

# 4-Mbit (256 K × 16) Static RAM

## Features

- Temperature ranges
  - Industrial: -40 °C to 85 °C
  - Automotive-A <sup>[1]</sup>: -40 °C to 85 °C
  - Automotive-E <sup>[1]</sup>: -40 °C to 125 °C
- Pin and function compatible with CY7C1041CV33
- High speed
  - $t_{AA} = 10$  ns
- Low active power
  - $I_{CC} = 90$  mA at 10 ns (industrial)
- Low CMOS standby power
  - $I_{SB2} = 10$  mA
- 2.0 V 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 48-ball VFBGA, 44-pin (400-mil) molded SOJ, and 44-pin TSOP II Packages

## Functional Description

The CY7C1041DV33 is a high performance CMOS Static RAM organized as 256 K words by 16-bits. To write to the device, take 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 ( $I/O_0$  to  $I/O_7$ ) is written into the location specified on the address pins ( $A_0$  to  $A_{17}$ ). If byte high enable ( $\overline{BHE}$ ) is LOW, then data from I/O pins ( $I/O_8$  to  $I/O_{15}$ ) is written into the location specified on the address pins ( $A_0$  to  $A_{17}$ ).

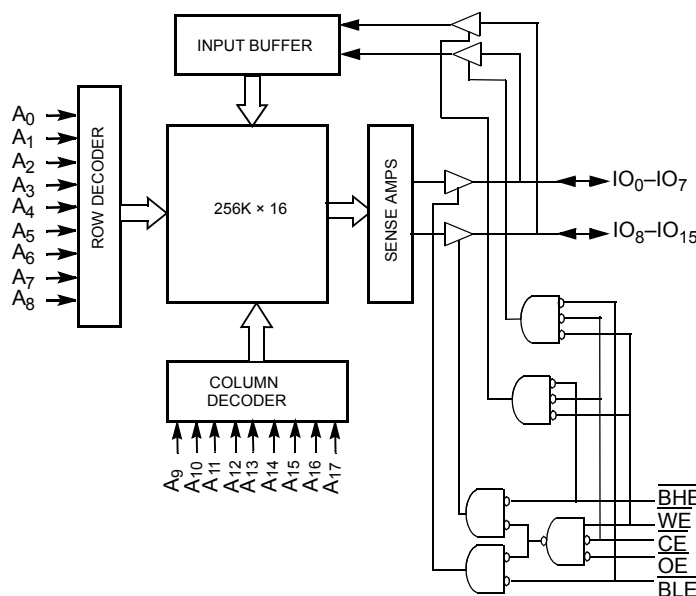
To read from the device, take chip enable ( $\overline{CE}$ ) and output enable ( $\overline{OE}$ ) LOW while forcing the write enable ( $\overline{WE}$ ) HIGH. If  $\overline{BLE}$  is LOW, then data from the memory location specified by the address pins appears on  $I/O_0$  to  $I/O_7$ . If  $\overline{BHE}$  is LOW, then data from memory appears on  $I/O_8$  to  $I/O_{15}$ . See the Truth Table on page 10 for a complete description of read and write modes.

The input and output pins ( $I/O_0$  to  $I/O_{15}$ ) are placed in a high impedance state when the device is deselected ( $\overline{CE}$  HIGH), outputs are disabled ( $\overline{OE}$  HIGH),  $\overline{BHE}$  and  $\overline{BLE}$  are disabled ( $\overline{BHE}$ ,  $\overline{BLE}$  HIGH), or during a write operation ( $\overline{CE}$  LOW and  $\overline{WE}$  LOW).

The CY7C1041DV33 is available in a standard 44-pin 400-mil wide SOJ and 44-pin TSOP II package with center power and ground (revolutionary) pinout and a 48-ball fine-pitch ball grid array (FBGA) package.

For best practice recommendations, refer to the Cypress application note AN1064, SRAM System Guidelines.

## Logic Block Diagram



### Note

1. Automotive product information is preliminary.

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**Selection Guide**

Description	-10 (Industrial)	-10 (Automotive-A) [2]	-12 (Automotive-E) [2]	Unit
Maximum access time	10	10	12	ns
Maximum operating current	90	90	95	mA
Maximum CMOS standby current	10	10	15	mA

**Pin Configuration**

Figure 1. 48-ball VFBGA (Pinout 1) [3, 4]

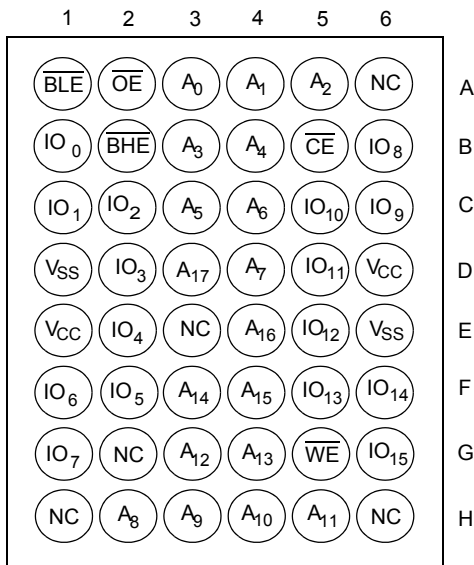


Figure 2. 48-ball VFBGA (Pinout 2) [3, 4]

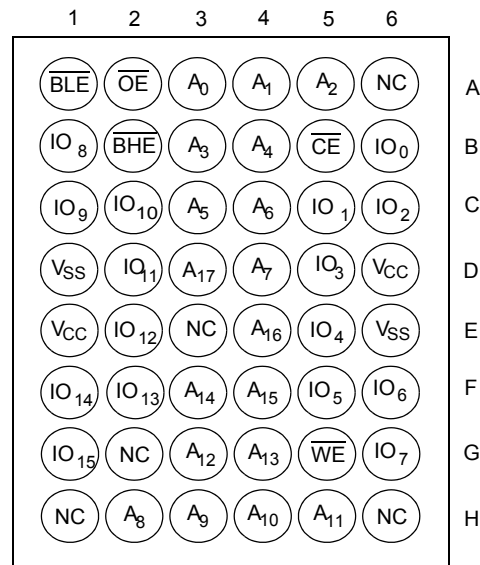
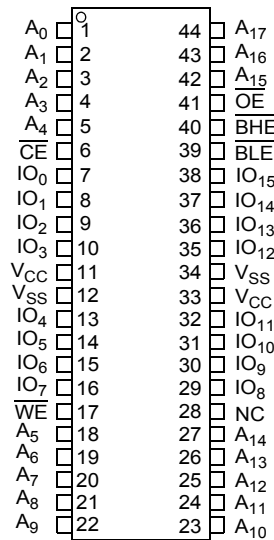


Figure 3. 44-pin SOJ/TSOP II



**Notes**

- 2. Automotive product information is preliminary.
- 3. NC pins are not connected on the die.
- 4. Pinout 1 is compliant with CY7C1041CV33 and pinout 2 is JEDEC compliant. The difference between the two is that the higher and lower byte I/Os (I/O<sub>[7:0]</sub> and I/O<sub>[15:8]</sub> balls) are swapped.

### Maximum Ratings

Exceeding maximum ratings may impair the useful life of the device. These user guidelines are not tested.

- Storage temperature ..... -65 °C to +150 °C
- Ambient temperature with power applied ..... -55 °C to +125 °C
- Supply voltage on V<sub>CC</sub> relative to GND <sup>[5]</sup>.....-0.3 V to +4.6 V
- DC voltage applied to outputs in high Z State<sup>[5]</sup> ..... -0.3 V to V<sub>CC</sub> +0.3 V
- DC input voltage<sup>[5]</sup>.....-0.3 V to V<sub>CC</sub> +0.3 V
- Current into outputs (LOW) ..... 20 mA

- Static discharge voltage.....> 2001 V (MIL-STD-883, method 3015)
- Latch-up current ..... > 200 mA

### Operating Range

Range	Ambient Temperature	V <sub>CC</sub>	Speed
Industrial	-40 °C to +85 °C	3.3 V ± 0.3 V	10 ns
Automotive-A <sup>[1]</sup>	-40 °C to +85 °C	3.3 V ± 0.3 V	10 ns
Automotive-E <sup>[1]</sup>	-40 °C to +125 °C	3.3 V ± 0.3 V	12 ns

### DC Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions	-10 (Industrial)		-10 (Automotive-A) <sup>[6]</sup>		-12 (Automotive-E) <sup>[6]</sup>		Unit	
			Min	Max	Min	Max	Min	Max		
V <sub>OH</sub>	Output HIGH voltage	V <sub>CC</sub> = Min, I <sub>OH</sub> = -4.0 mA	2.4	-	2.4	-	2.4	-	V	
V <sub>OL</sub>	Output LOW voltage	V <sub>CC</sub> = Min, I <sub>OL</sub> = 8.0 mA	-	0.4	-	0.4	-	0.4	V	
V <sub>IH</sub> <sup>[5]</sup>	Input HIGH voltage		2.0	V <sub>CC</sub> + 0.3	2.0	V <sub>CC</sub> + 0.3	2.0	V <sub>CC</sub> + 0.3	V	
V <sub>IL</sub> <sup>[5]</sup>	Input LOW voltage		-0.3	0.8	-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	-1	+1	μA	
I <sub>OZ</sub>	Output leakage current	GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> , output disabled	-1	+1	-1	+1	-1	+1	μA	
I <sub>CC</sub>	V <sub>CC</sub> operating supply current	V <sub>CC</sub> = Max, f = f <sub>MAX</sub> = 1/t <sub>RC</sub>	100 MHz	-	90	-	90	-	-	mA
			83 MHz	-	80	-	80	-	95	mA
			66 MHz	-	70	-	70	-	85	mA
			40 MHz	-	60	-	60	-	75	mA
I <sub>SB1</sub>	Automatic CE power-down current —TTL inputs	Max V <sub>CC</sub> , CE ≥ V <sub>IH</sub> , V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>IL</sub> , f = f <sub>MAX</sub>	-	20	-	20	-	15	mA	
I <sub>SB2</sub>	Automatic CE power-down current —CMOS inputs	Max V <sub>CC</sub> , CE ≥ V <sub>CC</sub> - 0.3 V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.3 V, or V <sub>IN</sub> ≤ 0.3 V, f = 0	-	10	-	10	-	15	mA	

**Notes**

- 5. Minimum voltage is -2.0 V and V<sub>IH</sub>(max) = V<sub>CC</sub> + 2 V for pulse durations of less than 20 ns.
- 6. Automotive product information is preliminary.

### Capacitance<sup>[7]</sup>

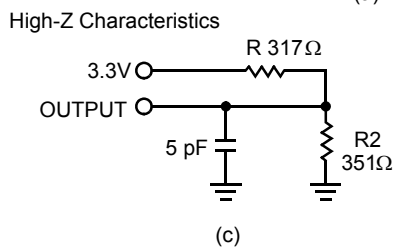
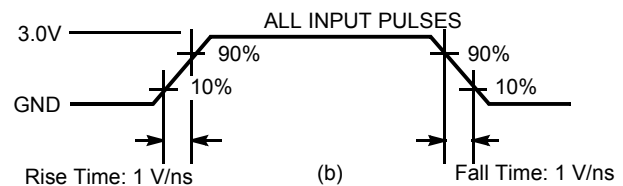
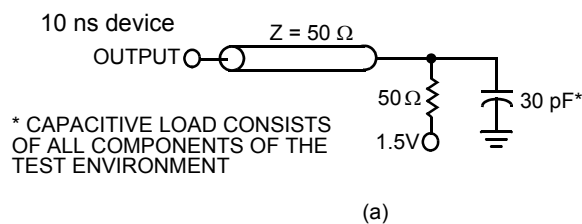
Parameter	Description	Test Conditions	Max	Unit
C <sub>IN</sub>	Input capacitance	T <sub>A</sub> = 25 °C, f = 1 MHz, V <sub>CC</sub> = 3.3 V	8	pF
C <sub>OUT</sub>	I/O capacitance		8	pF

### Thermal Resistance<sup>[7]</sup>

Parameter	Description	Test Conditions	FBGA Package	SOJ Package	TSOP II Package	Unit
Θ <sub>JA</sub>	Thermal resistance (junction to ambient)	Still Air, soldered on a 3 × 4.5 inch, four layer printed circuit board	27.89	57.91	50.66	°C/W
Θ <sub>JC</sub>	Thermal resistance (junction to case)		14.74	36.73	17.17	°C/W

### AC Test Loads and Waveforms

The AC test loads and waveform diagram follows.<sup>[8]</sup>



#### Notes

7. Tested initially and after any design or process changes that may affect these parameters.
8. AC characteristics (except high Z) are tested using the load conditions shown in [AC Test Loads and Waveforms](#) (a). High Z characteristics are tested for all speeds using the test load shown in (c).

## AC Switching Characteristics

 Over the Operating Range<sup>[9]</sup>

Parameter	Description	-10 (Industrial)		-10 (Automotive-A) <sup>[10]</sup>		-12 (Automotive-E) <sup>[10]</sup>		Unit
		Min	Max	Min	Max	Min	Max	
<b>Read Cycle</b>								
$t_{power}^{[11]}$	$V_{CC}$ (Typical) to the first access	100	–	100	–	100	–	μs
$t_{RC}$	Read cycle time	10	–	10	–	12	–	ns
$t_{AA}$	Address to data valid	–	10	–	10	–	12	ns
$t_{OHA}$	Data hold from address change	3	–	3	–	3	–	ns
$t_{ACE}$	$\overline{CE}$ LOW to data valid	–	10	–	10	–	12	ns
$t_{DOE}$	$\overline{OE}$ LOW to data valid	–	5	–	5	–	7	ns
$t_{LZOE}$	$\overline{OE}$ LOW to low Z	0	–	0	–	0	–	ns
$t_{HZOE}$	$\overline{OE}$ HIGH to high Z <sup>[12, 13]</sup>	–	5	–	5	–	6	ns
$t_{LZCE}$	$\overline{CE}$ LOW to low Z <sup>[13]</sup>	3	–	3	–	3	–	ns
$t_{HZCE}$	$\overline{CE}$ HIGH to high Z <sup>[12, 13]</sup>	–	5	–	5	–	6	ns
$t_{PU}$	$\overline{CE}$ LOW to power-up	0	–	0	–	0	–	ns
$t_{PD}$	$\overline{CE}$ HIGH to power-down	–	10	–	10	–	12	ns
$t_{DBE}$	Byte enable to data valid	–	5	–	5	–	7	ns
$t_{LZBE}$	Byte enable to low Z	0	–	0	–	0	–	ns
$t_{HZBE}$	Byte disable to high Z	–	6	–	6	–	6	ns
<b>Write Cycle</b> <sup>[14, 15]</sup>								
$t_{WC}$	Write cycle time	10	–	10	–	12	–	ns
$t_{SCE}$	$\overline{CE}$ LOW to write end	7	–	7	–	8	–	ns
$t_{AW}$	Address setup to write end	7	–	7	–	8	–	ns
$t_{HA}$	Address hold from write end	0	–	0	–	0	–	ns
$t_{SA}$	Address setup to write start	0	–	0	–	0	–	ns
$t_{PWE}$	$\overline{WE}$ pulse width	7	–	7	–	8	–	ns
$t_{SD}$	Data setup to write end	5	–	5	–	6	–	ns
$t_{HD}$	Data hold from write end	0	–	0	–	0	–	ns
$t_{LZWE}$	$\overline{WE}$ HIGH to low Z <sup>[13]</sup>	3	–	3	–	3	–	ns
$t_{HZWE}$	$\overline{WE}$ LOW to high Z <sup>[12, 13]</sup>	–	5	–	5	–	6	ns
$t_{BW}$	Byte enable to end of write	7	–	7	–	8	–	ns

### Notes

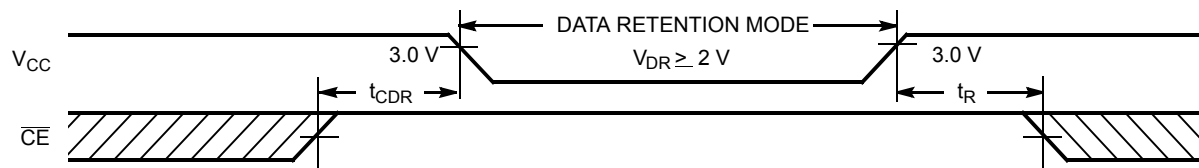
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3.0 V, and output loading of the specified  $I_{OL}/I_{OH}$  and 30-pF load capacitance.
- Automotive product information is preliminary.
- $t_{POWER}$  gives the minimum amount of time that the power supply should be at typical  $V_{CC}$  values until the first memory access is performed.
- $t_{HZOE}$ ,  $t_{HZCE}$ ,  $t_{HZBE}$ , and  $t_{HZWE}$  are specified with a load capacitance of 5 pF as in part (c) of [AC Test Loads and Waveforms](#). Transition is measured when the outputs enter a high impedance state.
- At any given temperature and voltage condition,  $t_{HZCE}$  is less than  $t_{LZCE}$ ,  $t_{HZOE}$  is less than  $t_{LZOE}$ ,  $t_{HZBE}$  is less than  $t_{LZBE}$ , 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 setup and hold timing should be referenced to the leading edge of the signal that terminates the write.
- The minimum write cycle time for Write Cycle No. 4 ( $\overline{WE}$  controlled,  $\overline{OE}$  LOW) is the sum of  $t_{HZWE}$  and  $t_{SD}$ .

## Data Retention Characteristics

Over the Operating Range

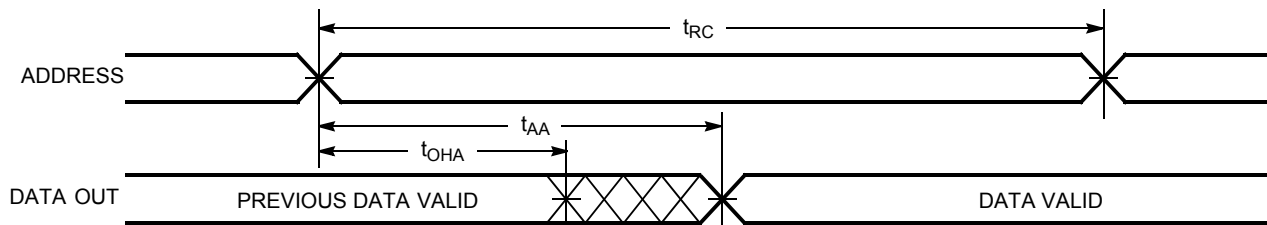
Parameter	Description	Conditions <sup>[16]</sup>	Min	Max	Unit	
$V_{DR}$	$V_{CC}$ for data retention		2.0	–	V	
$I_{CCDR}$	Data retention current	$V_{CC} = V_{DR} = 2.0\text{ V}$ , $CE \geq V_{CC} - 0.3\text{ V}$ , $V_{IN} \geq V_{CC} - 0.3\text{ V}$ or $V_{IN} \leq 0.3\text{ V}$	Industrial	–	10	mA
			Auto-A <sup>[17]</sup>	–	10	mA
			Auto-E <sup>[17]</sup>	–	15	mA
$t_{CDR}^{[18]}$	Chip deselect to data retention time		0	–	ns	
$t_R^{[19]}$	Operation recovery time		$t_{RC}$	–	ns	

## Data Retention Waveform



## Switching Waveforms

Figure 4. Read Cycle No. 1<sup>[20, 21]</sup>



### Notes

16. No input may exceed  $V_{CC} + 0.3\text{ V}$ .

17. Automotive product information is preliminary.

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

19. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(\text{min.})} \geq 50\ \mu\text{s}$  or stable at  $V_{CC(\text{min.})} \geq 50\ \mu\text{s}$ .

20. Device is continuously selected. OE, CE, BHE, and BLE =  $V_{IL}$ .

21. WE is HIGH for read cycle.

Switching Waveforms (continued)

Figure 5. Read Cycle No. 2 ( $\overline{OE}$  Controlled)<sup>[22, 23]</sup>

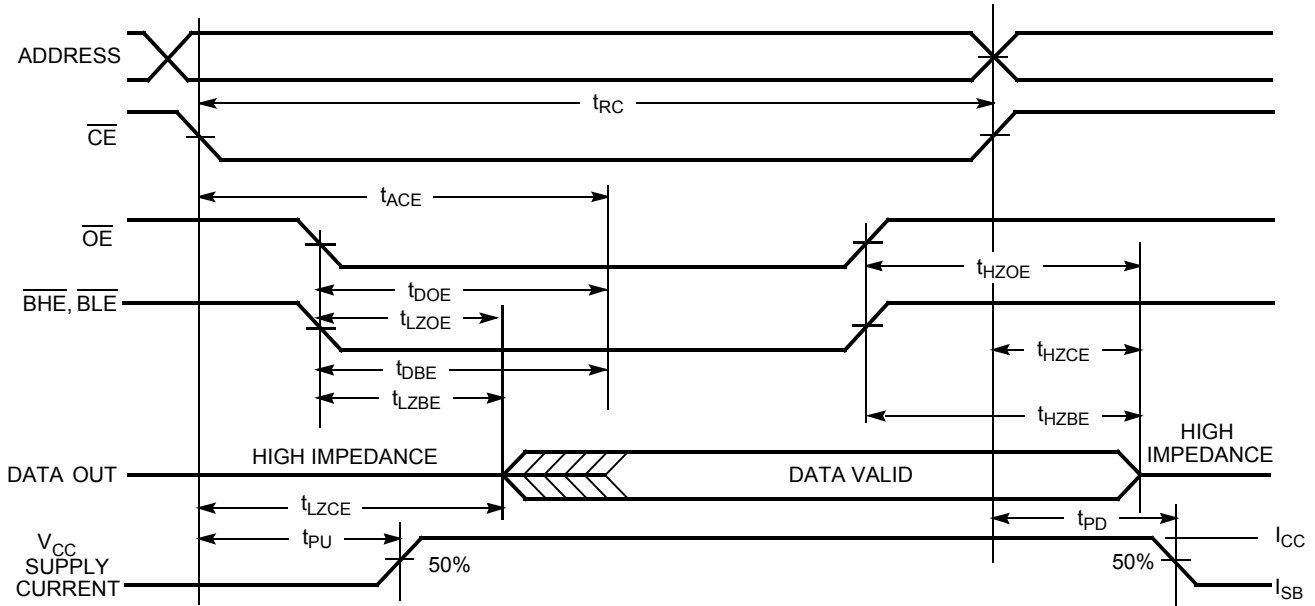
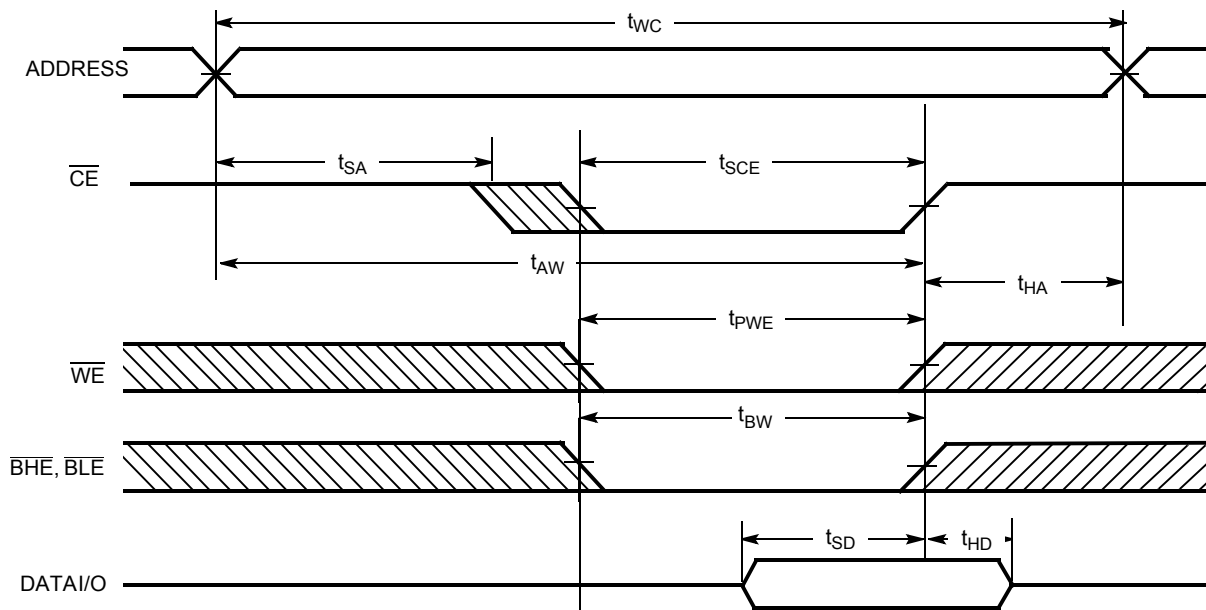


Figure 6. Write Cycle No. 1 ( $\overline{CE}$  Controlled)<sup>[24, 25]</sup>



Notes

- 22.  $\overline{WE}$  is HIGH for read cycle.
- 23. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.
- 24. Data I/O is high impedance if  $\overline{OE}$  or  $\overline{BHE}$  and  $\overline{BLE} = V_{IH}$ .
- 25. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE}$  going HIGH, the output remains in a high impedance state.



Switching Waveforms (continued)

Figure 7. Write Cycle No. 2 ( $\overline{\text{BLE}}$  or  $\overline{\text{BHE}}$  Controlled)

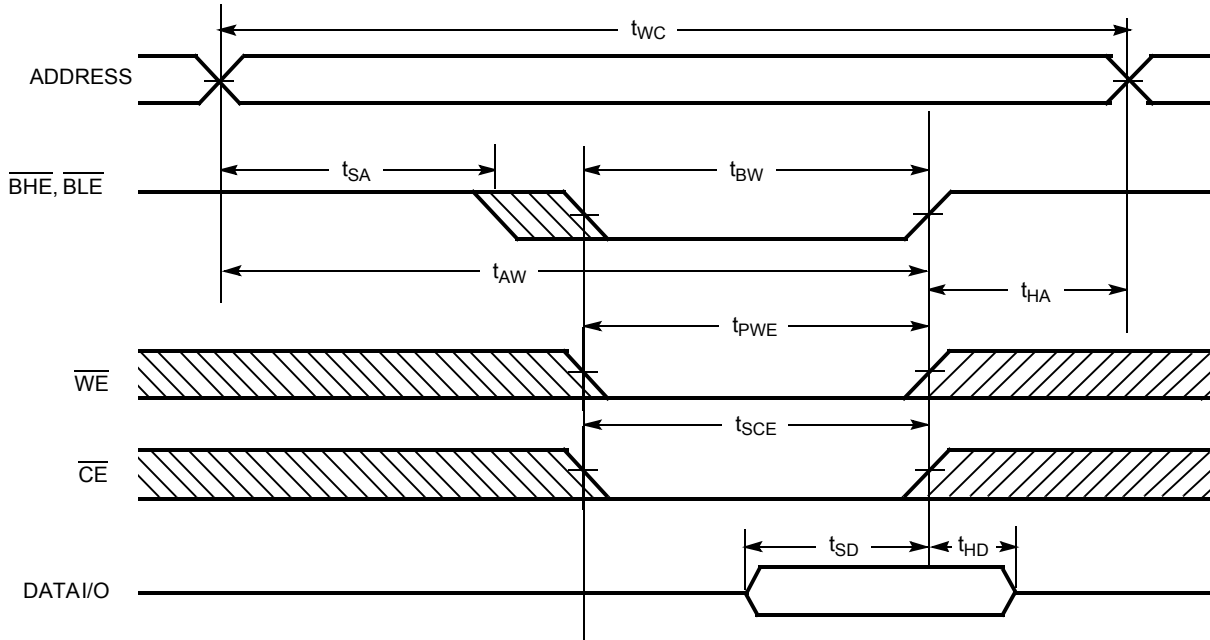
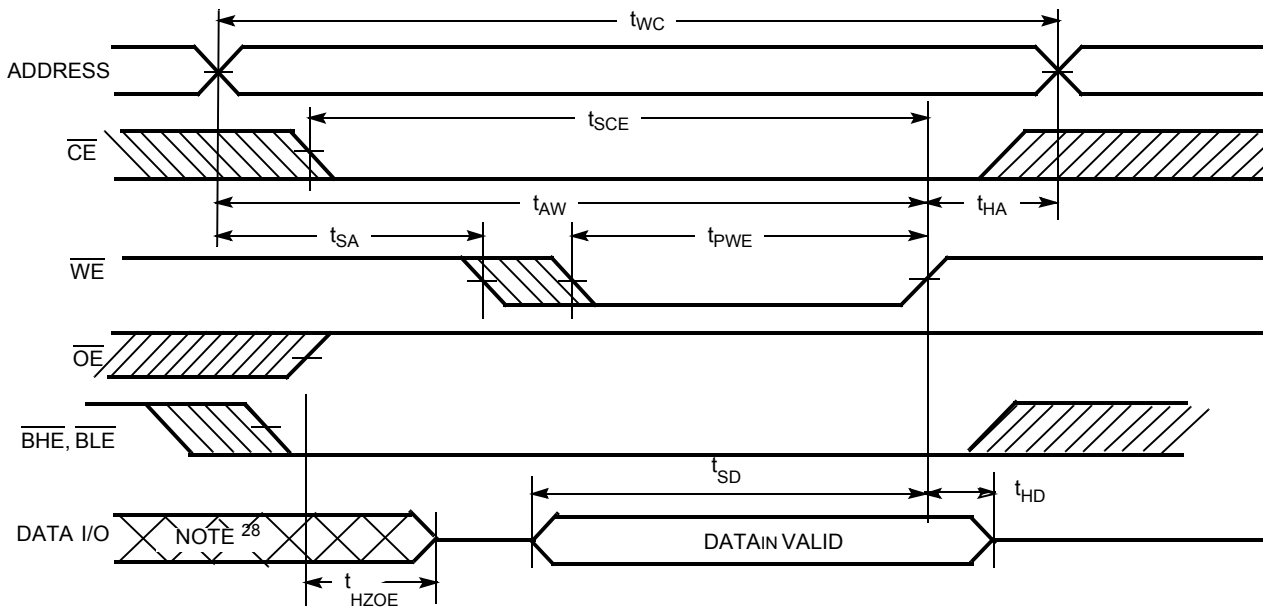


Figure 8. Write Cycle No. 3 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  HIGH During Write)<sup>[26, 27]</sup>

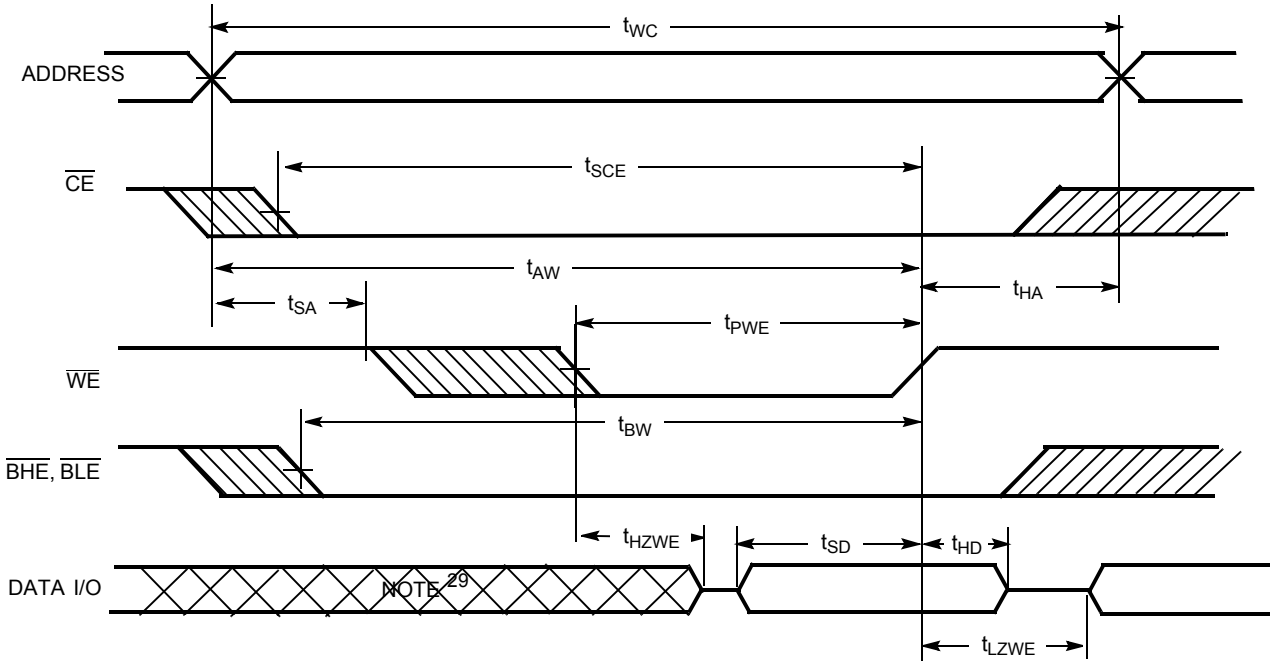


Notes

- 26. Data I/O is high impedance if  $\overline{\text{OE}}$  or  $\overline{\text{BHE}}$  and  $\overline{\text{BLE}} = V_{IH}$ .
- 27. If  $\overline{\text{CE}}$  goes HIGH simultaneously with  $\overline{\text{WE}}$  going HIGH, the output remains in a high impedance state.
- 28. During this period the I/Os are in the output state and input signals should not be applied.

Switching Waveforms (continued)

Figure 9. Write Cycle No. 4 ( $\overline{WE}$  Controlled,  $\overline{OE}$  LOW)



Truth Table

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

Note 29. During this period the I/Os are in the output state and input signals should not be applied.

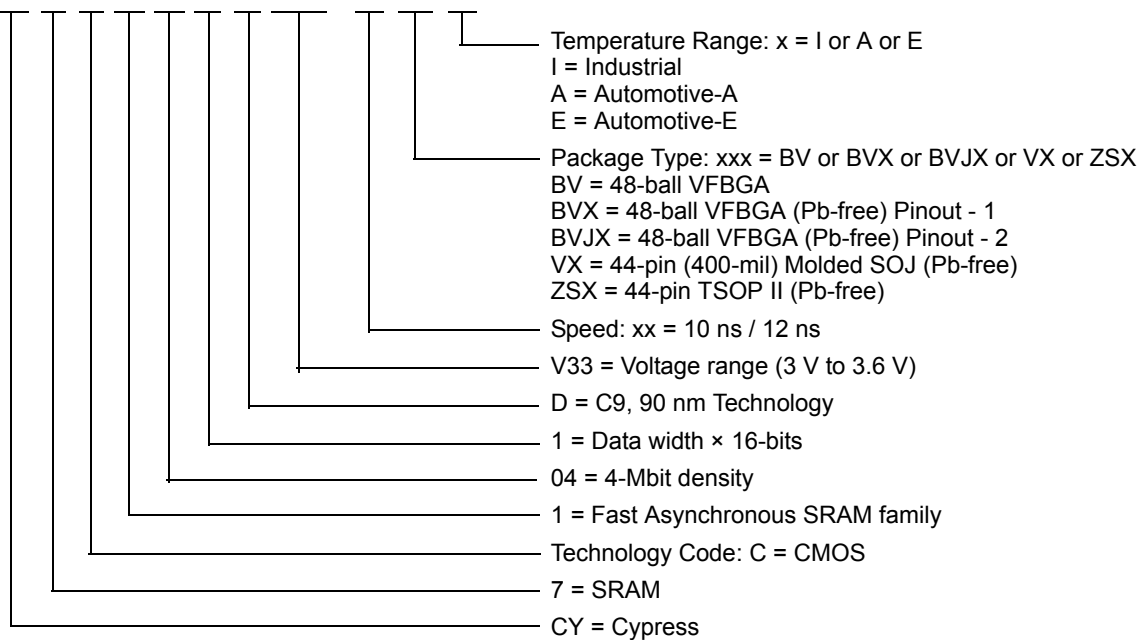
**Ordering Information**

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
10	CY7C1041DV33-10BVI	51-85150	48-ball VFBGA	Industrial
	CY7C1041DV33-10BVXI		48-ball VFBGA (Pb-free) Pinout - 1 <sup>[4]</sup>	
	CY7C1041DV33-10BVJXI		48-ball VFBGA (Pb-free) Pinout - 2 <sup>[4]</sup>	
	CY7C1041DV33-10VXI	51-85082	44-pin (400-mil) Molded SOJ (Pb-free)	
	CY7C1041DV33-10ZSXI	51-85087	44-pin TSOP II (Pb-free)	
10	CY7C1041DV33-10BVXA	51-85150	48-ball VFBGA (Pb-free) Pinout - 1 <sup>[4]</sup>	Automotive-A <sup>[1]</sup>
	CY7C1041DV33-10ZSXA	51-85087	44-pin TSOP II (Pb-free)	
12	CY7C1041DV33-12BVXE	51-85150	48-ball VFBGA (Pb-free) Pinout - 1 <sup>[4]</sup>	Automotive-E <sup>[1]</sup>
	CY7C1041DV33-12BVJXE		48-ball VFBGA (Pb-free) Pinout - 2 <sup>[4]</sup>	
	CY7C1041DV33-12VXE	51-85082	44-pin (400-mil) Molded SOJ (Pb-free)	
	CY7C1041DV33-12ZSXE	51-85087	44-pin TSOP II (Pb-free)	

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

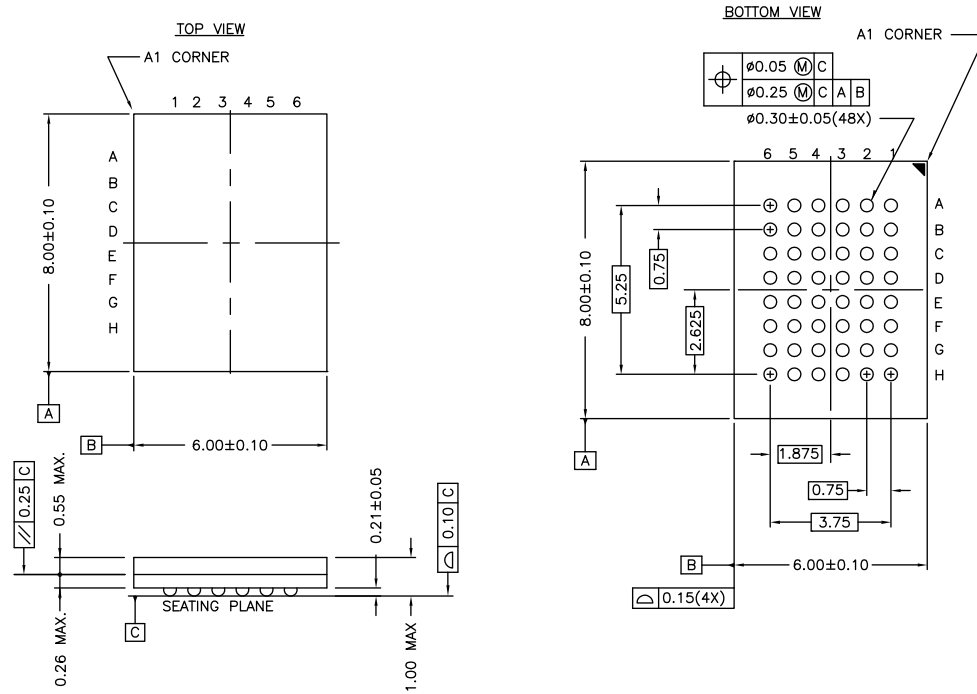
**Ordering Code Definitions**

CY 7 C 1 04 1 D V33 - xx xxx x



Package Diagrams

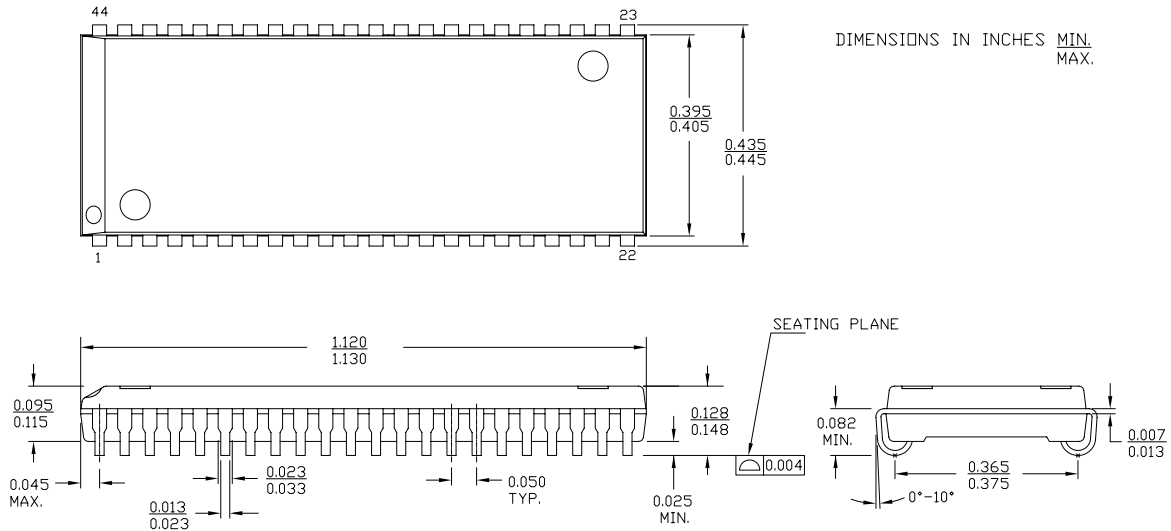
Figure 1. 48-ball VFBGA (6 × 8 × 1 mm), 51-85150



51-85150 \*F

Package Diagrams (continued)

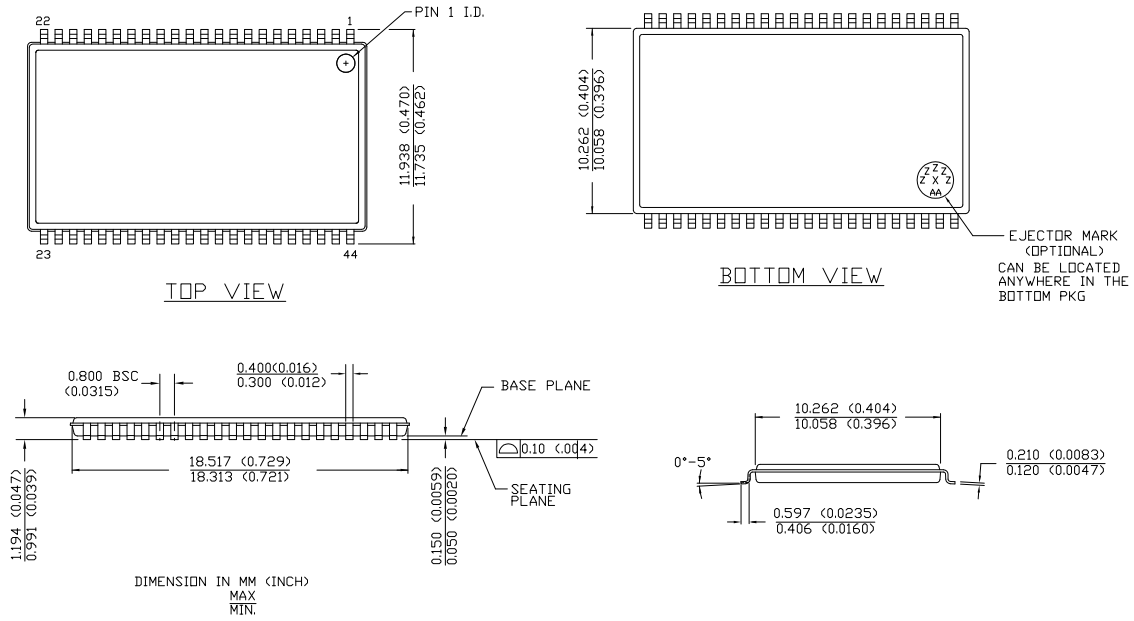
Figure 2. 44-pin (400-mil) Molded SOJ, 51-85082



51-85082 \*C

Package Diagrams (continued)

Figure 3. 44-pin TSOP II, 51-85087



51-85087 \*C

## Acronyms

Acronym	Description
CE	chip enable
CMOS	Complementary metal oxide semiconductor
I/O	Input/output
OE	output enable
SRAM	Static random access memory
SOJ	Small Outline J-Lead
TSOP	Thin Small Outline Package
VFBGA	Very Fine-Pitch Ball Grid Array

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
ns	nano seconds
V	Volts
μA	micro Amperes
mA	milli Amperes
mV	milli Volts
mW	milli Watts
MHz	Mega Hertz
pF	pico Farad
°C	degree Celcius
W	Watts

Document History Page

Document Title: CY7C1041DV33 4-Mbit (256 K × 16) Static RAM				
Document Number: 38-05473				
Rev.	ECN No.	Orig. of Change	Submission Date	Description of Change
**	201560	SWI	See ECN	Advance Data sheet for C9 IPP
*A	233729	RKF	See ECN	1.AC, DC parameters are modified as per EROS(Spec # 01-2165) 2.Pb-free offering in the 'Ordering information'
*B	351117	PCI	See ECN	Changed from Advance to Preliminary Removed 15 and 20 ns Speed bin Corrected DC voltage (min) value in maximum ratings section from - 0.5 to - 0.3V Redefined I <sub>CC</sub> values for Com'l and Ind'l temperature ranges I <sub>CC</sub> (Com'l): Changed from 100, 80 and 67 mA to 90, 80 and 75 mA for 8, 10 and 12ns speed bins respectively I <sub>CC</sub> (Ind'l): Changed from 80 and 67 mA to 90 and 85 mA for 10 and 12ns speed bins respectively Added Static Discharge Voltage and latch-up current spec Added V <sub>IH(max)</sub> spec in Note# 2 Changed Note# 4 on AC Test Loads Changed reference voltage level for measurement of Hi-Z parameters from ±500 mV to ±200 mV Added Data Retention Characteristics/Waveform and footnote # 11, 12 Added Write Cycle (WE Controlled, OE HIGH During Write) Timing Diagram Changed Package Diagram name from 44-Pin TSOP II Z44 to 44-Pin TSOP II ZS44 and from 44-Pin (400-mil) Molded SOJ V34 to 44-Pin (400-mil) Molded SOJ V44 Changed part names from Z to ZS in the Ordering Information Table Added 8 ns Product Information Added Pin-Free Ordering Information Shaded Ordering Information Table
*C	446328	NXR	See ECN	Converted from Preliminary to Final Removed -8 speed bin Removed Commercial Operating Range product information Included Automotive Operating Range product information Updated Thermal Resistance table Updated footnote #8 on High-Z parameter measurement Updated the ordering information and replaced Package Name column with Package Diagram in the Ordering Information Table
*D	480177	VKN	See ECN	Added -10BVI product ordering code in the Ordering Information table
*E	2541850	VKN/PYRS	07/22/08	Added -10BVJXI part
*F	2752971	VKN	08/18/2009	Added Automotive-A information For 12 ns speed, changed I <sub>SB1</sub> spec from 25 mA to 15 mA For 12 ns speed, changed t <sub>DOE</sub> and t <sub>DBE</sub> specs from 6 ns to 7 ns Updated ordering information table
*G	3034079	PRAS	09/20/2010	Added <a href="#">Ordering Code Definitions</a> . Added <a href="#">Acronyms and Units of Measure</a> . Minor edits
*H	3082285	HRP	11/09/2010	Corrected typo in Note 20.
*I	3149096	AJU	01/24/2011	No technical updates



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