

## Features

- Pin- and function-compatible with CY7C109B/CY7C1009B
- High speed
  - $t_{AA} = 10$  ns
- Low active power
  - $I_{CC} = 80$  mA at 10 ns
- Low CMOS standby power
  - $I_{SB2} = 3$  mA
- 2.0 V Data Retention
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with  $\overline{CE}_1$ ,  $CE_2$  and  $\overline{OE}$  options
- CY7C109D available in Pb-free 32-pin 400-Mil wide Molded SOJ and 32-pin TSOP I packages. CY7C1009D available in Pb-free 32-pin 300-Mil wide Molded SOJ package

## Functional Description

The CY7C109D/CY7C1009D [1] is a high-performance CMOS static RAM organized as 131,072 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ( $\overline{CE}_1$ ), an active HIGH Chip Enable ( $CE_2$ ), an active LOW Output Enable

( $\overline{OE}$ ), and tri-state drivers. The eight input and output pins ( $I/O_0$  through  $I/O_7$ ) are placed in a high-impedance state when:

- Deselected ( $\overline{CE}_1$  HIGH or  $CE_2$  LOW),
- Outputs are disabled ( $\overline{OE}$  HIGH),
- When the write operation is active ( $\overline{CE}_1$  LOW,  $CE_2$  HIGH, and  $WE$  LOW)

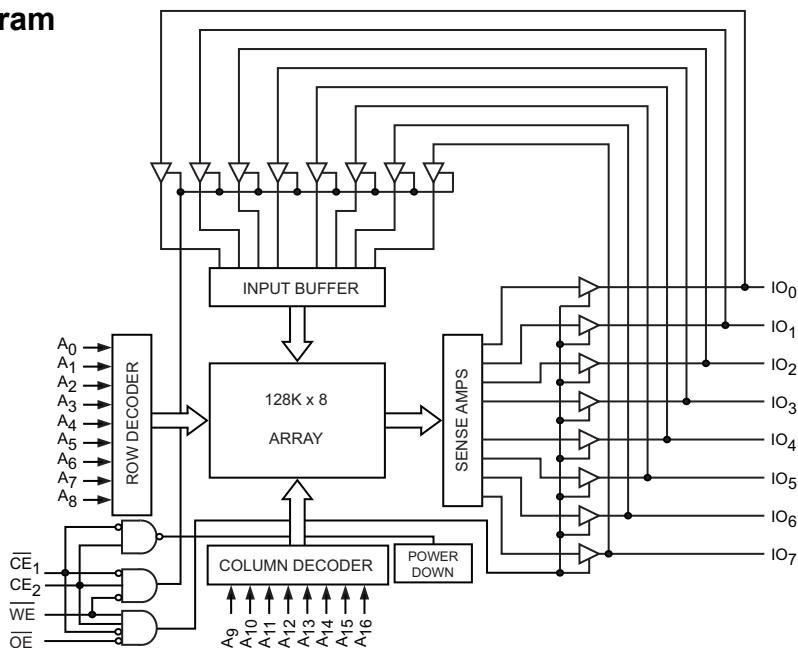
Write to the device by taking Chip Enable One ( $\overline{CE}_1$ ) and Write Enable ( $WE$ ) inputs LOW and Chip Enable Two ( $CE_2$ ) input HIGH. Data on the eight I/O pins ( $I/O_0$  through  $I/O_7$ ) is then written into the location specified on the address pins ( $A_0$  through  $A_{16}$ ).

Read from the device by taking Chip Enable One ( $\overline{CE}_1$ ) and Output Enable ( $OE$ ) LOW while forcing Write Enable ( $WE$ ) and Chip Enable Two ( $CE_2$ ) HIGH. Under these conditions, the contents of the memory location specified by the address pins appears on the I/O pins.

The CY7C109D/CY7C1009D device is suitable for interfacing with processors that have TTL I/P levels. It is not suitable for processors that require CMOS I/P levels. Please see [Electrical Characteristics on page 4](#) for more details and suggested alternatives.

For a complete list of related documentation, click [here](#).

## Logic Block Diagram



## Contents

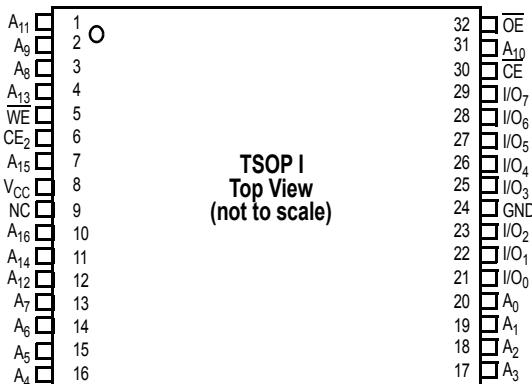
|   |           |  |           |
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**Note**

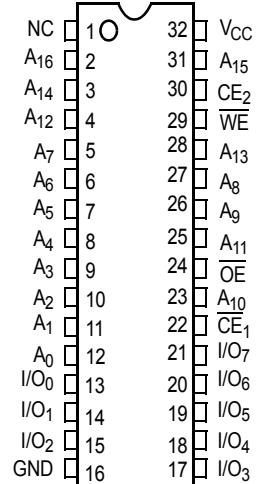
1. For guidelines on SRAM system design, please refer to the 'System Design Guidelines' Cypress application note, available on the internet at [www.cypress.com](http://www.cypress.com).

## Pin Configurations

**Figure 1. 32-pin TSOP I pinout**



**Figure 2. 32-pin SOJ pinout (Top View) [2]**



## Selection Guide

| Description                  | CY7C109D-10<br>CY7C1009D-10 | Unit |
|------------------------------|-----------------------------|------|
| Maximum Access Time          | 10                          | ns   |
| Maximum Operating Current    | 80                          | mA   |
| Maximum CMOS Standby Current | 3                           | mA   |

## Note

**Note** 2. NC pins are not connected on the die.

## Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. User guidelines are not tested.

Storage Temperature .....  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$

Ambient Temperature with Power Applied .....  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Supply Voltage on  $V_{\text{CC}}$  to Relative GND <sup>[3]</sup> .....  $-0.5\text{ V}$  to  $+6.0\text{ V}$

DC Voltage Applied to Outputs in High-Z State <sup>[3]</sup> .....  $-0.5\text{ V}$  to  $V_{\text{CC}} + 0.5\text{ V}$

DC Input Voltage <sup>[3]</sup> .....  $-0.5\text{ V}$  to  $V_{\text{CC}} + 0.5\text{ V}$   
 Current into Outputs (LOW) .....  $20\text{ mA}$   
 Static Discharge Voltage (per MIL-STD-883, Method 3015) .....  $> 2001\text{ V}$   
 Latch-up Current .....  $> 200\text{ mA}$

## Operating Range

| Range      | Ambient Temperature                            | $V_{\text{CC}}$               | Speed |
|------------|--|-------------------------------|-------|
| Industrial | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | $5\text{ V} \pm 0.5\text{ V}$ | 10 ns |

## Electrical Characteristics

Over the Operating Range

| Parameter        | Description                                   | Test Conditions  | 7C109D-10<br>7C1009D-10 |                       | Unit          |
|------------------|---|--|-------------------------|-----------------------|---------------|
|                  |   |  | Min                     | Max                   |               |
| $V_{\text{OH}}$  | Output HIGH Voltage                           | $I_{\text{OH}} = -4.0\text{ mA}$   | 2.4                     | —                     | V             |
|                  |   | $I_{\text{OH}} = -0.1\text{ mA}$   | —                       | $3.4$ <sup>[4]</sup>  |               |
| $V_{\text{OL}}$  | Output LOW Voltage                            | $I_{\text{OL}} = 8.0\text{ mA}$  |                         | 0.4                   | V             |
| $V_{\text{IH}}$  | Input HIGH Voltage                            |  | 2.2                     | $V_{\text{CC}} + 0.5$ | V             |
| $V_{\text{IL}}$  | Input LOW Voltage <sup>[3]</sup>              |  | -0.5                    | 0.8                   | V             |
| $I_{\text{IX}}$  | Input Leakage Current                         | $\text{GND} \leq V_{\text{I}} \leq V_{\text{CC}}$  | -1                      | +1                    | $\mu\text{A}$ |
| $I_{\text{OZ}}$  | Output Leakage Current                        | $\text{GND} \leq V_{\text{I}} \leq V_{\text{CC}}$ , Output Disabled  | -1                      | +1                    | $\mu\text{A}$ |
| $I_{\text{CC}}$  | $V_{\text{CC}}$ Operating Supply Current      | $V_{\text{CC}} = \text{Max}$ , $I_{\text{OUT}} = 0\text{ mA}$ ,<br>$f = f_{\text{max}} = 1/\text{RC}$  | 100 MHz                 | —                     | 80 mA         |
|                  |   |  | 83 MHz                  | —                     | 72 mA         |
|                  |   |  | 66 MHz                  | —                     | 58 mA         |
|                  |   |  | 40 MHz                  | —                     | 37 mA         |
| $I_{\text{SB1}}$ | Automatic CE Power-Down Current – TTL Inputs  | $\text{Max } V_{\text{CC}}, \overline{\text{CE}}_1 \geq V_{\text{IH}}$ or $\text{CE}_2 \leq V_{\text{IL}}$ ,<br>$V_{\text{IN}} \geq V_{\text{IH}}$ or $V_{\text{IN}} \leq V_{\text{IL}}$ , $f = f_{\text{max}}$                    | —                       | 10                    | mA            |
| $I_{\text{SB2}}$ | Automatic CE Power-Down Current – CMOS Inputs | $\text{Max } V_{\text{CC}}, \overline{\text{CE}}_1 \geq V_{\text{CC}} - 0.3\text{ V}$ , or $\text{CE}_2 \leq 0.3\text{ V}$ ,<br>$V_{\text{IN}} \geq V_{\text{CC}} - 0.3\text{ V}$ , or $V_{\text{IN}} \leq 0.3\text{ V}$ , $f = 0$ | —                       | 3                     | mA            |

### Note

3.  $V_{\text{IL}}(\text{min}) = -2.0\text{ V}$  and  $V_{\text{IH}}(\text{max}) = V_{\text{CC}} + 1\text{ V}$  for pulse durations of less than 5 ns.

4. Please note that the maximum  $V_{\text{OH}}$  limit does not exceed minimum CMOS  $V_{\text{IH}}$  of 3.5 V. If you are interfacing this SRAM with 5 V legacy processors that require a minimum  $V_{\text{IH}}$  of 3.5 V, please refer to Application Note [AN6081](#) for technical details and options you may consider.

## Capacitance

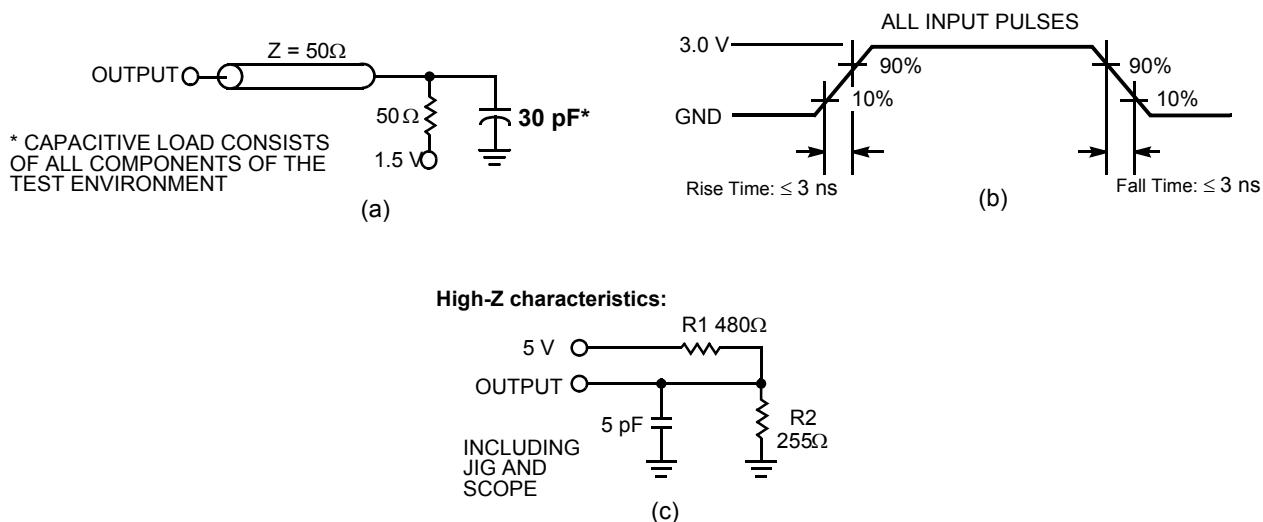
| Parameter <sup>[5]</sup> | Description        | Test Conditions   | Max | Unit |
|--------------------------|--------------------|---|-----|------|
| $C_{IN}$                 | Input capacitance  | $T_A = 25^\circ\text{C}$ , $f = 1\text{ MHz}$ , $V_{CC} = 5.0\text{ V}$ | 8   | pF   |
| $C_{OUT}$                | Output capacitance |   | 8   | pF   |

## Thermal Resistance

| Parameter <sup>[5]</sup> | Description                              | Test Conditions   | 300-Mil Wide SOJ | 400-Mil Wide SOJ | TSOP I | Unit |
|--------------------------|--|---|------------------|------------------|--------|------|
| $\Theta_{JA}$            | Thermal resistance (junction to ambient) | Still Air, soldered on a 3 x 4.5 inch, four-layer printed circuit board | 57.61            | 56.29            | 50.72  | °C/W |
| $\Theta_{JC}$            | Thermal resistance (junction to case)    |   | 40.53            | 38.14            | 16.21  | °C/W |

## AC Test Loads and Waveforms

Figure 3. AC Test Loads and Waveforms <sup>[6]</sup>



### Notes

5. Tested initially and after any design or process changes that may affect these parameters.
6. AC characteristics (except High-Z) are tested using the load conditions shown in Figure 3 (a). High-Z characteristics are tested for all speeds using the test load shown in Figure 3 (c).

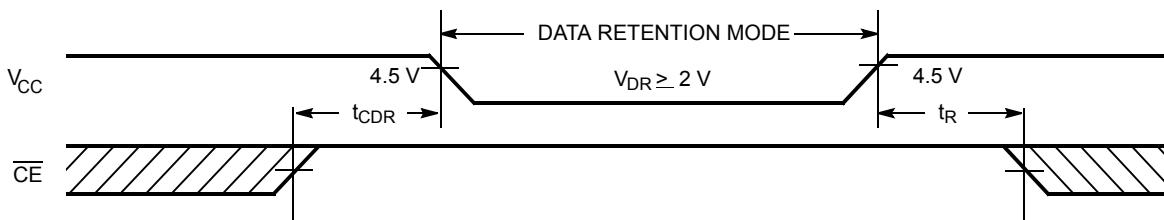
## Data Retention Characteristics

Over the Operating Range

| Parameter                | Description                          | Conditions   | Min      | Max | Unit |
|--------------------------|--------------------------------------|--|----------|-----|------|
| $V_{DR}$                 | $V_{CC}$ for Data Retention          | $V_{CC} = V_{DR} = 2.0 \text{ V}$ ,<br>$\overline{CE}_1 \geq V_{CC} - 0.3 \text{ V}$ or $CE_2 \leq 0.3 \text{ V}$ ,<br>$V_{IN} \geq V_{CC} - 0.3 \text{ V}$ or $V_{IN} \leq 0.3 \text{ V}$ | 2.0      | –   | V    |
| $I_{CCDR}$               | Data Retention Current               |  | –        | 3   | mA   |
| $t_{CDR}$ <sup>[7]</sup> | Chip Deselect to Data Retention Time |  | 0        | –   | ns   |
| $t_R$ <sup>[8]</sup>     | Operation Recovery Time              |  | $t_{RC}$ | –   | ns   |

## Data Retention Waveform

Figure 4. Data Retention Waveform



### Notes

7. Tested initially and after any design or process changes that may affect these parameters.
8. Full device operation requires linear  $V_{CC}$  ramp from  $V_{DR}$  to  $V_{CC(\min)} \geq 50 \mu\text{s}$  or stable at  $V_{CC(\min)} \geq 50 \mu\text{s}$ .

## Switching Characteristics

Over the Operating Range

| Parameter <sup>[9]</sup>               | Description  | 7C109D-10<br>7C1009D-10 |     | Unit |
|--|--|-------------------------|-----|------|
|  |  | Min                     | Max |      |
| <b>Read Cycle</b>                      |  |                         |     |      |
| $t_{\text{power}}^{[10]}$              | $V_{\text{CC}}$ (typical) to the first access  | 100                     | —   | μs   |
| $t_{\text{RC}}$                        | Read Cycle Time  | 10                      | —   | ns   |
| $t_{\text{AA}}$                        | Address to Data Valid  | —                       | 10  | ns   |
| $t_{\text{OHA}}$                       | Data Hold from Address Change  | 3                       | —   | ns   |
| $t_{\text{ACE}}$                       | $\overline{\text{CE}}_1$ LOW to Data Valid, $\text{CE}_2$ HIGH to Data Valid             | —                       | 10  | ns   |
| $t_{\text{DOE}}$                       | $\text{OE}$ LOW to Data Valid  | —                       | 5   | ns   |
| $t_{\text{LZOE}}$                      | $\text{OE}$ LOW to Low Z   | 0                       | —   | ns   |
| $t_{\text{HZOE}}$                      | $\text{OE}$ HIGH to High Z <sup>[11, 12]</sup>   | —                       | 5   | ns   |
| $t_{\text{LZCE}}$                      | $\overline{\text{CE}}_1$ LOW to Low Z, $\text{CE}_2$ HIGH to Low Z <sup>[12]</sup>       | 3                       | —   | ns   |
| $t_{\text{HZCE}}$                      | $\overline{\text{CE}}_1$ HIGH to High Z, $\text{CE}_2$ LOW to High Z <sup>[11, 12]</sup> | —                       | 5   | ns   |
| $t_{\text{PU}}^{[13]}$                 | $\overline{\text{CE}}_1$ LOW to Power-Up, $\text{CE}_2$ HIGH to Power-Up                 | 0                       | —   | ns   |
| $t_{\text{PD}}^{[13]}$                 | $\overline{\text{CE}}_1$ HIGH to Power-Down, $\text{CE}_2$ LOW to Power-Down             | —                       | 10  | ns   |
| <b>Write Cycle</b> <sup>[14, 15]</sup> |  |                         |     |      |
| $t_{\text{WC}}$                        | Write Cycle Time   | 10                      | —   | ns   |
| $t_{\text{SCE}}$                       | $\overline{\text{CE}}_1$ LOW to Write End, $\text{CE}_2$ HIGH to Write End               | 7                       | —   | ns   |
| $t_{\text{AW}}$                        | Address Set-Up to Write End  | 7                       | —   | ns   |
| $t_{\text{HA}}$                        | Address Hold from Write End  | 0                       | —   | ns   |
| $t_{\text{SA}}$                        | Address Set-Up to Write Start  | 0                       | —   | ns   |
| $t_{\text{PWE}}$                       | WE Pulse Width   | 7                       | —   | ns   |
| $t_{\text{SD}}$                        | Data Set-Up to Write End   | 6                       | —   | ns   |
| $t_{\text{HD}}$                        | Data Hold from Write End   | 0                       | —   | ns   |
| $t_{\text{LZWE}}$                      | WE HIGH to Low Z <sup>[12]</sup>   | 3                       | —   | ns   |
| $t_{\text{HZWE}}$                      | WE LOW to High Z <sup>[11, 12]</sup>   | —                       | 5   | ns   |

### Notes

9. 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  $I_{\text{OL}}/I_{\text{OH}}$  and 30-pF load capacitance.
10.  $t_{\text{POWER}}$  gives the minimum amount of time that the power supply should be at typical  $V_{\text{CC}}$  values until the first memory access can be performed.
11.  $t_{\text{HZOE}}$ ,  $t_{\text{HZCE}}$  and  $t_{\text{HZWE}}$  are specified with a load capacitance of 5 pF as in part (c) of [Figure 3 on page 5](#). Transition is measured when the outputs enter a high impedance state.
12. At any given temperature and voltage condition,  $t_{\text{LZCE}}$  is less than  $t_{\text{LZOE}}$ ,  $t_{\text{HZOE}}$  is less than  $t_{\text{LZOE}}$ , and  $t_{\text{HZWE}}$  is less than  $t_{\text{LZWE}}$  for any given device.
13. This parameter is guaranteed by design and is not tested.
14. The internal write time of the memory is defined by the overlap of  $\overline{\text{CE}}_1$  LOW,  $\text{CE}_2$  HIGH, and  $\overline{\text{WE}}$  LOW.  $\overline{\text{CE}}_1$  and  $\overline{\text{WE}}$  must be LOW and  $\text{CE}_2$  HIGH to initiate a write, and the transition of any 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.
15. The minimum write cycle time for Write Cycle No. 3 (WE controlled,  $\text{OE}$  LOW) is the sum of  $t_{\text{HZWE}}$  and  $t_{\text{SD}}$ .

## Switching Waveforms

Figure 5. Read Cycle No. 1 (Address Transition Controlled) [16, 17]

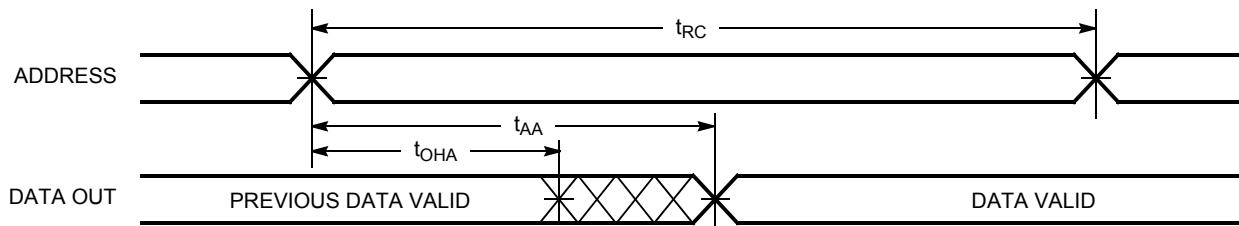
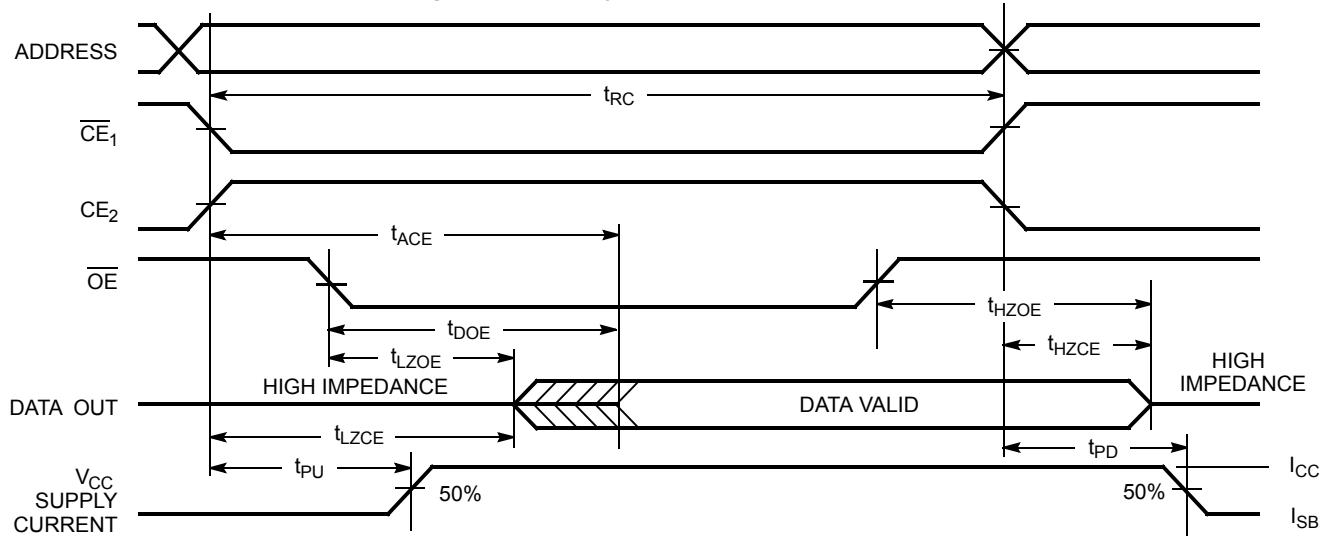


Figure 6. Read Cycle No. 2 ( $\overline{OE}$  Controlled) [17, 18]

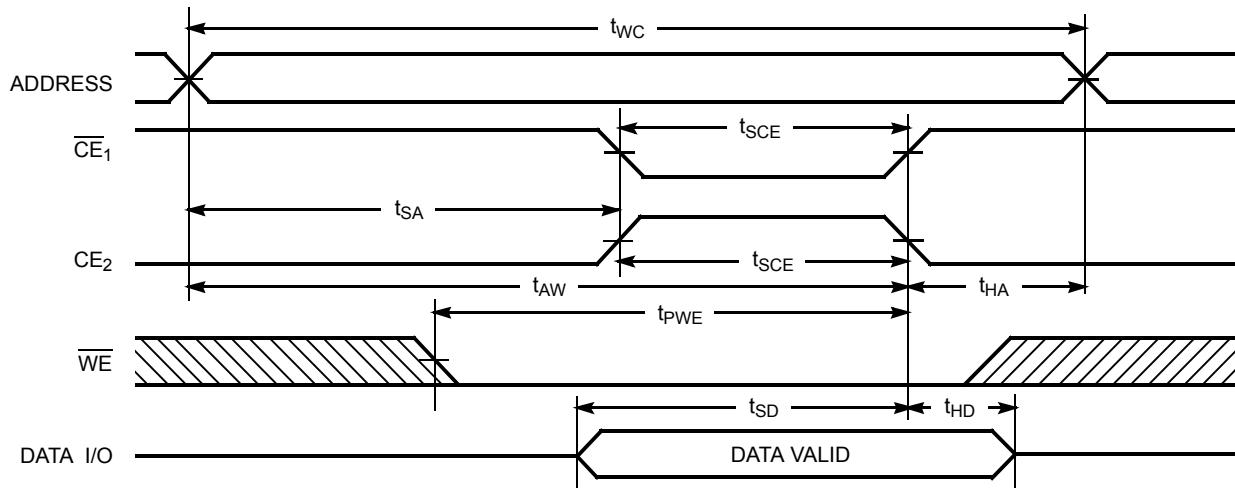


### Notes

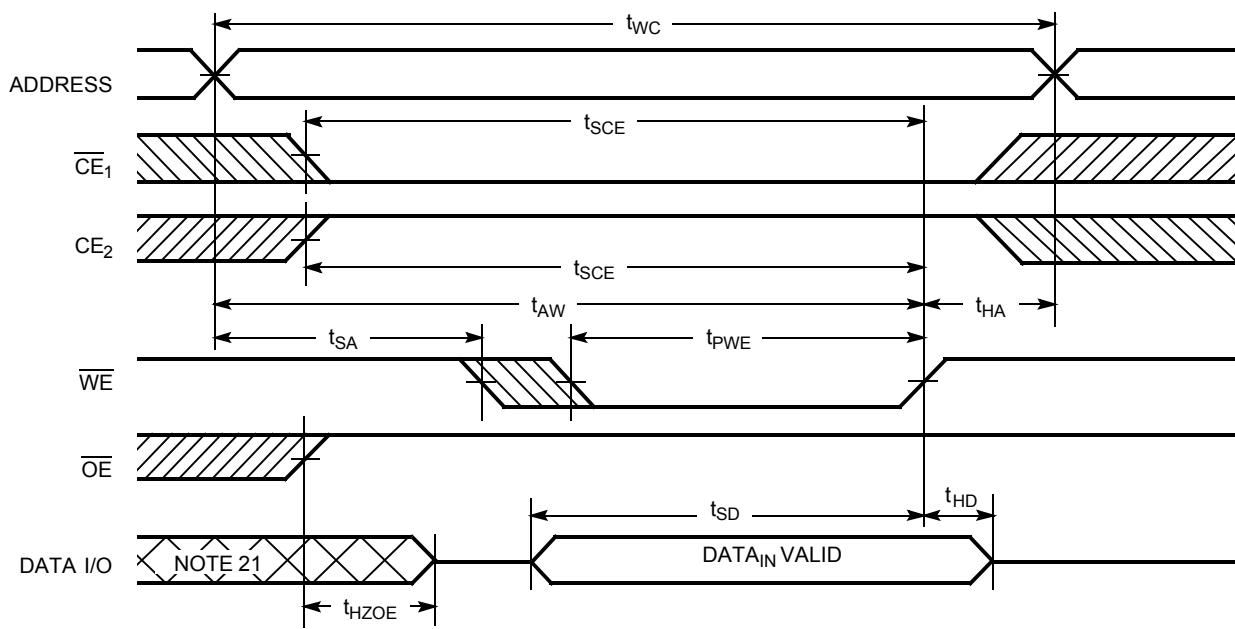
16. Device is continuously selected.  $\overline{OE}$ ,  $\overline{CE}_1 = V_{IL}$ ,  $CE_2 = V_{IH}$ .
17.  $\overline{WE}$  is HIGH for read cycle.
18. Address valid prior to or coincident with  $\overline{CE}_1$  transition LOW and  $CE_2$  transition HIGH.

## Switching Waveforms (continued)

**Figure 7. Write Cycle No. 1 ( $\overline{CE}_1$  or  $CE_2$  Controlled) [19, 20]**



**Figure 8. Write Cycle No. 2 ( $\overline{WE}$  Controlled,  $\overline{OE}$  HIGH During Write) [19, 20]**

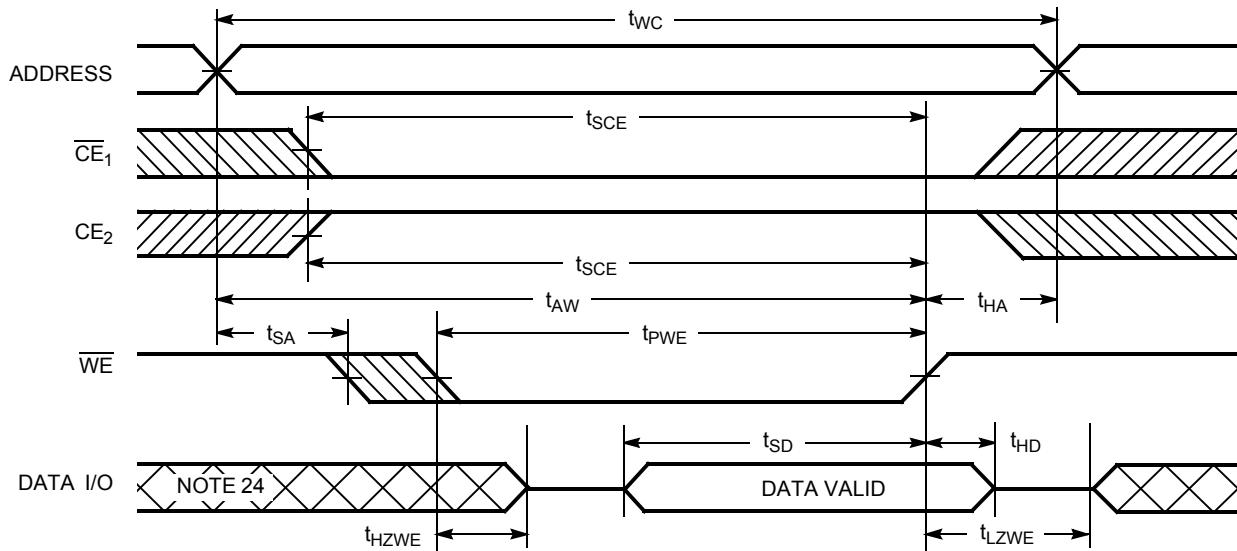


### Notes

19. Data I/O is high impedance if  $\overline{OE} = V_{IH}$ .
20. If  $CE_1$  goes HIGH or  $CE_2$  goes LOW simultaneously with  $\overline{WE}$  going HIGH, the output remains in a high-impedance state.
21. 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. 3 ( $\overline{\text{WE}}$  Controlled,  $\overline{\text{OE}}$  LOW)** [22, 23]



### Notes

22. The minimum write cycle pulse width should be equal to the sum of  $t_{\text{SD}}$  and  $t_{\text{HZWE}}$ .
23. If  $\overline{\text{CE}}_1$  goes HIGH or  $\text{CE}_2$  goes LOW simultaneously with  $\overline{\text{WE}}$  going HIGH, the output remains in a high-impedance state.
24. During this period the I/Os are in the output state and input signals should not be applied.

## Truth Table

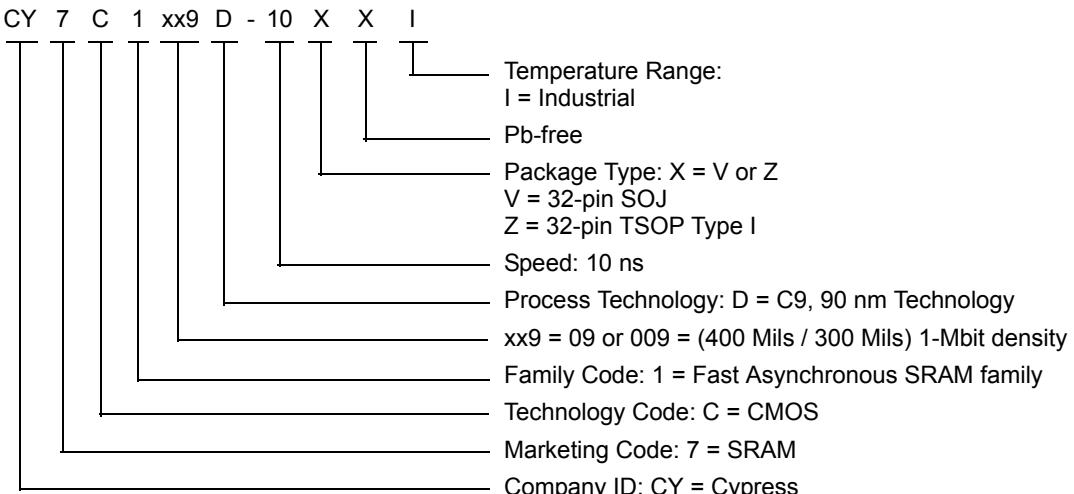
| <b><math>\overline{CE}_1</math></b> | <b><math>CE_2</math></b> | <b><math>\overline{OE}</math></b> | <b><math>\overline{WE}</math></b> | <b><math>I/O_0-I/O_7</math></b> | <b>Mode</b>                | <b>Power</b>         |
|-------------------------------------|--------------------------|-----------------------------------|-----------------------------------|---------------------------------|----------------------------|----------------------|
| H                                   | X                        | X                                 | X                                 | High Z                          | Power-down                 | Standby ( $I_{SB}$ ) |
| X                                   | L                        | X                                 | X                                 | High Z                          | Power-down                 | Standby ( $I_{SB}$ ) |
| L                                   | H                        | L                                 | H                                 | Data Out                        | Read                       | Active ( $I_{CC}$ )  |
| L                                   | H                        | X                                 | L                                 | Data In                         | Write                      | Active ( $I_{CC}$ )  |
| L                                   | H                        | H                                 | H                                 | High Z                          | Selected, Outputs Disabled | Active ( $I_{CC}$ )  |

## Ordering Information

| <b>Speed<br/>(ns)</b> | <b>Ordering Code</b> | <b>Package<br/>Diagram</b> | <b>Package Type</b>           | <b>Operating<br/>Range</b> |
|-----------------------|----------------------|----------------------------|-------------------------------|----------------------------|
| 10                    | CY7C109D-10VXI       | 51-85033                   | 32-pin SOJ (400 Mils) Pb-free | Industrial                 |
|                       | CY7C109D-10ZXI       | 51-85056                   | 32-pin TSOP (Type I) Pb-free  |                            |
|                       | CY7C1009D-10VXI      | 51-85041                   | 32-pin SOJ (300 Mils) Pb-free |                            |

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

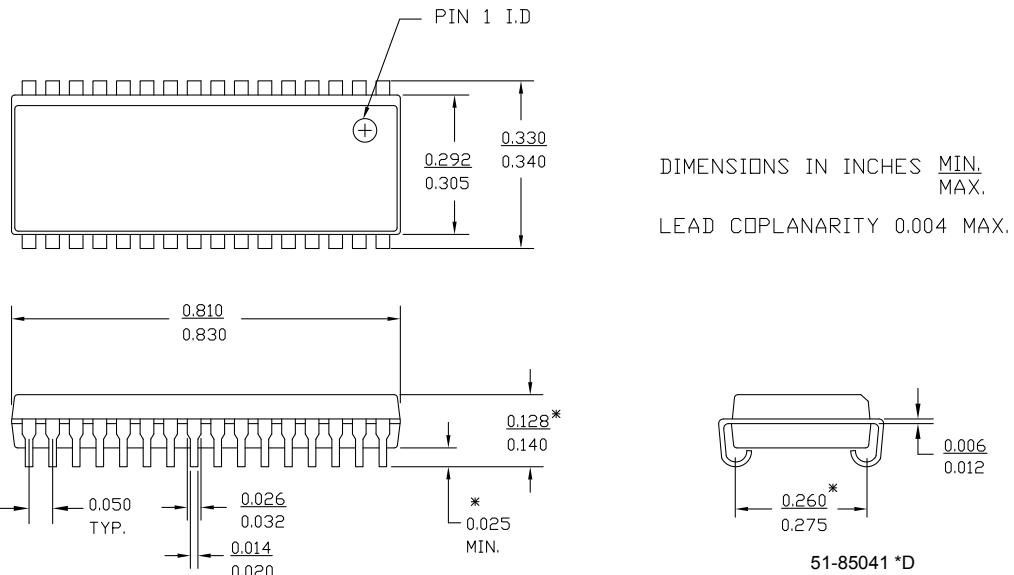
## Ordering Code Definitions



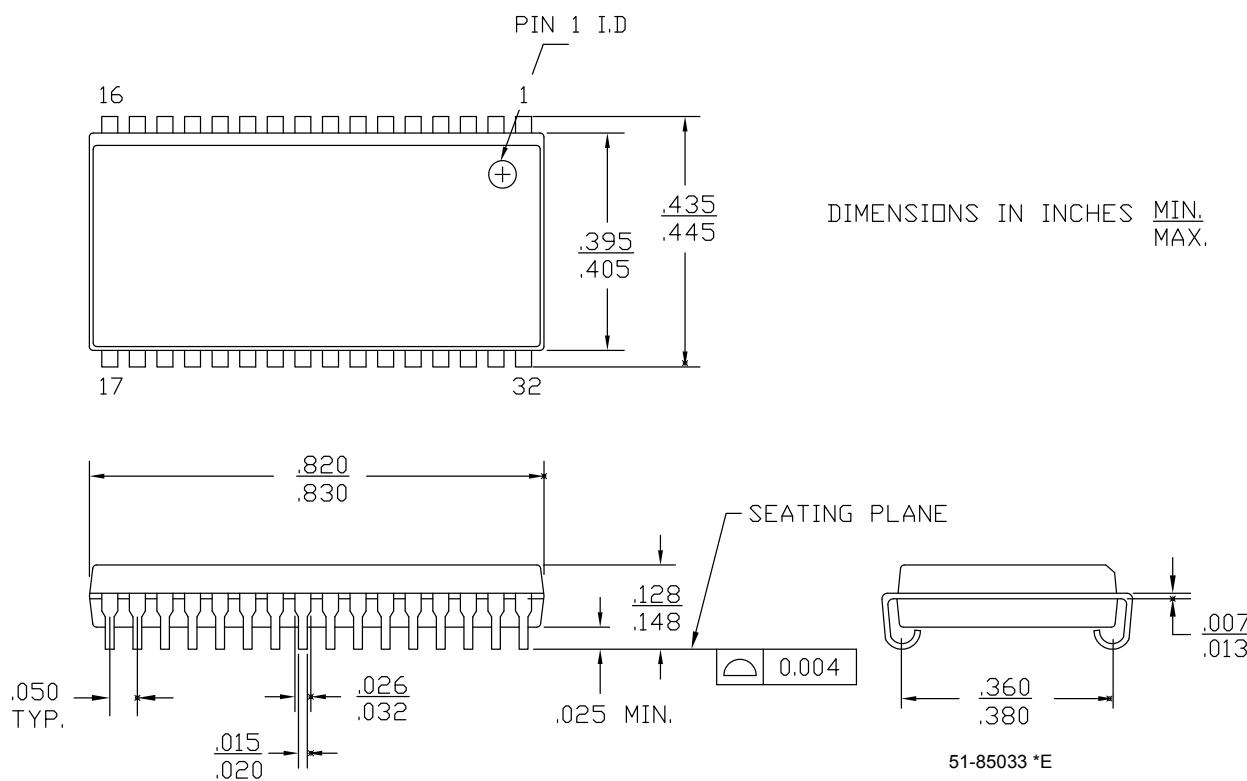
## Package Diagrams

**Figure 10. 32-pin SOJ (300 Mil) V32.3 (Catalog 32.3 Molded SOJ) Package Outline, 51-85041**

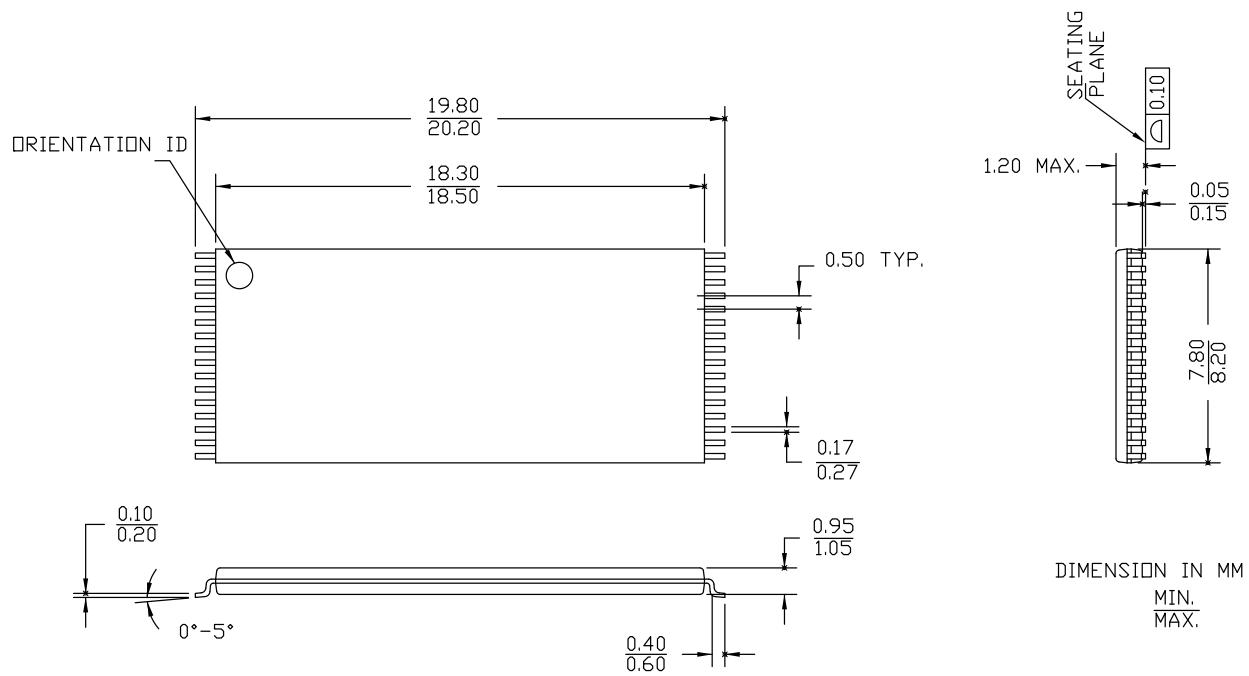
32 Lead (300 MIL) Molded SOJ



**Figure 11. 32-pin SOJ (400 Mil) V32.4 (Molded SOJ V33) Package Outline, 51-85033**



**Package Diagrams** (continued)

**Figure 12. 32-pin TSOP I (8 × 20 × 1.0 mm) Z32R Package Outline, 51-85056**


51-85056 \*G

## 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 |
|--------|-----------------|
| °C     | degree Celsius  |
| MHz    | megahertz       |
| µA     | microampere     |
| mA     | milliampere     |
| mV     | millivolt       |
| mW     | milliwatt       |
| ns     | nanosecond      |
| pF     | picofarad       |
| V      | volt            |
| W      | watt            |

## Document History Page

Document Title: CY7C109D/CY7C1009D, 1-Mbit (128 K × 8) Static RAM  
 Document Number: 38-05468

| Revision | ECN     | Submission Date | Orig. of Change | Description of Change   |
|----------|---------|-----------------|-----------------|---|
| **       | 201560  | See ECN         | SWI             | Advance Information data sheet for C9 IPP   |
| *A       | 233722  | See ECN         | RKF             | DC parameters are modified as per EROS (Spec # 01-2165)<br>Pb-free offering in Ordering Information   |
| *B       | 262950  | See ECN         | RKF             | Added Data Retention Characteristics table<br>Added $T_{power}$ Spec in Switching Characteristics Table<br>Shaded Ordering Information  |
| *C       | See ECN | See ECN         | RKF             | Reduced Speed bins to -10 and -12 ns  |
| *D       | 560995  | See ECN         | VKN             | Converted from Preliminary to Final<br>Removed Commercial Operating range<br>Removed 12 ns speed bin<br>Added $I_{CC}$ values for the frequencies 83MHz, 66MHz and 40MHz<br>Changed Overshoot spec from $V_{CC}+2$ V to $V_{CC}+1$ V in footnote #3<br>Updated Thermal Resistance table<br>Updated Ordering Information Table   |
| *E       | 802877  | See ECN         | VKN             | Changed $I_{CC}$ spec from 60 mA to 80 mA for 100 MHz, 55 mA to 72 mA for 83 MHz, 45 mA to 58 mA for 66 MHz, 30 mA to 37 mA for 40 MHz  |
| *F       | 3104943 | 12/08/2010      | AJU             | Added <a href="#">Ordering Code Definitions</a> .<br>Updated <a href="#">Package Diagrams</a> .   |
| *G       | 3220123 | 04/08/2011      | PRAS            | Updated package diagrams:<br>51-85033 to *D<br>51-85056 to *F<br>Added Acronyms and Units of measure.<br>Updated template and styles as per current Cypress standards.  |
| *H       | 4041855 | 06/27/2013      | MEMJ            | Updated <a href="#">Functional Description</a> .<br>Updated <a href="#">Electrical Characteristics</a> :<br>Added one more Test Condition " $I_{OH} = -0.1$ mA" for $V_{OH}$ parameter and added maximum value corresponding to that Test Condition.<br>Added Note 4 and referred the same note in maximum value for $V_{OH}$ parameter corresponding to Test Condition " $I_{OH} = -0.1$ mA".<br>Updated <a href="#">Package Diagrams</a> :<br>spec 51-85041 – Changed revision from *B to *C.<br>Updated in new template. |
| *I       | 4386284 | 05/21/2014      | MEMJ            | Updated <a href="#">Package Diagrams</a> :<br>spec 51-85033 – Changed revision from *D to *E.<br>spec 51-85056 – Changed revision from *F to *G.<br>Completing Sunset Review.   |
| *J       | 4578447 | 01/16/2015      | MEMJ            | Added related documentation hyperlink in page 1.<br>Updated <a href="#">Figure 10</a> in <a href="#">Package Diagrams</a> (spec 51-85041 *C to *D).   |

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