CY62157CV30/33

512K x 16 Static RAM

Features

- **Temperature Ranges**
  - **— Automotive-A: –40°C to 85°C**
  - **— Automotive-E: –40°C to 125°C**
- **Voltage range:**
  - **— CY62157CV30: 2.7V–3.3V**
  - **— CY62157CV33: 3.0V–3.6V**
- **Ultra-low active power**
  - **— Typical active current: 1.5 mA @ f = 1 MHz**
  - **— Typical active current: 5.5 mA @ f = f_{max}**
- **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**
- **Available in Pb-free and non Pb-free 48-ball FBGA package**

Functional Description[1]

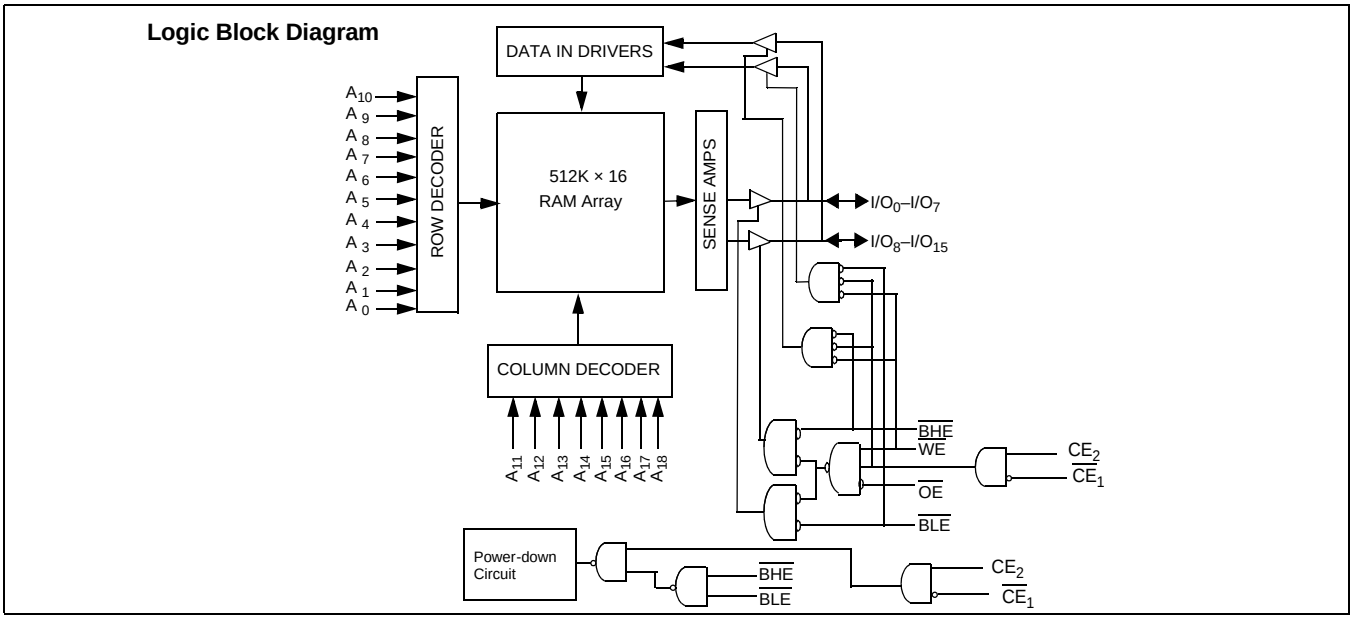
The CY62157CV30/33 are high-performance CMOS static RAMs organized as 512K words by 16 bits. These devices feature advanced circuit design to provide ultra-low active current. This is ideal for providing More Battery Life™ (MoBL™) in portable applications such as cellular telephones. The devices also have 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 ($\overline{CE}_1$ HIGH or CE_2 LOW or both $\overline{BLE}$ and $\overline{BHE}$ 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 ($\overline{CE}_1$ LOW and CE_2 HIGH and $\overline{WE}$ LOW).

Writing to the device is accomplished by taking Chip Enable 1 ($\overline{CE}_1$) and Write Enable ($\overline{WE}$) inputs LOW and Chip Enable 2 (CE_2) HIGH. 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_{18}). 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_{18}).

Reading from the device is accomplished by taking Chip Enable 1 ($\overline{CE}_1$) and Output Enable ($\overline{OE}$) LOW and Chip Enable 2 (CE_2) HIGH 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 will appear on I/O_0 to I/O_7. If Byte High Enable ($\overline{BHE}$) is LOW, then data from memory will 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.

The CY62157CV30/33 are available in a 48-ball FBGA package.

Logic Block Diagram



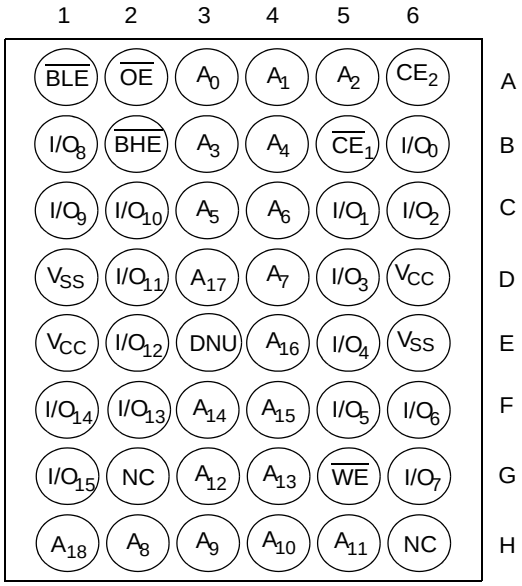
Note:
1. For best practice recommendations, please refer to the Cypress application note “System Design Guidelines” on http://www.cypress.com.

Product Portfolio

Product	Range	V_{CC} Range			Power Dissipation					
					Operating (I_{CC}) mA				Standby (I_{SB2}) µA	
					f = 1 MHz		f = f_{max}			
		Min.	Typ.[2]	Max.	Typ.[2]	Max.	Typ.[2]	Max.	Typ.[2]	Max.
CY62157CV30	Automotive-E	2.7V	3.0V	3.3V	1.5	3	7	15	8	70
CY62157CV33	Automotive-A	3.0V	3.3V	3.6V	1.5	3	5.5	12	10	30
	Automotive-E				1.5	3	7	15	10	80

Pin Configurations[2, 3, 4]

FBGA (Top View)



Pin Definitions

Name	Definition
Input	**A_0-A_{18}**. Address Inputs
Input/Output	**I/O_0-I/O_{15}**. Data lines. Used as input or output lines depending on operation
Input/Control	**$\overline{WE}$**. Write Enable, Active LOW. When selected LOW, a WRITE is conducted. When selected HIGH, a READ is conducted.
Input/Control	**$\overline{CE_1}$**. Chip Enable 1, Active LOW.
Input/Control	**CE_2**. Chip Enable 2, Active HIGH.
Input/Control	**$\overline{OE}$**. Output Enable, Active LOW. Controls the direction of the I/O pins. When LOW, the I/O pins behave as outputs. When deasserted HIGH, I/O pins are three-stated, and act as input data pins
Ground	**Vss**. Ground for the device
Power Supply	**Vcc**. Power supply for the device

Notes:
2. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at $V_{CC} = V_{CC(typ.)}$, $T_A = 25°C$.
3. NC pins are not connected on the die.
4. E3 (DNU) can be left as NC or V_{SS} to ensure proper application.

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_{ccmax} + 0.5V

DC Voltage Applied to Outputs in High-Z State[5] .....–0.5V to V_{CC} + 0.3V

DC Input Voltage[5].....–0.5V to V_{CC} + 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 [T_A][6]	V_{CC}
CY62157CV30	Automotive-E	–40°C to +125°C	2.7V – 3.3V
CY62157CV33	Automotive-A	–40°C to +85°C	3.0V – 3.6V
	Automotive-E	–40°C to +125°C	

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions		CY62157CV30-70 Min.	Typ.[2]	Max.	Unit
V_{OH}	Output HIGH Voltage	I_{OH} = –1.0 mA	V_{CC} = 2.7V	2.4			V
V_{OL}	Output LOW Voltage	I_{OL} = 2.1 mA	V_{CC} = 2.7V			0.4	V
V_{IH}	Input HIGH Voltage			2.2		V_{CC} + 0.3V	V
V_{IL}	Input LOW Voltage			–0.3		0.8	V
I_{IX}	Input Leakage Current	GND ≤ V_I ≤ V_{CC}		–10		+10	µA
I_{OZ}	Output Leakage Current	GND ≤ V_O ≤ V_{CC}, Output Disabled		–10		+10	µA
I_{CC}	V_{CC} Operating Supply Current	f = f_{MAX} = 1/t_{RC}	V_{CC} = 3.3V, I_{OUT} = 0 mA, CMOS Levels		7	15	mA
		f = 1 MHz			1.5	3	
I_{SB1}	Automatic CE Power-Down Current— CMOS Inputs	$\overline{CE}_1$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2V, V_{IN} ≥ V_{CC} – 0.2V or V_{IN} ≤ 0.2V, f = f_{max} (Address and Data Only), f = 0 (OE, WE, BHE and BLE)			8	70	µA
I_{SB2}	Automatic CE Power-Down Current—CMOS Inputs	$\overline{CE}_1$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2V, V_{IN} ≥ V_{CC} – 0.2V or V_{IN} ≤ 0.2V, f = 0, V_{CC} = 3.3V			8	70	µA

Notes:
5. $V_{IL(min.)}$ = –2.0V for pulse durations less than 20 ns.
6. T_A is the "Instant-On" case temperature.

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions			CY62157CV33-70 Min.	CY62157CV33-70 Typ.[2]	CY62157CV33-70 Max.	Unit
V_{OH}	Output HIGH Voltage	I_{OH} = –1.0 mA V_{CC} = 3.0V			2.4			V
V_{OL}	Output LOW Voltage	I_{OL} = 2.1 mA V_{CC} = 3.0V					0.4	V
V_{IH}	Input HIGH Voltage				2.2		V_{CC} + 0.3V	V
V_{IL}	Input LOW Voltage				–0.3		0.8	V
I_{IX}	Input Leakage Current	GND ≤ V_I ≤ V_{CC}		Auto-A	–1		+1	µA
				Auto-E	–10		+10	µA
I_{OZ}	Output Leakage Current	GND ≤ V_O ≤ V_{CC}, Output Disabled		Auto-A	–1		+1	µA
				Auto-E	–10		+10	µA
I_{CC}	V_{CC} Operating Supply Current	f = f_{MAX} = 1/t_{RC}	V_{CC} = 3.6V I_{OUT} = 0 mA CMOS Levels	Auto-A		5.5	12	mA
				Auto-E		7	15	
		f = 1 MHz		Auto-A/ Auto-E		1.5	3	
I_{SB1}	Automatic CE Power-Down Current—CMOS Inputs	$\overline{CE}_1$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2V V_{IN} ≥ V_{CC} – 0.2V or V_{IN} ≤ 0.2V, f = f_{max} (Address and Data Only), f = 0 ($\overline{OE}$,$\overline{WE}$,$\overline{BHE}$,and $\overline{BLE}$)		Auto-A		10	30	µA
				Auto-E		10	80	µA
I_{SB2}	Automatic CE Power-Down Current—CMOS Inputs	$\overline{CE}_1$ ≥ V_{CC} – 0.2V or CE_2 ≤ 0.2V V_{IN} ≥ V_{CC} – 0.2V or V_{IN} ≤ 0.2V, f = 0, V_{CC} = 3.6V		Auto-A		10	30	µA
				Auto-E		10	80	µA

Thermal Resistance[7]

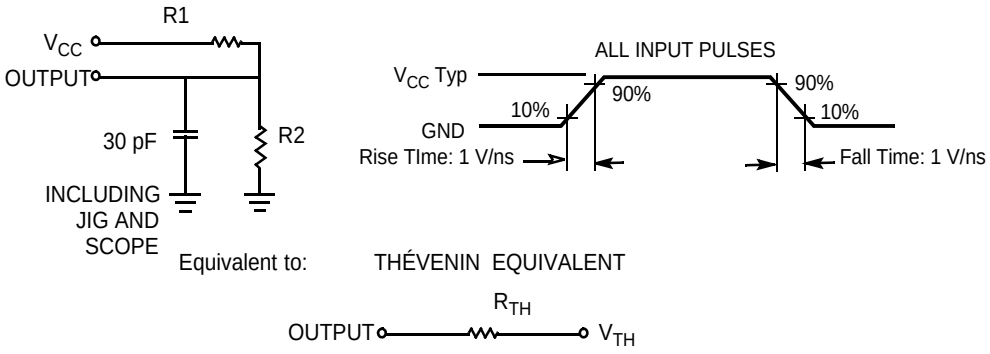
Parameter	Description	Test Conditions	FBGA	Unit
Θ_{JA}	Thermal Resistance (Junction to Ambient)	Still Air, soldered on a 3 x 4.5 inch, two-layer printed circuit board	55	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		16	°C/W

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

Capacitance[7]

Parameter	Description	Test Conditions	Max.	Unit
C_{IN}	Input Capacitance	T_A = 25°C, f = 1 MHz, V_{CC} = $V_{CC(typ.)}$	6	pF
C_{OUT}	Output Capacitance		8	pF

AC Test Loads and Waveforms

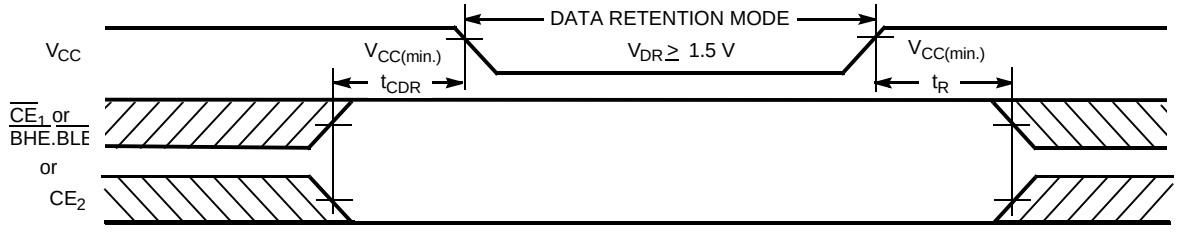


Parameters	3.0V	3.3V	Unit
R1	1.105	1.216	KΩ
R2	1.550	1.374	KΩ
R_{TH}	0.645	0.645	KΩ
V_{TH}	1.75	1.75	V

Data Retention Characteristics (Over the Operating Range)

Parameter	Description	Conditions		Min.	Typ.[2]	Max.	Unit
V_{DR}	V_{CC} for Data Retention			1.5			V
I_{CCDR}	Data Retention Current	V_{CC} = 1.5V, $\overline{CE_1} \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	Auto-A		4	20	µA
			Auto-E		4	60	µA
t_{CDR}[8]	Chip Deselect to Data Retention Time			0			ns
t_R[8]	Operation Recovery Time			t_{RC}			ns

Data Retention Waveform[9]



Notes:
8. Full Device AC operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min.)}$ > 100 µs or stable at $V_{CC(min.)}$ >100 µs.
9. 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.

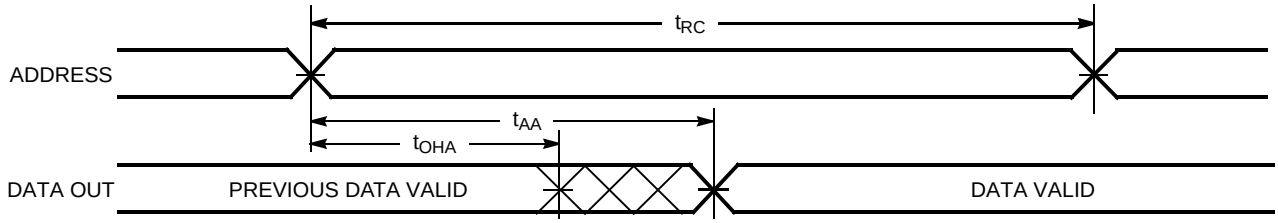
Switching Characteristics Over the Operating Range [10]

Parameter	Description	70 ns		Unit
		Min.	Max.	
Read Cycle				
t_{RC}	Read Cycle Time	70		ns
t_{AA}	Address to Data Valid		70	ns
t_{OHA}	Data Hold from Address Change	10		ns
t_{ACE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Data Valid		70	ns
t_{DOE}	$\overline{OE}$ LOW to Data Valid		35	ns
t_{LZOE}	$\overline{OE}$ LOW to Low-Z[11]	5		ns
t_{HZOE}	$\overline{OE}$ HIGH to High-Z[11, 12]		25	ns
t_{LZCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Low-Z[11]	10		ns
t_{HZCE}	$\overline{CE}_1$ HIGH or CE_2 LOW to High-Z[11, 12]		25	ns
t_{PU}	$\overline{CE}_1$ LOW and CE_2 HIGH to Power-up	0		ns
t_{PD}	$\overline{CE}_1$ HIGH or CE_2 LOW to Power-down		70	ns
t_{DBE}	$\overline{BHE}$/$\overline{BLE}$ LOW to Data Valid		70	ns
t_{LZBE}[11]	$\overline{BHE}$/$\overline{BLE}$ LOW to Low-Z[13]	5		ns
t_{HZBE}	$\overline{BHE}$/$\overline{BLE}$ HIGH to High-Z[11, 12]		25	ns
Write Cycle[14]				
t_{WC}	Write Cycle Time	70		ns
t_{SCE}	$\overline{CE}_1$ LOW and CE_2 HIGH to Write End	60		ns
t_{AW}	Address Set-up to Write End	60		ns
t_{HA}	Address Hold from Write End	0		ns
t_{SA}	Address Set-up to Write Start	0		ns
t_{PWE}	$\overline{WE}$ Pulse Width	50		ns
t_{BW}	$\overline{BHE}$/$\overline{BLE}$ Pulse Width	60		ns
t_{SD}	Data Set-up to Write End	30		ns
t_{HD}	Data Hold from Write End	0		ns
t_{HZWE}	$\overline{WE}$ LOW to High-Z[11, 12]		25	ns
t_{LZWE}	$\overline{WE}$ HIGH to Low-Z[11]	5		ns

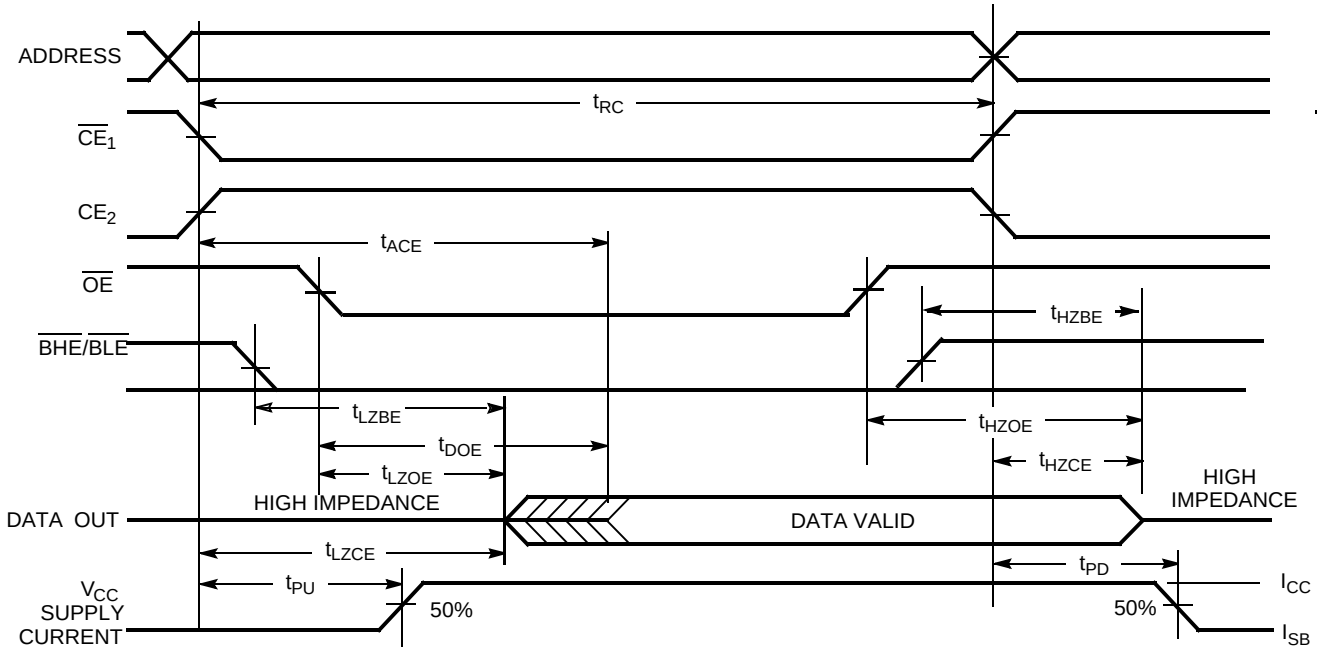
Notes:
10. Test conditions assume signal transition time of 5 ns or less, timing reference levels of $V_{CC(typ.)}/2$, input pulse levels of 0 to $V_{CC(typ.)}$, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
11. At any given temperature and voltage condition, t_{HZCE} 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.
12. t_{HZOE}, t_{HZCE}, t_{HZBE}, and t_{HZWE} transitions are measured when the outputs enter a high-impedance state.
13. When both byte enables are toggled together this value is 10 ns.
14. The internal Write time of the memory is defined by the overlap of $\overline{WE}$, $\overline{CE}_1 = V_{IL}$, $\overline{BHE}$ and/or $\overline{BLE} = V_{IL}$, $CE_2 = V_{IH}$. All signals must be ACTIVE to initiate a Write and any of these signals can terminate a Write by going INACTIVE. The data input set-up and hold timing should be referenced to the edge of the signal that terminates the Write.

Switching Waveforms

Read Cycle No. 1 (Address Transition Controlled)[15, 16]



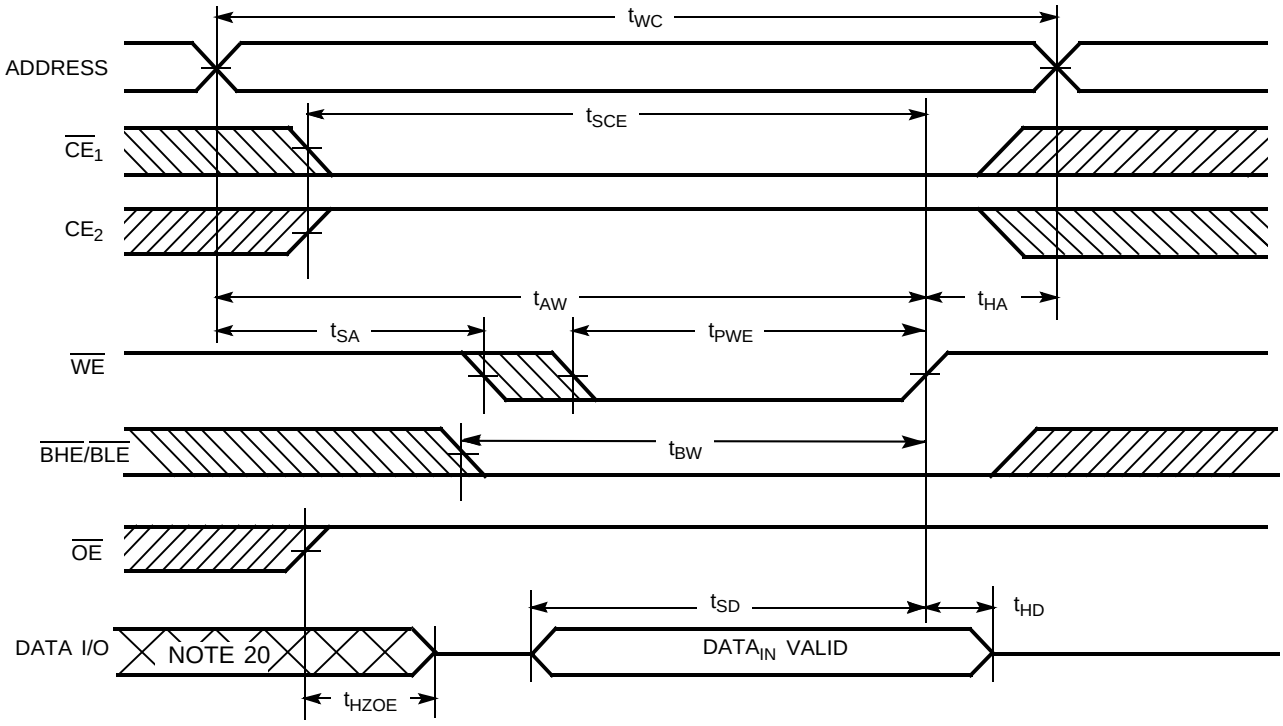
Read Cycle No. 2 ($\overline{OE}$ Controlled)[16, 17]



Notes:
15. Device is continuously selected. $\overline{OE}$, $\overline{CE_1}$ = V_{IL}, $\overline{BHE}$ and/or $\overline{BLE}$ = V_{IL}, CE_2 = V_{IH}.
16. $\overline{WE}$ is HIGH for Read cycle.
17. Address valid prior to or coincident with $\overline{CE_1}$, $\overline{BHE}$, $\overline{BLE}$ transition LOW and CE_2 transition HIGH.

Switching Waveforms (continued)

Write Cycle No. 1 ($\overline{WE}$ Controlled)[14, 18, 19]

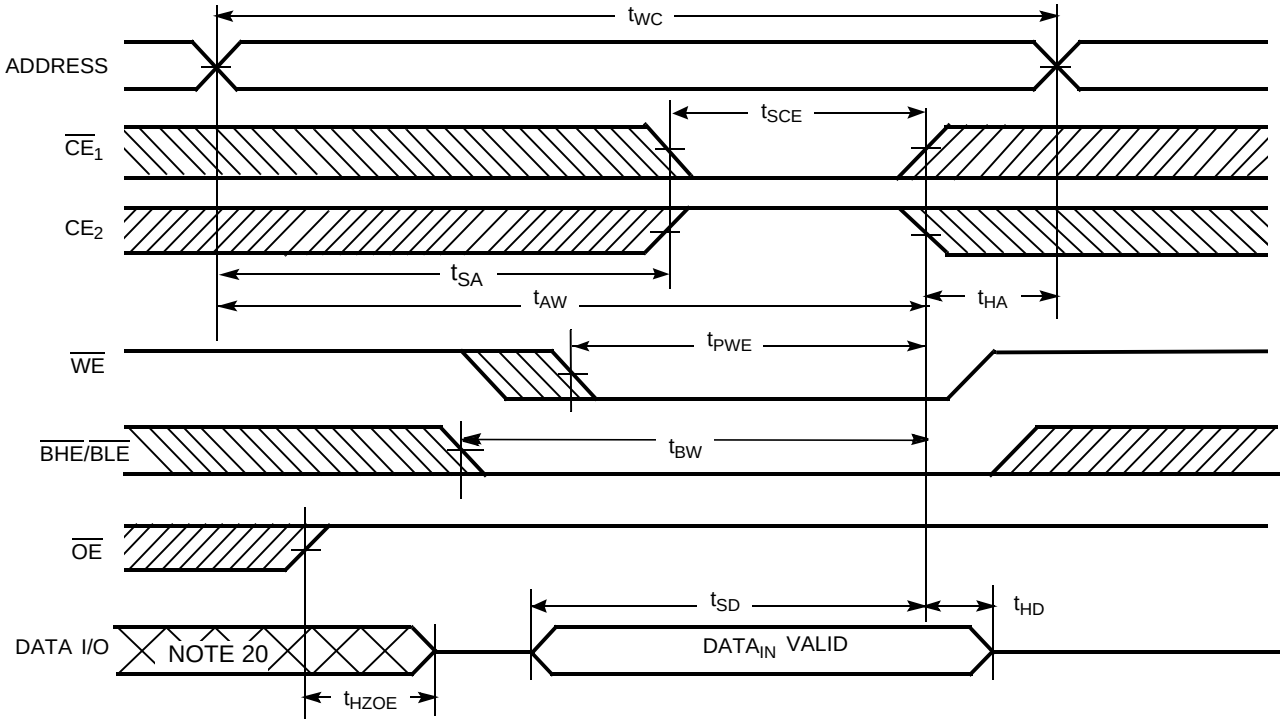


Notes:

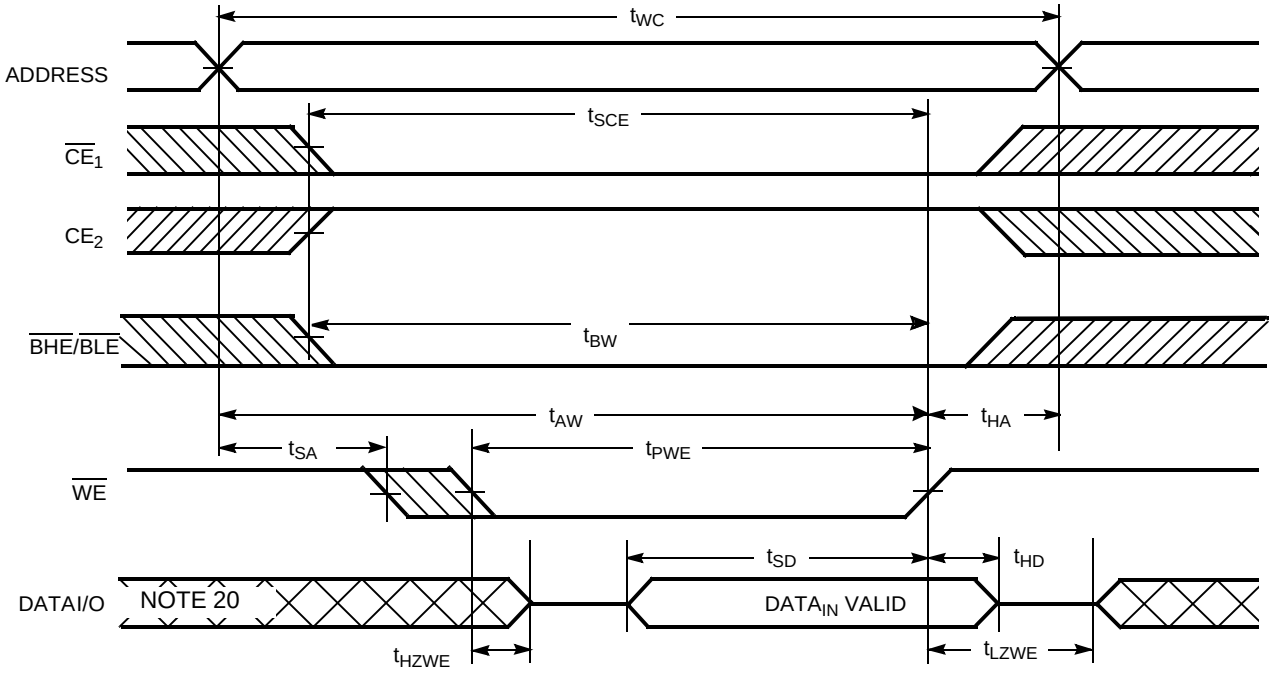
18. Data I/O is high-impedance if $\overline{OE}$ = V_{IH}.
19. If $\overline{CE_1}$ goes HIGH or CE_2 goes LOW simultaneously with $\overline{WE}$ HIGH, the output remains in a high-impedance state.
20. During this period, the I/Os are in output state and input signals should not be applied.

Switching Waveforms (continued)

Write Cycle No. 2 ($\overline{CE_1}$ or CE_2 Controlled) [14, 18, 19]

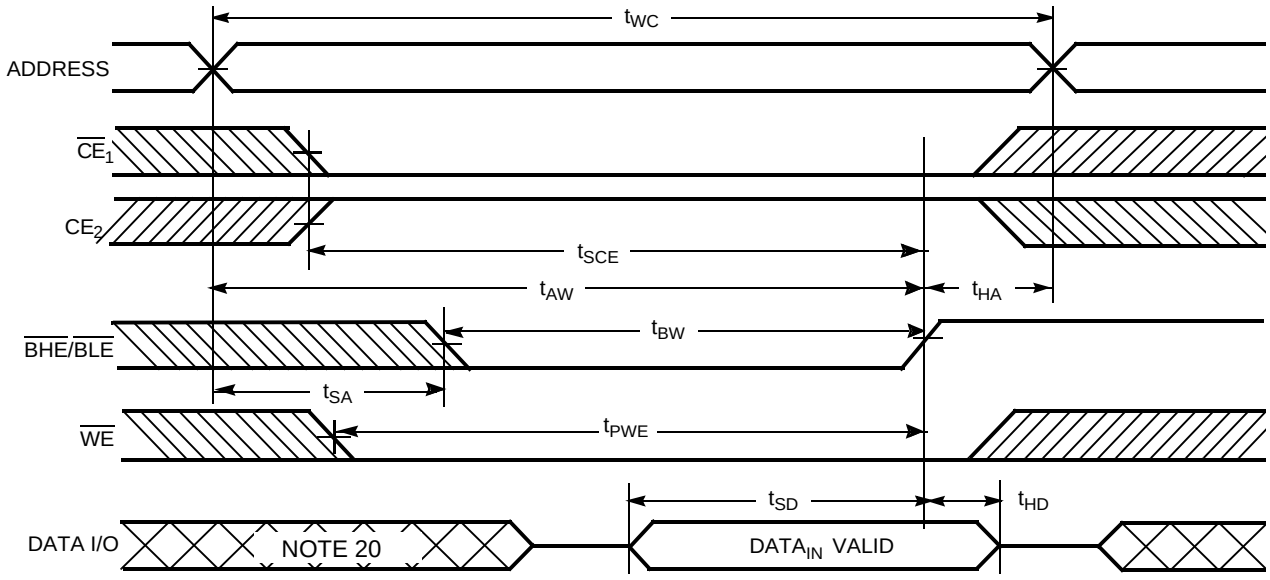


Write Cycle No. 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW)[19]



Switching Waveforms (continued)

Write Cycle No. 4 (BHE/BLE Controlled, OE LOW)[19]

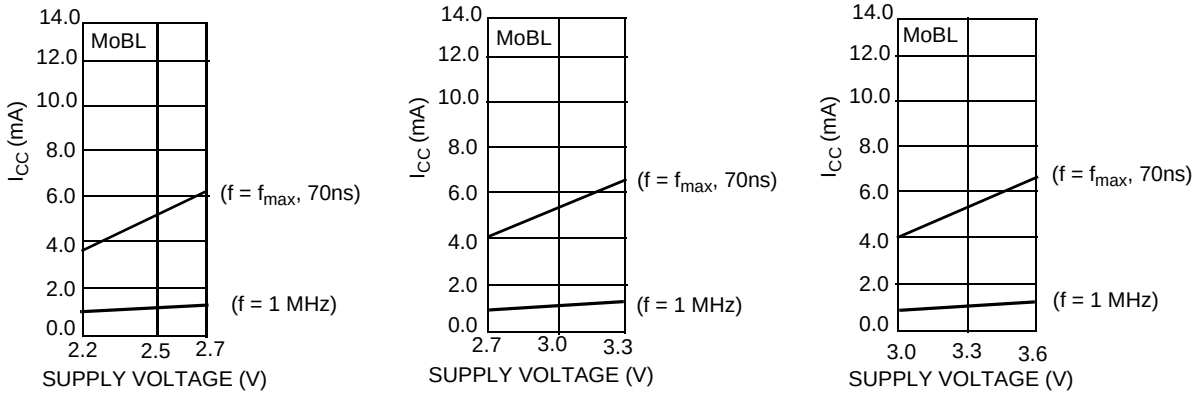


Truth Table

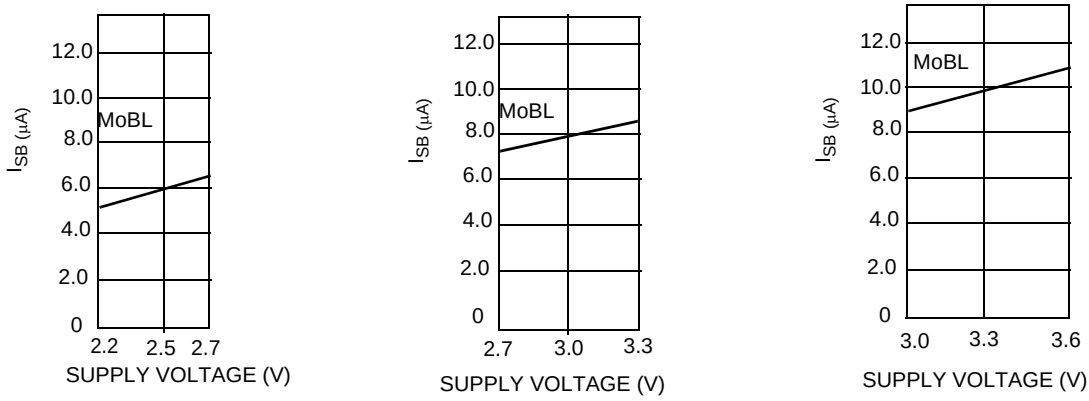
$\overline{CE_1}$	CE_2	$\overline{WE}$	$\overline{OE}$	$\overline{BHE}$	$\overline{BLE}$	Inputs/Outputs	Mode	Power
H	X	X	X	X	X	High Z	Deselect/Power-Down	Standby (I_{SB})
X	L	X	X	X	X	High Z	Deselect/Power-Down	Standby (I_{SB})
X	X	X	X	H	H	High Z	Deselect/Power-Down	Standby (I_{SB})
L	H	H	L	L	L	Data Out (I/O_O–I/O_{15})	Read	Active (I_{CC})
L	H	H	L	H	L	Data Out (I/O_O–I/O_7); I/O_8–I/O_{15} in High Z	Read	Active (I_{CC})
L	H	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	H	L	L	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	H	High Z	Output Disabled	Active (I_{CC})
L	H	L	X	L	L	Data In (I/O_O–I/O_{15})	Write	Active (I_{CC})
L	H	L	X	H	L	Data In (I/O_O–I/O_7); I/O_8–I/O_{15} in High Z	Write	Active (I_{CC})
L	H	L	X	L	H	Data In (I/O_8–I/O_{15}); I/O_0–I/O_7 in High Z	Write	Active (I_{CC})

Typical DC and AC Characteristics [2]

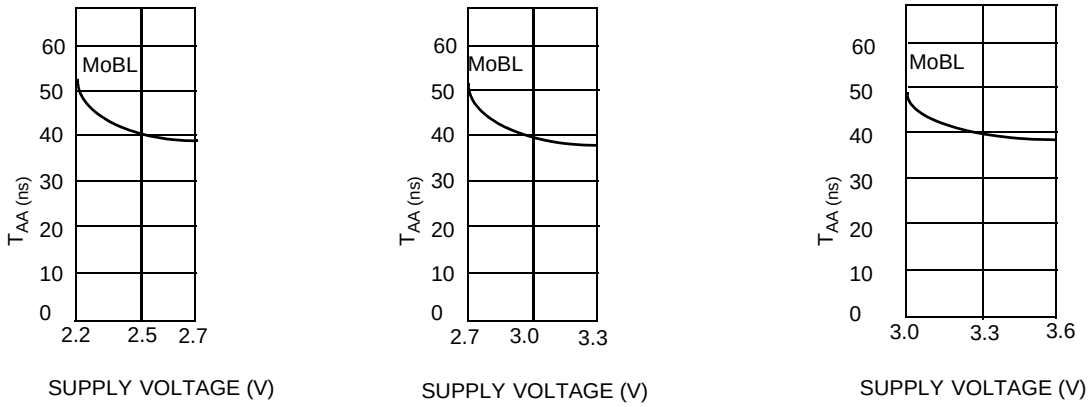
Operating Current vs. Supply Voltage



Standby Current vs. Supply Voltage



Access Time vs. Supply Voltage

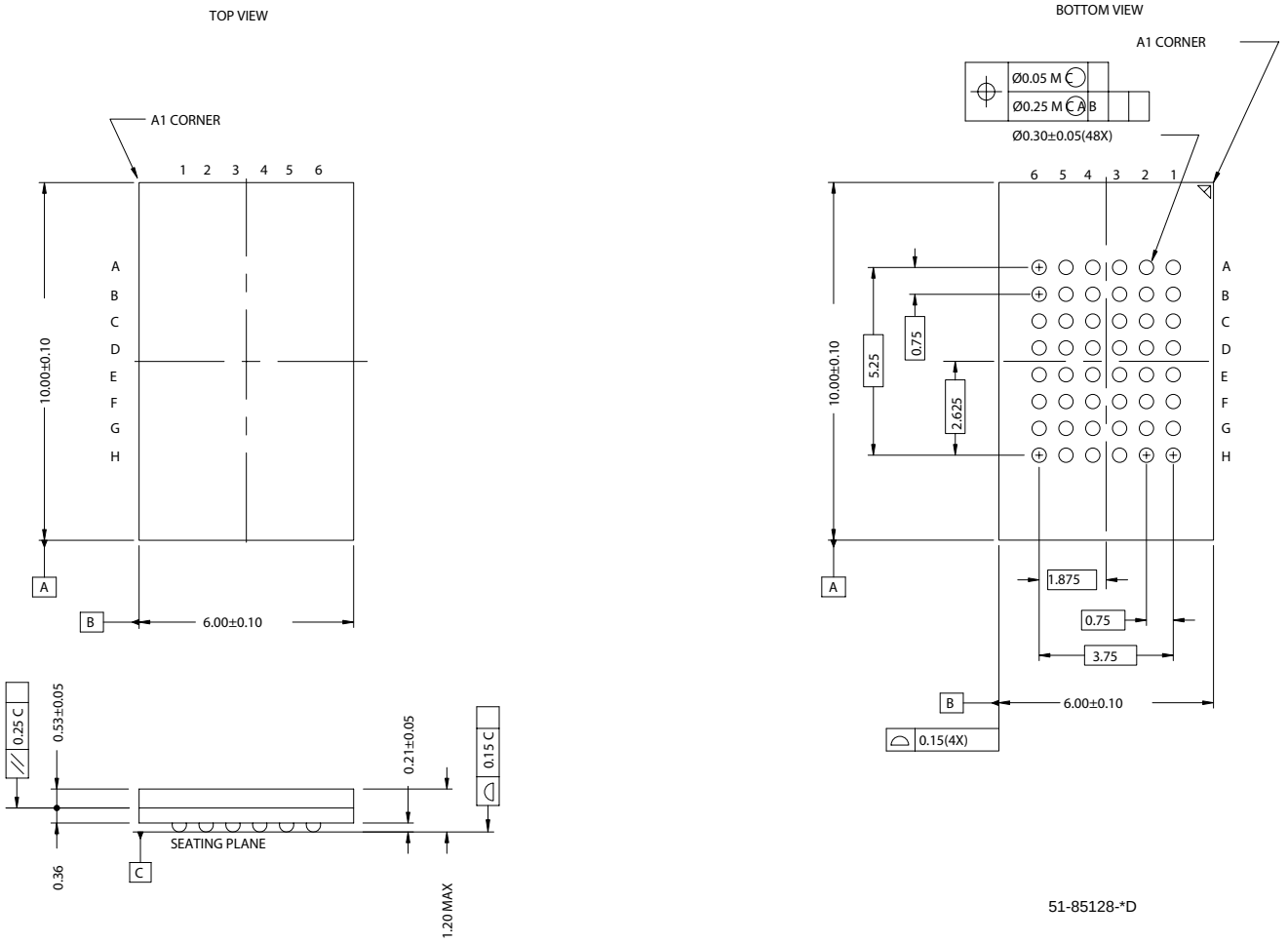


Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
70	CY62157CV30LL-70BAE	51-85128	48-Ball (6 mm x 10 mm x 1.2 mm) FBGA	Automotive-E
	CY62157CV33LL-70BAXA			Automotive-A
	CY62157CV33LL-70BAE			Automotive-E

Package Diagram

48-Ball (6 mm x 10 mm x 1.2 mm) FBGA (51-85128)



Document History Page

Document Title: CY62157CV30/33 512K x 16 Static RAM Document Number: 38-05014				
REV.	**ECN NO.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	106184	05/10/01	HRT/MGN	New data sheet – Advance Information
*A	107241	07/24/01	MGN	Made corrections to Advance Information Added 55 ns bin
*B	109621	03/11/02	MGN	Changed from Advance Information to Final
*C	114218	05/01/02	GUG/MGN	Improved Typical and Max I_{CC} values
*D	238448	See ECN	AJU	Added Automotive Product Information
*E	269729	See ECN	SYT	Added Automotive Product information for CY62157CV30 – 70 ns Added I_{IX} and I_{OZ} values for Automotive range of CY62157CV33 – 70 ns
*F	498575	See ECN	NXR	Removed Industrial Operating Range Removed 55 ns speed bin Removed CY62157CV25 part number from the Product Offering Added Automotive-A operating range Updated the Ordering Information Table