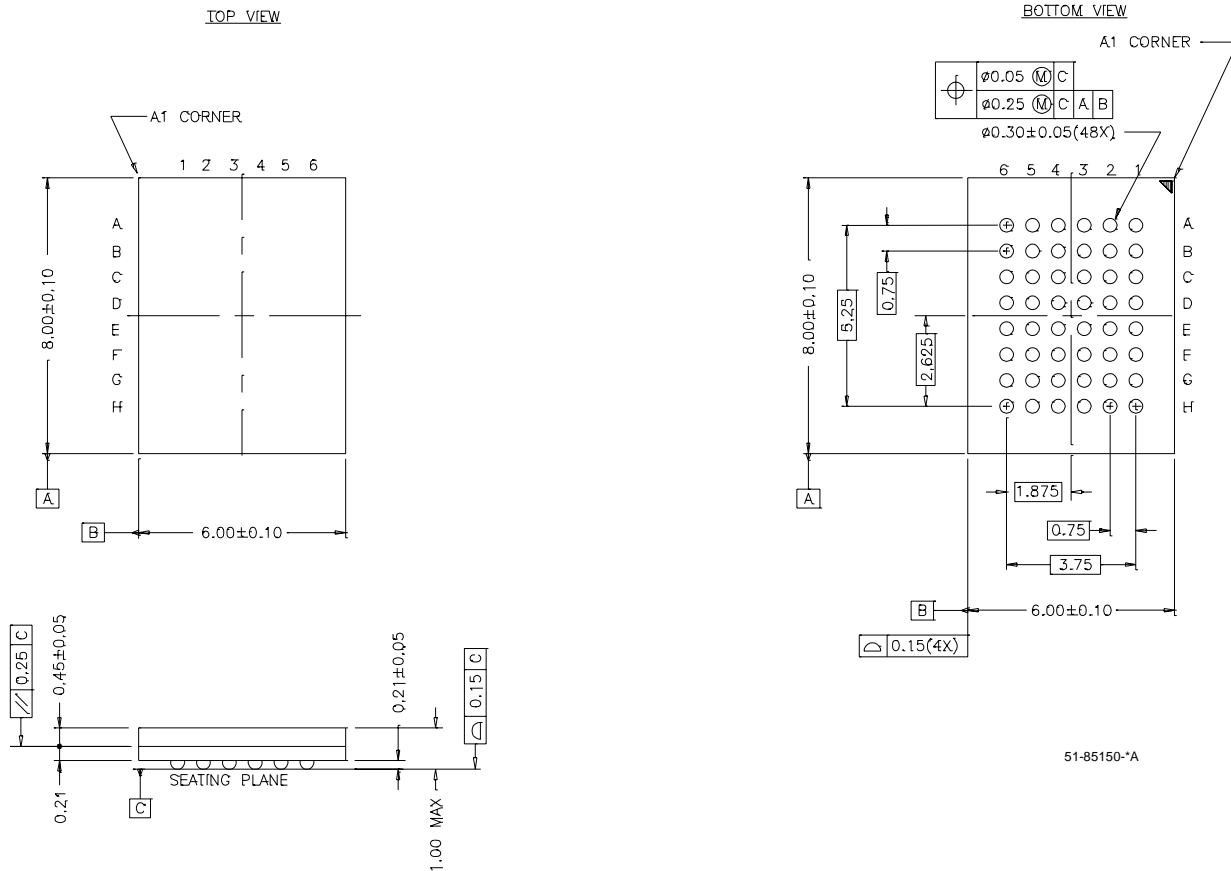
**Truth Table** (continued)

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
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 <sub>0</sub> –I/O <sub>15</sub> )	Write	Active ( $I_{CC}$ )
L	L	X	H	L	Data In (I/O <sub>0</sub> –I/O <sub>7</sub> ); I/O <sub>8</sub> –I/O <sub>15</sub> in High-Z	Write	Active ( $I_{CC}$ )
L	L	X	L	H	Data In (I/O <sub>8</sub> –I/O <sub>15</sub> ); I/O <sub>0</sub> –I/O <sub>7</sub> in High-Z	Write	Active ( $I_{CC}$ )

**Ordering Information**

Speed (ns)	Ordering Code	Voltage Range (V)	Package Name	Package Type	Operating Range
70	CY62136CV30LL-70BAI	2.7–3.3	BA48A	48-ball Fine Pitch BGA (7 mm x 7 mm x 1.2 mm)	Industrial
	CY62136CV30LL-70BVI	2.7–3.3	BV48A	48-ball Fine Pitch BGA (6 mm x 8 mm x 1 mm)	
	CY62136CV33LL-70BAI	3.0–3.6	BA48A	48-ball Fine Pitch BGA (7 mm x 7 mm x 1.2 mm)	
	CY62136CV33LL-70BVI	3.0–3.6	BV48A	48-ball Fine Pitch BGA (6 mm x 8 mm x 1 mm)	
	CY62136CVLL-70BAI	2.7–3.6	BA48A	48-ball Fine Pitch BGA (7 mm x 7 mm x 1.2 mm)	
	CY62136CVLL-70BVI	2.7–3.6	BV48A	48-ball Fine Pitch BGA (6 mm x 8 mm x 1 mm)	
55	CY62136CV30LL-55BAI	2.7–3.3	BA48A	48-ball Fine Pitch BGA (7 mm x 7 mm x 1.2 mm)	Industrial
	CY62136CV30LL-55BVI	2.7–3.3	BV48A	48-ball Fine Pitch BGA (6 mm x 8 mm x 1 mm)	
	CY62136CV33LL-55BAI	3.0–3.6	BA48A	48-ball Fine Pitch BGA (7 mm x 7 mm x 1.2 mm)	
	CY62136CV33LL-55BVI	3.0–3.6	BV48A	48-ball Fine Pitch BGA (6 mm x 8 mm x 1 mm)	



**Package Diagrams (continued)**
**48-ball VFBGA (6 x 8 x 1 mm) BV48A**


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Document History Page

Document Title: CY62136CV30/33/CY62136CV/CY62136CV30/33 2M (128K x 16) Static RAM				
Document Number: 38-05199				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	112379	02/19/02	GAV	New Data Sheet (advance information)
*A	114023	04/25/02	JUI	Added BV package diagram Changed Advance Information to Preliminary
*B	117063	07/12/02	MGN	Changed Preliminary to Final
*C	118121	08/26/02	MGN	Added new part numbers: CY62136CV with wider voltage (2.7V – 3.6V); CY62136CV33 narrower voltage range (3.0V – 3.6V) For T <sub>AA</sub> = 55 ns, improved t <sub>PWE</sub> Min from 45 ns to 40 ns For T <sub>AA</sub> = 70 ns, improved t <sub>PWE</sub> Min from 50 ns to 45 ns For T <sub>AA</sub> = 70 ns, improved t <sub>LZWE</sub> Min from 5 ns to 10 ns
*D	118622	10/3/02	MGN	Improved Typ. I <sub>CC</sub> spec. to 7 mA (for 55 ns) and 5.5 mA (for 70 ns) Improved Max I <sub>CC</sub> spec. to 15 mA (for 55 ns) and 12 mA (for 70 ns) For T <sub>AA</sub> = 55 ns, improved t <sub>LZWE</sub> min. from 5 ns to 10 ns Changed upper spec. for Supply Voltage to Ground Potential to V <sub>CCMAX</sub> + 0.5V Changed upper spec. for DC Voltage Applied to Outputs in High-Z State and DC Input Voltage to V <sub>CC</sub> + 0.3V