

# 4-Mbit (256K x 16) Static RAM

## Features

- Pin equivalent to CY7C1041BV33
- Temperature Ranges
  - Commercial: 0°C to 70°C
  - Industrial: -40°C to 85°C
  - Automotive-A: -40°C to 85°C
  - Automotive-E: -40°C to 125°C
- High speed
  - $t_{AA} = 10$  ns
- Low active power
  - 324 mW (max.)
- 2.0V data retention
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with  $\overline{CE}$  and  $\overline{OE}$  features
- Available in Pb-free and non Pb-free 44-pin 400-mil-SOJ, 44-pin TSOP II and 48-ball FBGA packages

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

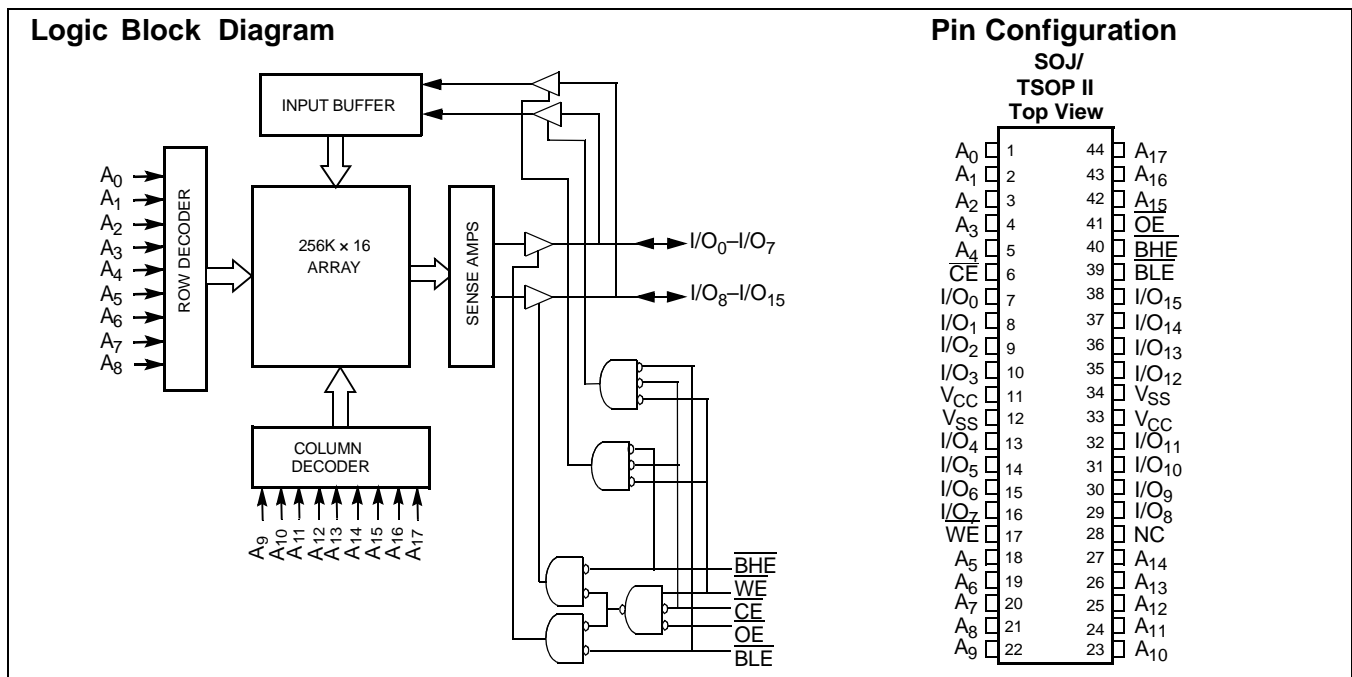
The CY7C1041CV33 is a high-performance CMOS Static RAM organized as 262,144 words by 16 bits.

Writing to the device is accomplished by taking Chip Enable ( $\overline{CE}$ ) and Write Enable ( $\overline{WE}$ ) inputs LOW. If Byte LOW Enable ( $\overline{BLE}$ ) is LOW, then data from I/O pins ( $I/O_0$ – $I/O_7$ ), is written into the location specified on the address pins ( $A_0$ – $A_{17}$ ). If Byte HIGH Enable ( $\overline{BHE}$ ) is LOW, then data from I/O pins ( $I/O_8$ – $I/O_{15}$ ) is written into the location specified on the address pins ( $A_0$ – $A_{17}$ ).

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 ( $\overline{BLE}$ ) is LOW, then data from the memory location specified by the address pins will appear on  $I/O_0$  –  $I/O_7$ . 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 input/output pins ( $I/O_0$ – $I/O_{15}$ ) are placed in a high-impedance state when the device is deselected ( $\overline{CE}$  HIGH), the outputs are disabled ( $\overline{OE}$  HIGH), the  $\overline{BHE}$  and  $\overline{BLE}$  are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or during a Write operation ( $\overline{CE}$  LOW, and  $\overline{WE}$  LOW).

The CY7C1041CV33 is available in a standard 44-pin 400-mil-wide body width SOJ and 44-pin TSOP II package with center power and ground (revolutionary) pinout, as well as a 48-ball fine-pitch ball grid array (FBGA) package.



### Notes:

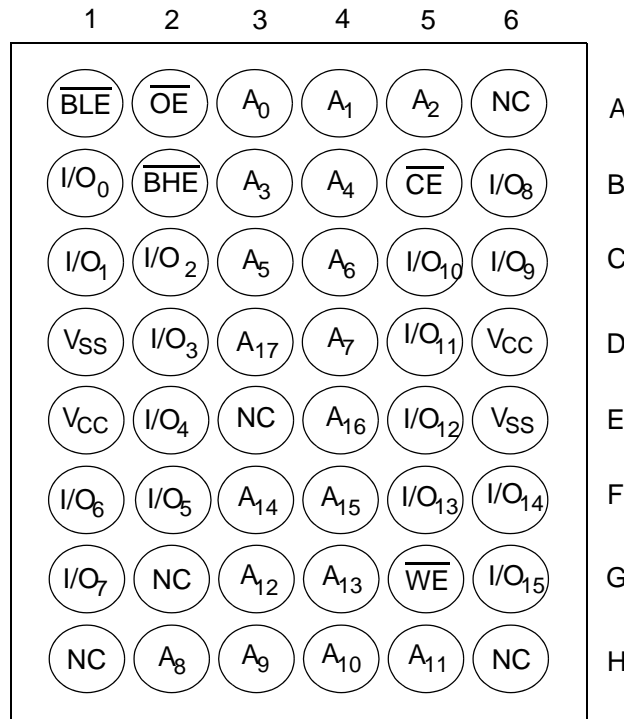
1. For guidelines on SRAM system design, please refer to the "System Design Guidelines" Cypress application note, available on the internet at [www.cypress.com](http://www.cypress.com).

**Selection Guide**

		<b>-10</b>	<b>-12</b>	<b>-15</b>	<b>-20</b>	<b>Unit</b>
Maximum Access Time		10	12	15	20	ns
Maximum Operating Current	Commercial	90	85	80	75	mA
	Industrial	100	95	90	85	mA
	Automotive-A	100			85	mA
	Automotive-E				90	mA
Maximum CMOS Standby Current	Commercial/ Industrial	10	10	10	10	mA
	Automotive-A	10				mA
	Automotive-E				15	mA

**Pin Configurations**

**48-ball FBGA  
(Top View)**



**Pin Definitions**

Pin Name	44-SOJ, 44-TSOP Pin Number	48-ball FBGA Pin Number	I/O Type	Description
A <sub>0</sub> –A <sub>17</sub>	1–5, 18–27, 42–44	A3, A4, A5, B3, B4, C3, C4, D4, H2, H3, H4, H5, G3, G4, F3, F4, E4, D3	Input	<b>Address Inputs used to select one of the address locations.</b>
I/O <sub>0</sub> –I/O <sub>15</sub>	7–10, 13–16, 29–32, 35–38	B1, C1, C2, D2, E2, F2, F1, G1, B6, C6, C5, D5, E5, F5, F6, G6	Input/Output	<b>Bidirectional Data I/O lines.</b> Used as input or output lines depending on operation
NC	28	A6, E3, G2, H1, H6	No Connect	<b>No Connects.</b> This pin is not connected to the die
$\overline{\text{WE}}$	17	G5	Input/Control	<b>Write Enable Input, active LOW.</b> When selected LOW, a WRITE is conducted. When selected HIGH, a READ is conducted.
$\overline{\text{CE}}$	6	B5	Input/Control	<b>Chip Enable Input, active LOW.</b> When LOW, selects the chip. When HIGH, deselects the chip.
$\overline{\text{BHE}}, \overline{\text{BLE}}$	40, 39	B2, A1	Input/Control	<b>Byte Write Select Inputs, active LOW.</b> $\overline{\text{BHE}}$ controls I/O <sub>15</sub> –I/O <sub>8</sub> , $\overline{\text{BLE}}$ controls I/O <sub>7</sub> –I/O <sub>0</sub>
$\overline{\text{OE}}$	41	A2	Input/Control	<b>Output Enable, active LOW.</b> Controls the direction of the I/O pins. When LOW, the I/O pins are allowed to behave as outputs. When deasserted HIGH, I/O pins are tri-stated, and act as input data pins.
V <sub>SS</sub>	12, 34	D1, E6	Ground	<b>Ground for the device.</b> Should be connected to ground of the system.
V <sub>CC</sub>	11, 33	D6, E1	Power Supply	<b>Power Supply inputs to the device.</b>

**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 on  $V_{CC}$  to Relative GND<sup>[2]</sup> .... -0.5V to +4.6V  
 DC Voltage Applied to Outputs in High-Z State<sup>[2]</sup> ..... -0.5V to  $V_{CC} + 0.5V$   
 DC Input Voltage<sup>[2]</sup> ..... -0.5V to  $V_{CC} + 0.5V$   
 Current into Outputs (LOW) ..... 20 mA

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

Latch-up Current..... >200 mA

**Operating Range**

Range	Ambient Temperature	$V_{CC}$
Commercial	0°C to +70°C	3.3V ± 0.3V
Industrial	-40°C to +85°C	
Automotive-A	-40°C to +85°C	
Automotive-E	-40°C to +125°C	

**DC Electrical Characteristics** Over the Operating Range

Parameter	Description	Test Conditions	-10		-12		-15		-20		Unit	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0 \text{ mA}$	2.4		2.4		2.4		2.4		V	
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0 \text{ mA}$		0.4		0.4		0.4		0.4	V	
$V_{IH}$	Input HIGH Voltage		2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	2.0	$V_{CC} + 0.3$	V	
$V_{IL}^{[2]}$	Input LOW Voltage		-0.3	0.8	-0.3	0.8	-0.3	0.8	-0.3	0.8	V	
$I_{IX}$	Input Leakage Current	$GND \leq V_I \leq V_{CC}$	Com'I/Ind'I	-1	+1	-1	+1	-1	+1	-1	+1	μA
			Auto-A	-1	+1					-1	+1	μA
			Auto-E							-20	+20	μA
$I_{OZ}$	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC}$ , Output Disabled	Com'I/Ind'I	-1	+1	-1	+1	-1	+1	-1	+1	μA
			Auto-A	-1	+1					-1	+1	μA
			Auto-E							-20	+20	μA
$I_{CC}$	$V_{CC}$ Operating Supply Current	$V_{CC} = \text{Max.}, f = f_{MAX} = 1/t_{RC}$	Com'I		90		85		80		75	mA
			Ind'I		100		95		90		85	mA
			Auto-A		100						85	mA
			Auto-E								90	mA
$I_{SB1}$	Automatic CE Power-down Current — TTL Inputs	Max. $V_{CC}$ , $CE \geq V_{IH}$ $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$ , $f = f_{MAX}$	Com'I/Ind'I		40		40		40		40	mA
			Auto-A		40						40	mA
			Auto-E								45	mA
$I_{SB2}$	Automatic CE Power-down Current — CMOS Inputs	Max. $V_{CC}$ , $CE \geq V_{CC} - 0.3V$ , $V_{IN} \geq V_{CC} - 0.3V$ , or $V_{IN} \leq 0.3V$ , $f = 0$	Com'I/Ind'I		10		10		10		10	mA
			Auto-A		10						10	mA
			Auto-E								15	mA

**Capacitance<sup>[3]</sup>**

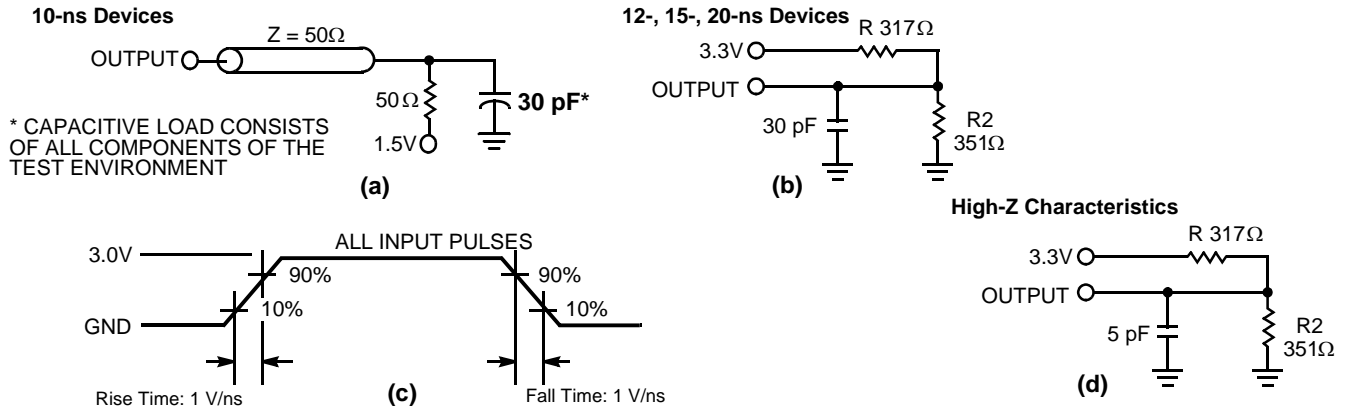
Parameter	Description	Test Conditions	Max.	Unit
$C_{IN}$	Input Capacitance	$T_A = 25^\circ\text{C}, f = 1 \text{ MHz}, V_{CC} = 3.3V$	8	pF
$C_{OUT}$	I/O Capacitance		8	pF

**Notes:**

- $V_{IL}(\text{min.}) = -2.0V$  and  $V_{IH}(\text{max.}) = V_{CC} + 0.5V$  for pulse durations of less than 20 ns.
- Tested initially and after any design or process changes that may affect these parameters.

**Thermal Resistance<sup>[3]</sup>**

Parameter	Description	Test Conditions	TSOP-II	FBGA	SOJ	Unit
$\Theta_{JA}$	Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA / JESD51.	42.96	38.15	25.99	°C/W
$\Theta_{JC}$	Thermal Resistance (Junction to Case)		10.75	9.15	18.8	°C/W

**AC Test Loads and Waveforms<sup>[4]</sup>**

**AC Switching Characteristics<sup>[5]</sup> Over the Operating Range**

Parameter	Description	-10		-12		-15		-20		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
<b>Read Cycle</b>										
$t_{power}^{[6]}$	$V_{CC}$ (typical) to the first access	100		100		100		100		μs
$t_{RC}$	Read Cycle Time	10		12		15		20		ns
$t_{AA}$	Address to Data Valid		10		12		15		20	ns
$t_{OHA}$	Data Hold from Address Change	3		3		3		3		ns
$t_{ACE}$	$\overline{CE}$ LOW to Data Valid		10		12		15		20	ns
$t_{DOE}$	$\overline{OE}$ LOW to Data Valid		5		6		7		8	ns
$t_{LZOE}$	$\overline{OE}$ LOW to Low-Z	0		0		0		0		ns
$t_{HZOE}$	$\overline{OE}$ HIGH to High-Z <sup>[7, 8]</sup>		5		6		7		8	ns
$t_{LZCE}$	$\overline{CE}$ LOW to Low-Z <sup>[8]</sup>	3		3		3		3		ns
$t_{HZCE}$	$\overline{CE}$ HIGH to High-Z <sup>[7, 8]</sup>		5		6		7		8	ns
$t_{PU}$	$\overline{CE}$ LOW to Power-Up	0		0		0		0		ns
$t_{PD}$	$\overline{CE}$ HIGH to Power-Down		10		12		15		20	ns
$t_{DBE}$	Byte Enable to Data Valid		5		6		7		8	ns
$t_{LZBE}$	Byte Enable to Low-Z	0		0		0		0		ns
$t_{HZBE}$	Byte Disable to High-Z		6		6		7		8	ns

**Notes:**

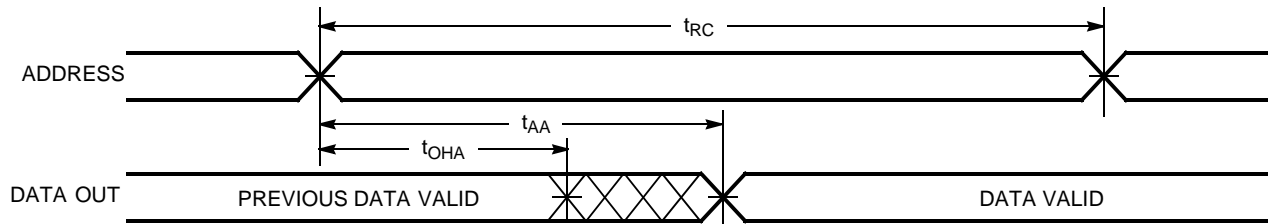
- AC characteristics (except High-Z) for 10-ns parts are tested using the load conditions shown in Figure (a). All other speeds are tested using the Thevenin load shown in Figure (b). High-Z characteristics are tested for all speeds using the test load shown in Figure (d).
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V.
- $t_{power}$  gives the minimum amount of time that the power supply should be at typical  $V_{CC}$  values until the first memory access can be performed.
- $t_{HZOE}$ ,  $t_{HZCE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (d) of AC Test Loads. Transition is measured ±500 mV from steady-state voltage.
- At any given temperature and voltage condition,  $t_{HZCE}$  is less than  $t_{LZCE}$ ,  $t_{HZOE}$  is less than  $t_{LZOE}$ , and  $t_{HZWE}$  is less than  $t_{LZWE}$  for any given device.
- The internal Write time of the memory is defined by the overlap of  $\overline{CE}$  LOW, and  $\overline{WE}$  LOW.  $\overline{CE}$  and  $\overline{WE}$  must be LOW to initiate a Write, and the transition of either of these signals can terminate the Write. The input data set-up and hold timing should be referenced to the leading edge of the signal that terminates the Write.

AC Switching Characteristics<sup>[5]</sup> Over the Operating Range (continued)

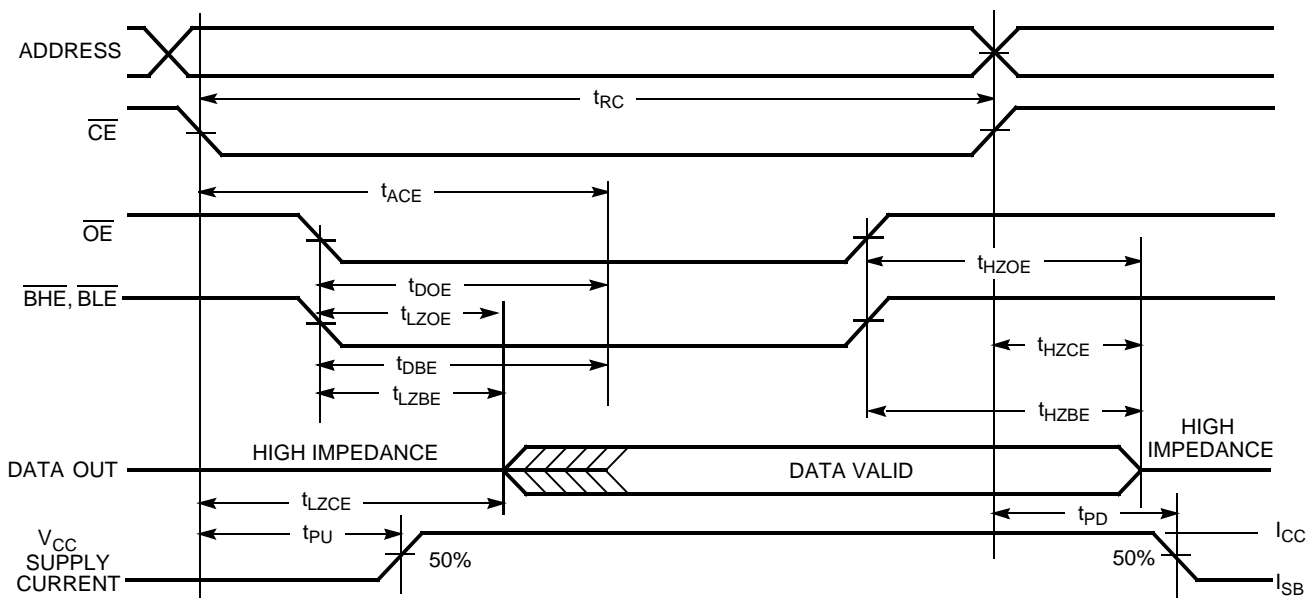
Parameter	Description	-10		-12		-15		-20		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
<b>Write Cycle<sup>[9, 10]</sup></b>										
$t_{WC}$	Write Cycle Time	10		12		15		20		ns
$t_{SCE}$	CE LOW to Write End	7		8		10		10		ns
$t_{AW}$	Address Set-Up to Write End	7		8		10		10		ns
$t_{HA}$	Address Hold from Write End	0		0		0		0		ns
$t_{SA}$	Address Set-Up to Write Start	0		0		0		0		ns
$t_{PWE}$	$\overline{WE}$ Pulse Width	7		8		10		10		ns
$t_{SD}$	Data Set-Up to Write End	5		6		7		8		ns
$t_{HD}$	Data Hold from Write End	0		0		0		0		ns
$t_{LZWE}$	$\overline{WE}$ HIGH to Low-Z <sup>[7]</sup>	3		3		3		3		ns
$t_{HZWE}$	$\overline{WE}$ LOW to High-Z <sup>[7, 8]</sup>		5		6		7		8	ns
$t_{BW}$	Byte Enable to End of Write	7		8		10		10		ns

Switching Waveforms

Read Cycle No. 1<sup>[11, 12]</sup>



Read Cycle No. 2 (OE Controlled)<sup>[12, 13]</sup>

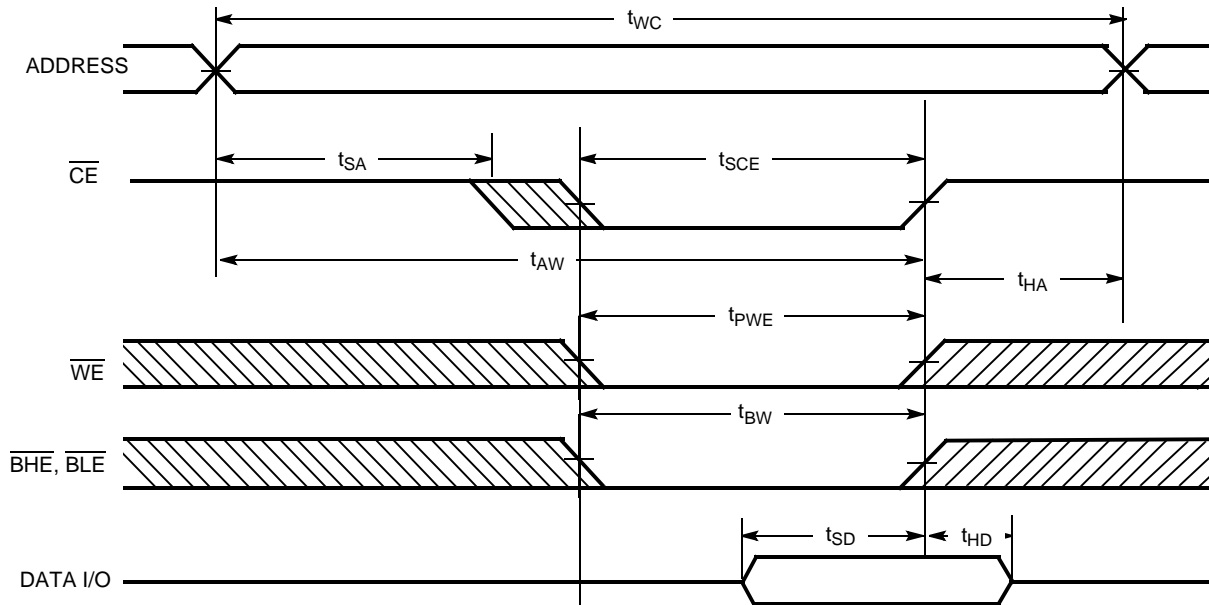


Notes:

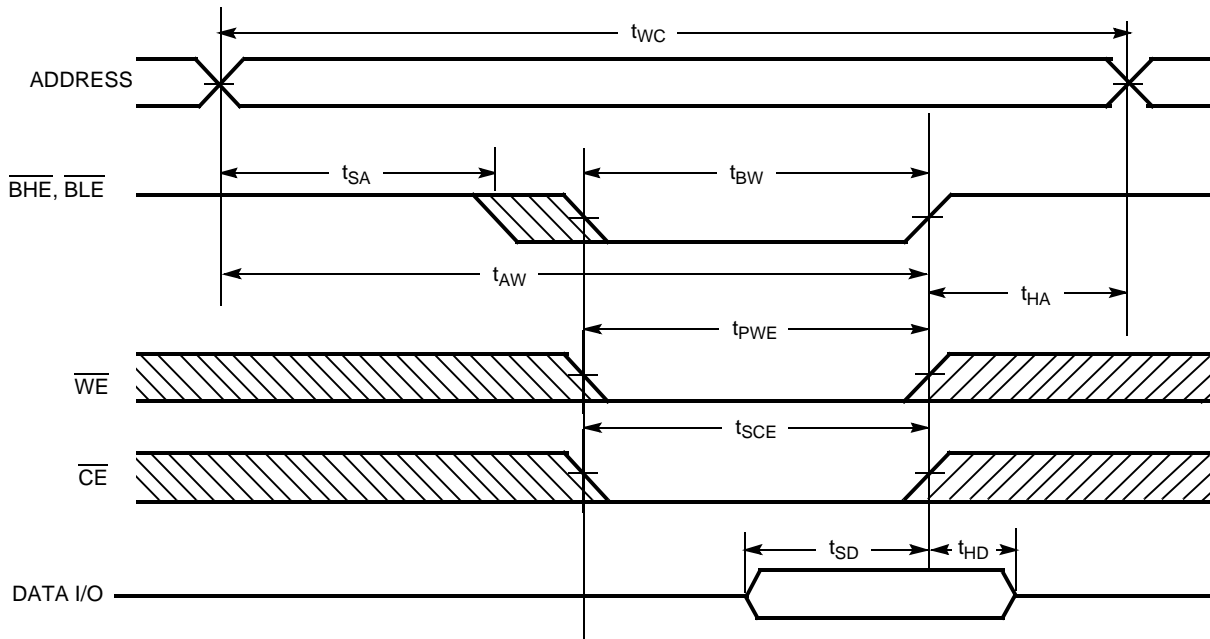
- 10. The minimum Write cycle time for Write Cycle No. 3 ( $\overline{WE}$  controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .
- 11. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}$ ,  $\overline{BHE}$  and/or  $\overline{BLA} = V_{IL}$ .
- 12.  $\overline{WE}$  is HIGH for Read cycle.
- 13. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.

Switching Waveforms (continued)

Write Cycle No. 1 ( $\overline{\text{CE}}$  Controlled)<sup>[14, 15]</sup>



Write Cycle No. 2 ( $\overline{\text{BLE}}$  or  $\overline{\text{BHE}}$  Controlled)

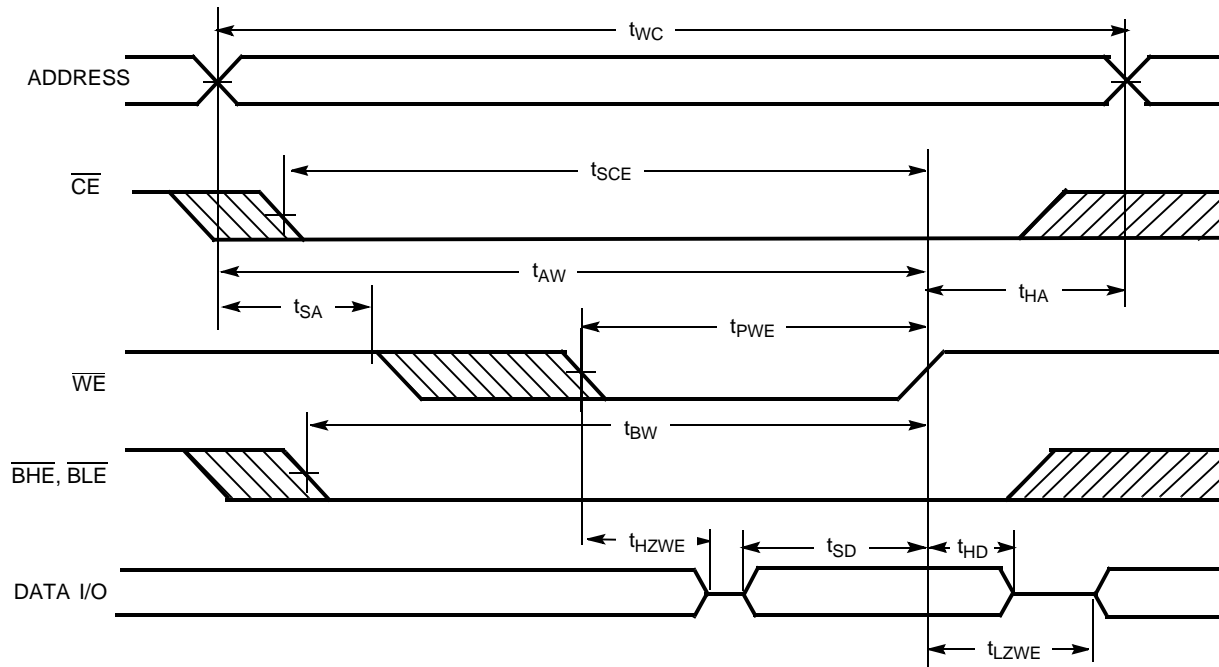


Notes:

- 14. Data I/O is high-impedance if  $\overline{\text{OE}}$  or  $\overline{\text{BHE}}$  and/or  $\overline{\text{BLE}} = V_{IH}$ .
- 15. If CE goes HIGH simultaneously with WE going HIGH, the output remains in a high-impedance state.

Switching Waveforms (continued)

Write Cycle No. 2 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)



Truth Table

CE	OE	WE	BLE	BHE	I/O <sub>0</sub> -I/O <sub>7</sub>	I/O <sub>8</sub> -I/O <sub>15</sub>	Mode	Power
H	X	X	X	X	High-Z	High-Z	Power-down	Standby ( $I_{SB}$ )
L	L	H	L	L	Data Out	Data Out	Read All Bits	Active ( $I_{CC}$ )
L	L	H	L	H	Data Out	High-Z	Read Lower Bits Only	Active ( $I_{CC}$ )
L	L	H	H	L	High-Z	Data Out	Read Upper Bits Only	Active ( $I_{CC}$ )
L	X	L	L	L	Data In	Data In	Write All Bits	Active ( $I_{CC}$ )
L	X	L	L	H	Data In	High-Z	Write Lower Bits Only	Active ( $I_{CC}$ )
L	X	L	H	L	High-Z	Data In	Write Upper Bits Only	Active ( $I_{CC}$ )
L	H	H	X	X	High-Z	High-Z	Selected, Outputs Disabled	Active ( $I_{CC}$ )



**Ordering Information**

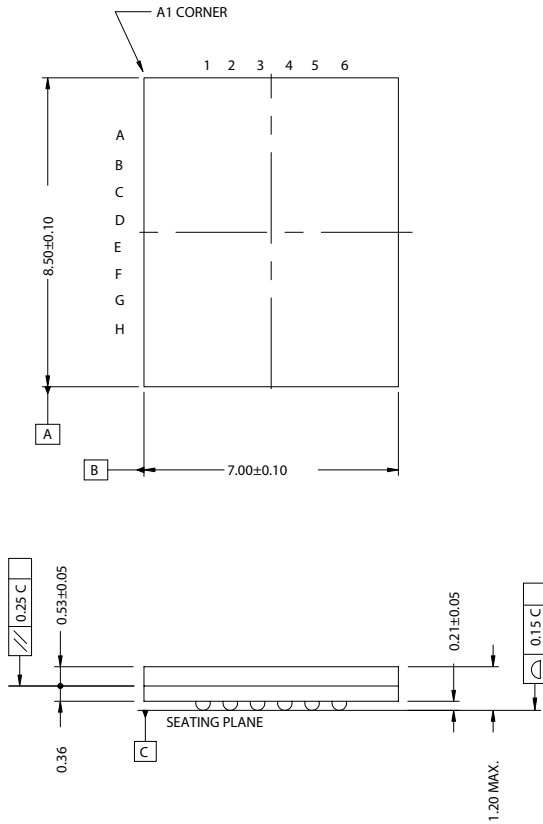
Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range		
10	CY7C1041CV33-10BAC	51-85106	48-ball Fine Pitch BGA	Commercial		
	CY7C1041CV33-10BAXC		48-ball Fine Pitch BGA (Pb-Free)			
	CY7C1041CV33-10VC	51-85082	44-lead (400-mil) Molded SOJ		Industrial	
	CY7C1041CV33-10VXC		44-lead (400-mil) Molded SOJ (Pb-Free)			
	CY7C1041CV33-10ZC	51-85087	44-pin TSOP II			Automotive-A
	CY7C1041CV33-10ZXC		44-pin TSOP II (Pb-Free)			
	CY7C1041CV33-10BAI	51-85106	48-ball Fine Pitch BGA	Automotive-A		
	CY7C1041CV33-10BAXI		48-ball Fine Pitch BGA (Pb-Free)			
	CY7C1041CV33-10ZI	51-85087	44-pin TSOP II		Automotive-A	
	CY7C1041CV33-10ZXI		44-pin TSOP II (Pb-Free)			
	CY7C1041CV33-10ZSXA	51-85106	44-pin TSOP II (Pb-Free)			Automotive-A
	CY7C1041CV33-10BAXA		48-ball Fine Pitch BGA (Pb-Free)			
12	CY7C1041CV33-12VC	51-85082	44-lead (400-mil) Molded SOJ	Commercial		
	CY7C1041CV33-12VXC		44-lead (400-mil) Molded SOJ (Pb-Free)			
	CY7C1041CV33-12ZC	51-85087	44-pin TSOP II		Industrial	
	CY7C1041CV33-12ZXC		44-pin TSOP II (Pb-Free)			
	CY7C1041CV33-12VXI	51-85082	44-lead (400-mil) Molded SOJ (Pb-Free)	Industrial		
	CY7C1041CV33-12ZI	51-85087	44-pin TSOP II			
	CY7C1041CV33-12ZXI		44-pin TSOP II (Pb-Free)			
15	CY7C1041CV33-15VC	51-85082	44-lead (400-mil) Molded SOJ	Commercial		
	CY7C1041CV33-15VXC		44-lead (400-mil) Molded SOJ (Pb-Free)			
	CY7C1041CV33-15ZC	51-85087	44-pin TSOP II		Industrial	
	CY7C1041CV33-15ZXC		44-pin TSOP II (Pb-Free)			
	CY7C1041CV33-15VI	51-85082	44-lead (400-mil) Molded SOJ			
	CY7C1041CV33-15VXI		44-lead (400-mil) Molded SOJ (Pb-Free)			
	CY7C1041CV33-15ZI	51-85087	44-pin TSOP II			
	CY7C1041CV33-15ZXI		44-pin TSOP II (Pb-Free)			
20	CY7C1041CV33-20ZC	51-85087	44-pin TSOP II	Commercial		
	CY7C1041CV33-20ZXC		44-pin TSOP II (Pb-Free)			
	CY7C1041CV33-20ZSXA		44-pin TSOP II (Pb-Free)			
	CY7C1041CV33-20VE	51-85082	44-lead (400-mil) Molded SOJ	Automotive-E		
	CY7C1041CV33-20VXE		44-lead (400-mil) Molded SOJ (Pb-Free)			
	CY7C1041CV33-20ZE	51-85087	44-pin TSOP II			
	CY7C1041CV33-20ZSXE		44-pin TSOP II (Pb-Free)			

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

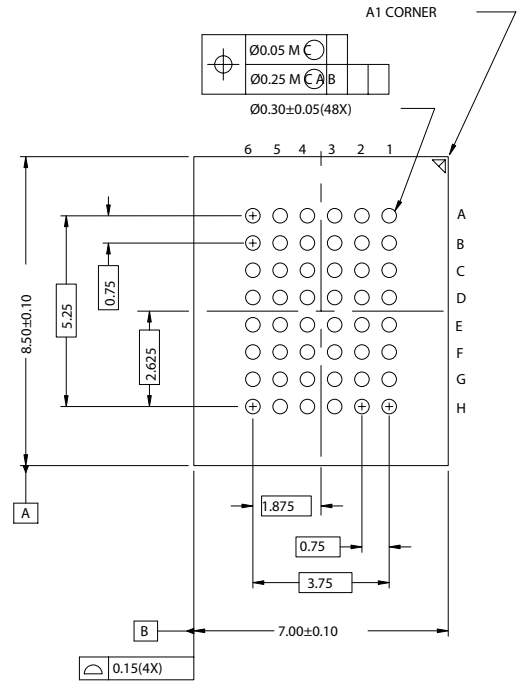
**Package Diagrams**

**48-Ball (7.00 mm x 8.5 mm x 1.2 mm) FBGA (51-85106)**

TOP VIEW



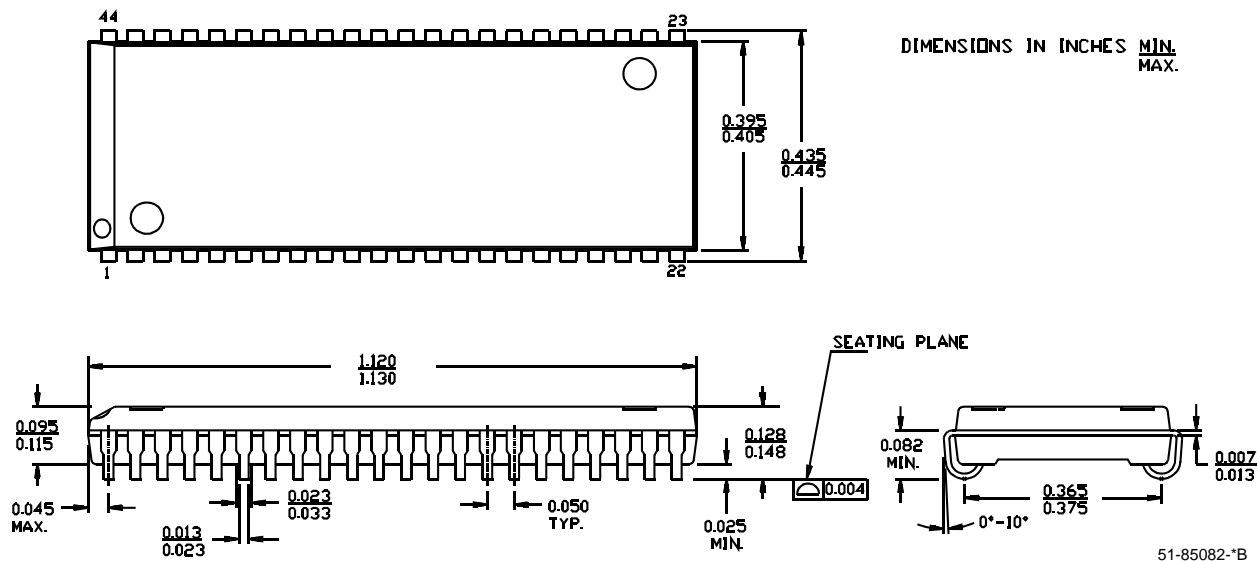
BOTTOM VIEW



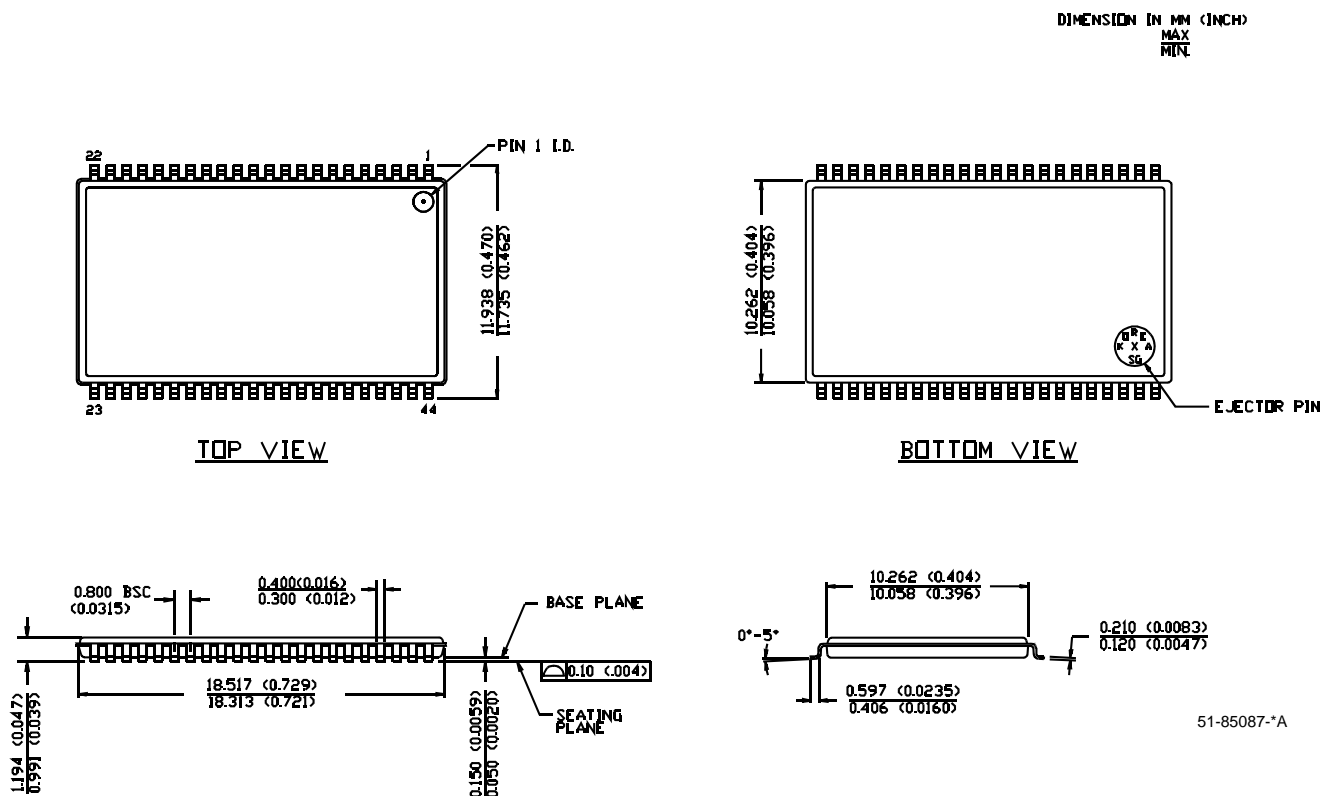
51-85106-\*E

Package Diagrams (continued)

44-lead (400-mil) Molded SOJ (51-85082)



44-pin TSOP II (51-85087)



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**Document History Page**

Document Title: CY7C1041CV33 4-Mbit (256K x 16) Static RAM				
Document Number: 38-05134				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	109513	12/13/01	HGK	New Data Sheet
*A	112440	12/20/01	BSS	Updated 51-85106 from revision *A to *C
*B	112859	03/25/02	DFP	Added CY7C1042CV33 in BGA package Removed 1042 BGA option pin ACC Final Data Sheet
*C	116477	09/16/02	CEA	Add applications foot note to data sheet
*D	119797	10/21/02	DFP	Added 20-ns speed bin
*E	262949	See ECN	RKF	1) Added Lead (Pb)-Free parts in the Ordering info (Page #9) 2) Added Automotive Specs to Datasheet
*F	361795	See ECN	SYT	Added Pb-Free offerings in the Ordering Information
*G	435387	See ECN	NXR	Removed -8 Speed bin from Product offering. Corrected typo in description for BHE/BLE in pin definitions table on Page# 3 corrected ther Pin name from OE2 to OE. Included the Maximum Ratings for Static Discharge Voltage and Latch up Current. Changed the description of I <sub>IX</sub> current from Input Load Current to Input Leakage Current Added note# 4 on page# 4 Updated the Ordering Information table
*H	499153	See ECN	NXR	Added Automotive-A Operating Range Changed t <sub>power</sub> value from 1 μs to 100 μs Updated Ordering Information table