

**4-Mbit (128K x 36) Flow Through Sync SRAM**

**Features**

- 128K x 36 common IO
- 3.3V core power supply ( $V_{DD}$ )
- 2.5V or 3.3V IO supply ( $V_{DDQ}$ )
- Fast clock-to-output times
  - 6.5 ns (133 MHz version)
- Provide high performance 2-1-1-1 access rate
- User selectable burst counter supporting Intel Pentium interleaved or linear burst sequences
- Separate processor and controller address strobes
- Synchronous self-timed write
- Asynchronous output enable
- Available in Pb-free 100-Pin TQFP package, Pb-free and non-Pb-free 119-Ball BGA package
- ZZ Sleep Mode option

**Functional Description**

The CY7C1345G is a 128K x 36 synchronous cache RAM designed to interface with high speed microprocessors with minimum glue logic. The maximum access delay from clock rise is 6.5 ns (133 MHz version). A two-bit on-chip counter captures the first address in a burst and increments the address automatically for the rest of the burst access. All synchronous inputs are gated by registers controlled by a positive edge triggered Clock Input (CLK). The synchronous inputs include all addresses, all data inputs, address pipelining Chip Enable ( $CE_1$ ), depth expansion Chip Enables ( $CE_2$  and  $CE_3$ ), Burst Control inputs (ADSC, ADSP, and ADV), Write Enables ( $BW_x$ , and BWE), and Global Write (GW). Asynchronous inputs include the Output Enable ( $\overline{OE}$ ) and the ZZ pin.

The CY7C1345G enables either interleaved or linear burst sequences, selected by the MODE input pin. A HIGH selects an interleaved burst sequence, while a LOW selects a linear burst sequence. Burst accesses are initiated with the Processor Address Strobe (ADSP) or the cache Controller Address Strobe (ADSC) inputs.

Addresses and chip enables are registered at rising edge of clock when either Address Strobe Processor (ADSP) or Address Strobe Controller (ADSC) is active. Subsequent burst addresses are internally generated as controlled by the Advance pin (ADV).

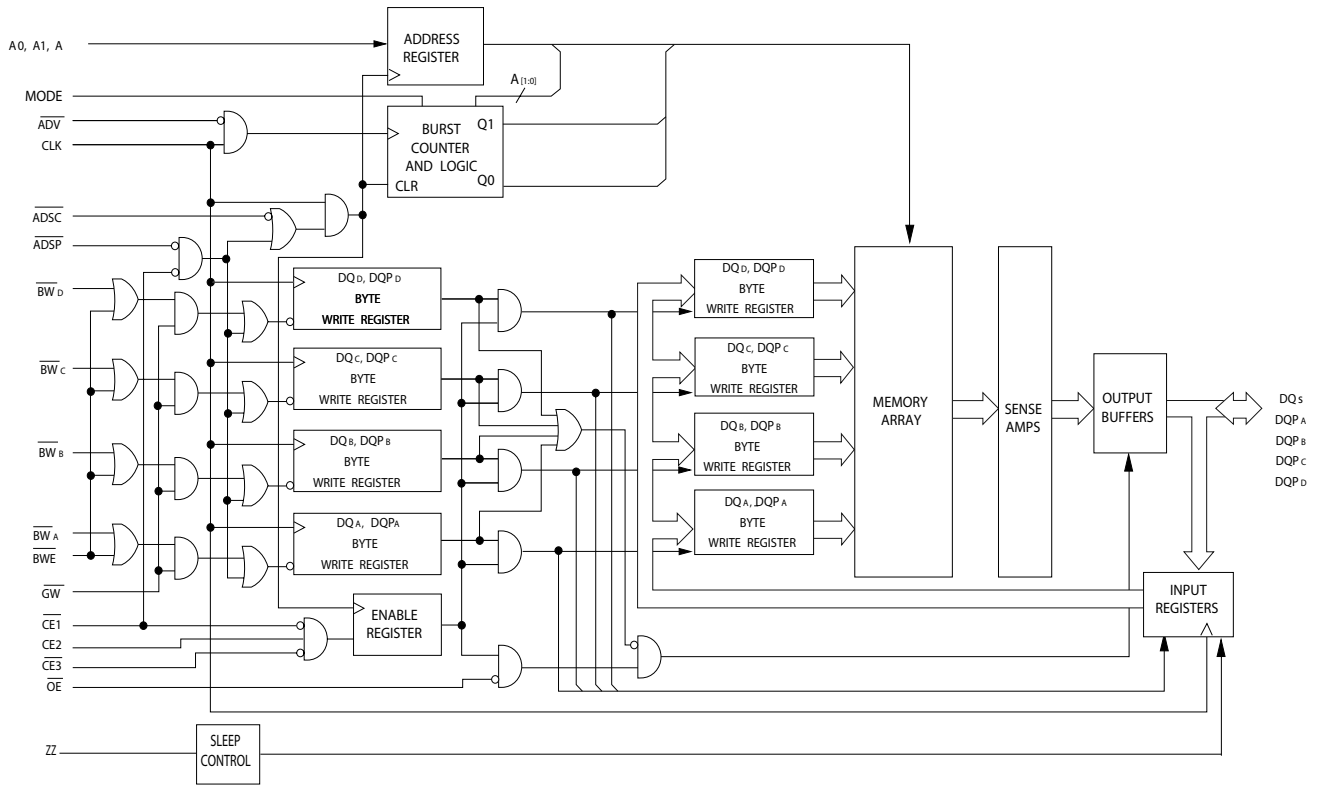
The CY7C1345G operates from a +3.3V core power supply while all outputs operate with either a +2.5 or +3.3V supply. All inputs and outputs are JEDEC standard JESD8-5 compatible.

For best practice recommendations, refer to the Cypress application note [AN1064, SRAM System Guidelines](#).

**Selection Guide**

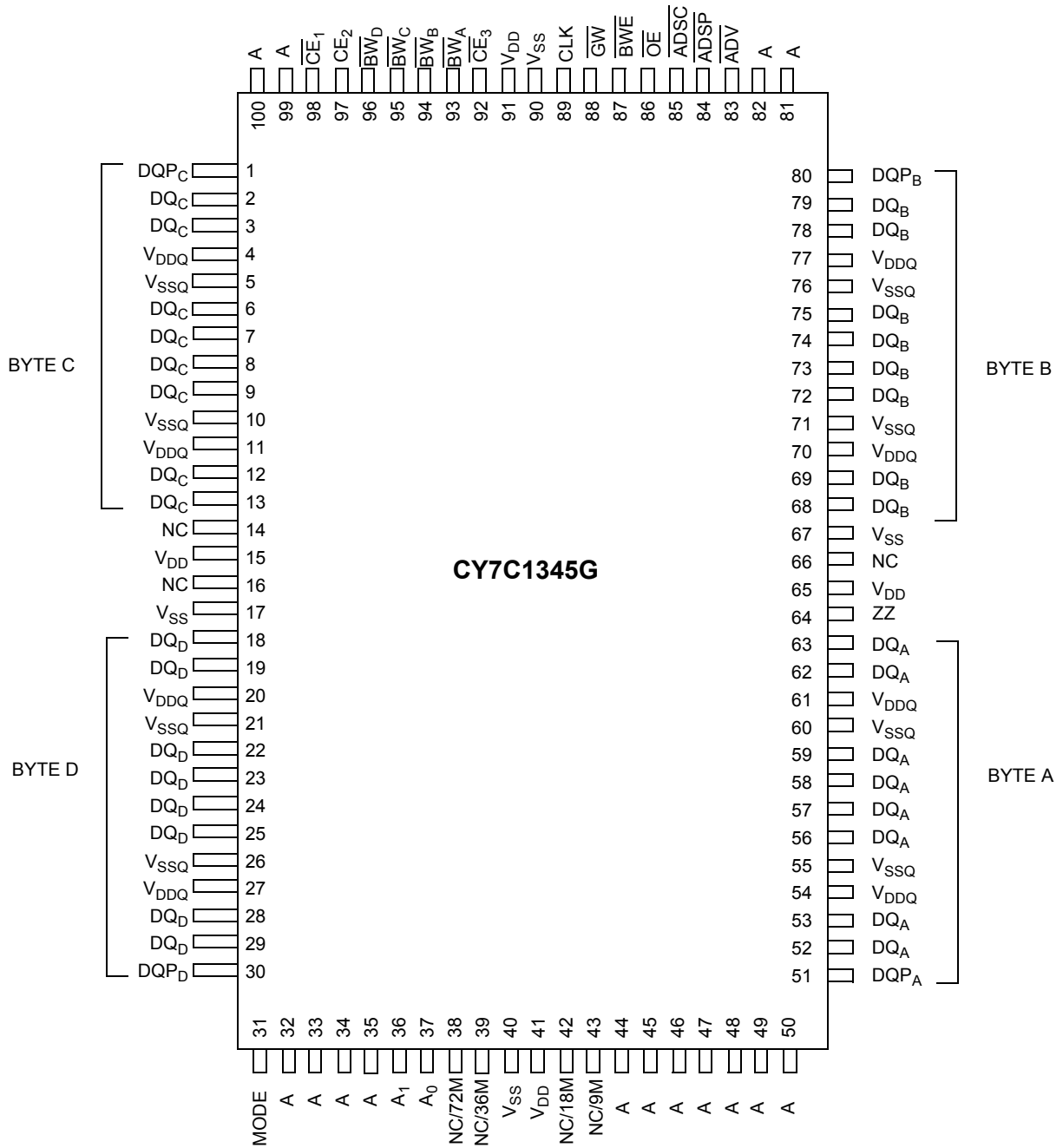
| Parameter                 | 133 MHz | 100 MHz | Unit |
|---------------------------|---------|---------|------|
| Maximum Access Time       | 6.5     | 8.0     | ns   |
| Maximum Operating Current | 225     | 205     | mA   |
| Maximum Standby Current   | 40      | 40      | mA   |

Logic Block Diagram



**Pin Configurations**

**100-Pin TQFP Pinout**



Pin Configurations (continued)

119-Ball BGA Pinout

|          | 1                | 2                | 3                        | 4                        | 5                        | 6                        | 7                |
|----------|------------------|------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------|
| <b>A</b> | V <sub>DDQ</sub> | A                | A                        | $\overline{\text{ADSP}}$ | A                        | A                        | V <sub>DDQ</sub> |
| <b>B</b> | NC/288M          | CE <sub>2</sub>  | A                        | $\overline{\text{ADSC}}$ | A                        | $\overline{\text{CE}}_3$ | NC/576M          |
| <b>C</b> | NC/144M          | A                | A                        | V <sub>DD</sub>          | A                        | A                        | NC/1G            |
| <b>D</b> | DQ <sub>C</sub>  | DQP <sub>C</sub> | V <sub>SS</sub>          | NC                       | V <sub>SS</sub>          | DQP <sub>B</sub>         | DQ <sub>B</sub>  |
| <b>E</b> | DQ <sub>C</sub>  | DQ <sub>C</sub>  | V <sub>SS</sub>          | $\overline{\text{CE}}_1$ | V <sub>SS</sub>          | DQ <sub>B</sub>          | DQ <sub>B</sub>  |
| <b>F</b> | V <sub>DDQ</sub> | DQ <sub>C</sub>  | V <sub>SS</sub>          | $\overline{\text{OE}}$   | V <sub>SS</sub>          | DQ <sub>B</sub>          | V <sub>DDQ</sub> |
| <b>G</b> | DQ <sub>C</sub>  | DQ <sub>C</sub>  | $\overline{\text{BW}}_C$ | $\overline{\text{ADV}}$  | $\overline{\text{BW}}_B$ | DQ <sub>B</sub>          | DQ <sub>B</sub>  |
| <b>H</b> | DQ <sub>C</sub>  | DQ <sub>C</sub>  | V <sub>SS</sub>          | $\overline{\text{GW}}$   | V <sub>SS</sub>          | DQ <sub>B</sub>          | DQ <sub>B</sub>  |
| <b>J</b> | V <sub>DDQ</sub> | V <sub>DD</sub>  | NC                       | V <sub>DD</sub>          | NC                       | V <sub>DD</sub>          | V <sub>DDQ</sub> |
| <b>K</b> | DQ <sub>D</sub>  | DQ <sub>D</sub>  | V <sub>SS</sub>          | CLK                      | V <sub>SS</sub>          | DQ <sub>A</sub>          | DQ <sub>A</sub>  |
| <b>L</b> | DQ <sub>D</sub>  | DQ <sub>D</sub>  | $\overline{\text{BW}}_D$ | NC                       | $\overline{\text{BW}}_A$ | DQ <sub>A</sub>          | DQ <sub>A</sub>  |
| <b>M</b> | V <sub>DDQ</sub> | DQ <sub>D</sub>  | V <sub>SS</sub>          | $\overline{\text{BWE}}$  | V <sub>SS</sub>          | DQ <sub>A</sub>          | V <sub>DDQ</sub> |
| <b>N</b> | DQ <sub>D</sub>  | DQ <sub>D</sub>  | V <sub>SS</sub>          | A1                       | V <sub>SS</sub>          | DQ <sub>A</sub>          | DQ <sub>A</sub>  |
| <b>P</b> | DQ <sub>D</sub>  | DQP <sub>D</sub> | V <sub>SS</sub>          | A0                       | V <sub>SS</sub>          | DQP <sub>A</sub>         | DQ <sub>A</sub>  |
| <b>R</b> | NC               | A                | MODE                     | V <sub>DD</sub>          | NC                       | A                        | NC               |
| <b>T</b> | NC               | NC/72M           | A                        | A                        | A                        | NC/36M                   | ZZ               |
| <b>U</b> | V <sub>DDQ</sub> | NC               | NC                       | NC                       | NC                       | NC                       | V <sub>DDQ</sub> |

**Pin Definitions**

| Name   | IO                    | Description  |
|--|-----------------------|--|
| A0, A1, A  | Input<br>Synchronous  | <b>Address Inputs Used to Select One of the 128K Address Locations.</b> Sampled at the rising edge of the CLK if $\overline{\text{ADSP}}$ or $\overline{\text{ADSC}}$ is active LOW, and $\overline{\text{CE}}_1$ , $\text{CE}_2$ , and $\overline{\text{CE}}_3$ are sampled active. $A_{[1:0]}$ feed the two-bit counter.   |
| $\overline{\text{BW}}_A$ , $\overline{\text{BW}}_B$<br>$\overline{\text{BW}}_C$ , $\overline{\text{BW}}_D$ | Input<br>Synchronous  | <b>Byte Write Select Inputs, Active LOW.</b> Qualified with $\overline{\text{BWE}}$ to conduct byte writes to the SRAM. Sampled on the rising edge of CLK.   |
| $\overline{\text{GW}}$   | Input<br>Synchronous  | <b>Global Write Enable Input, Active LOW.</b> When asserted LOW on the rising edge of CLK, a global write is conducted (ALL bytes are written, regardless of the values on $\text{BW}_{[A:D]}$ and BWE).   |
| $\overline{\text{BWE}}$  | Input<br>Synchronous  | <b>Byte Write Enable Input, Active LOW.</b> Sampled on the rising edge of CLK. This signal is asserted LOW to conduct a byte write.  |
| CLK  | Input Clock           | <b>Clock Input.</b> Used to capture all synchronous inputs to the device. Also used to increment the burst counter when ADV is asserted LOW, during a burst operation.   |
| $\overline{\text{CE}}_1$   | Input<br>Synchronous  | <b>Chip Enable 1 Input, Active LOW.</b> Sampled on the rising edge of CLK. Used in conjunction with $\text{CE}_2$ and $\text{CE}_3$ to select or deselect the device. ADSP is ignored if $\overline{\text{CE}}_1$ is HIGH. $\overline{\text{CE}}_1$ is sampled only when a new external address is loaded.   |
| $\text{CE}_2$  | Input<br>Synchronous  | <b>Chip Enable 2 Input, Active HIGH.</b> Sampled on the rising edge of CLK. Used in conjunction with $\overline{\text{CE}}_1$ and $\text{CE}_3$ to select or deselect the device. $\text{CE}_2$ is sampled only when a new external address is loaded.   |
| $\overline{\text{CE}}_3$   | Input<br>Synchronous  | <b>Chip Enable 3 Input, Active LOW.</b> Sampled on the rising edge of CLK. Used in conjunction with $\overline{\text{CE}}_1$ and $\text{CE}_2$ to select or deselect the device. $\overline{\text{CE}}_3$ is sampled only when a new external address is loaded.   |
| $\overline{\text{OE}}$   | Input<br>Asynchronous | <b>Output Enable, asynchronous Input, Active LOW.</b> Controls the direction of the IO pins. When LOW, the IO pins act as outputs. When deasserted HIGH, IO pins are tri-stated and act as input data pins. $\overline{\text{OE}}$ is masked during the first clock of a read cycle when emerging from a deselected state.   |
| ADV  | Input<br>Synchronous  | <b>Advance Input Signal,</b> Sampled on the Rising Edge of CLK. When asserted, it automatically increments the address in a burst cycle.   |
| $\overline{\text{ADSP}}$   | Input<br>Synchronous  | <b>Address Strobe from Processor, sampled on the rising edge of CLK, Active LOW.</b> When asserted LOW, addresses presented to the device are captured in the address registers. $A_{[1:0]}$ are also loaded into the burst counter. When $\overline{\text{ADSP}}$ and $\overline{\text{ADSC}}$ are both asserted, only $\overline{\text{ADSP}}$ is recognized. $\overline{\text{ADSP}}$ is ignored when $\overline{\text{CE}}_1$ is deasserted HIGH.  |
| $\overline{\text{ADSC}}$   | Input<br>Synchronous  | <b>Address Strobe from Controller, sampled on the rising edge of CLK, Active LOW.</b> When asserted LOW, addresses presented to the device are captured in the address registers. $A_{[1:0]}$ are also loaded into the burst counter. When $\overline{\text{ADSP}}$ and $\overline{\text{ADSC}}$ are both asserted, only $\overline{\text{ADSP}}$ is recognized.   |
| ZZ   | Input<br>Asynchronous | <b>ZZ sleep Input, Active HIGH.</b> When asserted HIGH places the device in a non-time critical sleep condition with data integrity preserved. During normal operation, this pin is low or left floating. ZZ pin has an internal pull down.  |
| DQs<br>$\text{DQP}_A$ , $\text{DQP}_B$<br>$\text{DQP}_C$ , $\text{DQP}_D$                                  | IO<br>Synchronous     | <b>Bidirectional Data IO lines.</b> As inputs, they feed into an on-chip data register that is triggered by the rising edge of CLK. As outputs, they deliver the data contained in the memory location specified by the addresses presented during the previous clock rise of the read cycle. The direction of the pins is controlled by $\overline{\text{OE}}$ . When $\overline{\text{OE}}$ is asserted LOW, the pins act as outputs. When HIGH, DQs and $\text{DQP}_{[A:D]}$ are placed in a tri-state condition. |
| $V_{DD}$   | Power Supply          | <b>Power supply inputs to the core of the device.</b>  |
| $V_{SS}$   | Ground                | <b>Ground for the core of the device.</b>  |
| $V_{DDQ}$  | IO Power<br>Supply    | <b>Power supply for the IO circuitry.</b>  |
| $V_{SSQ}$  | IO Ground             | <b>Ground for the IO circuitry.</b>  |

**Pin Definitions** (continued)

| Name  | IO           | Description   |
|---|--------------|---|
| MODE  | Input Static | <b>Selects Burst Order.</b> When tied to GND selects linear burst sequence. When tied to V <sub>DD</sub> or left floating selects interleaved burst sequence. This is a strap pin and must remain static during device operation. Mode Pin has an internal pull up. |
| NC  |              | <b>No Connects.</b> Not Internally connected to the die.  |
| NC/9M,<br>NC/18M,<br>NC/36M<br>NC/72M,<br>NC/144M,<br>NC/288M,<br>NC/576M,<br>NC/1G | –            | <b>No Connects.</b> Not internally connected to the die. NC/9M, NC/18M, NC/36M, NC/72M, NC/144M, NC/288M, NC/576M, and NC/1G are address expansion pins and are not internally connected to the die.  |

**Functional Overview**

All synchronous inputs pass through input registers controlled by the rising edge of the clock. Maximum access delay from the clock rise (t<sub>CO</sub>) is 6.5 ns (133 MHz device).

The CY7C1345G supports secondary cache in systems using either a linear or interleaved burst sequence. The interleaved burst order supports Pentium and i486™ processors. The linear burst sequence is suited for processors that use a linear burst sequence. The burst order is user selectable and is determined by sampling the MODE input. Accesses are initiated with either the Processor Address Strobe (ADSP) or the Controller Address Strobe (ADSC). Address advancement through the burst sequence is controlled by the ADV input. A two-bit on-chip wrap around burst counter captures the first address in a burst sequence and automatically increments the address for the rest of the burst access.

Byte write operations are qualified with the Byte Write Enable (BWE) and Byte Write Select (BW<sub>[A:D]</sub>) inputs. A Global Write Enable (GW) overrides all byte write inputs and writes data to all four bytes. All writes are simplified with on-chip synchronous self-timed write circuitry.

Three synchronous Chip Selects ( $\overline{CE}_1$ , CE<sub>2</sub>, and  $\overline{CE}_3$ ) and an asynchronous Output Enable ( $\overline{OE}$ ) provide for easy bank selection and output tri-state control. ADSP is ignored if CE<sub>1</sub> is HIGH.

**Single Read Accesses**

A single read access is initiated when the following conditions are satisfied at clock rise:

1.  $\overline{CE}_1$ , CE<sub>2</sub>, and  $\overline{CE}_3$  are all asserted active.
2. ADSP or ADSC is asserted LOW (if the access is initiated by ADSC, the write inputs are deasserted during this first cycle).

The address presented to the address inputs is latched into the address register and the burst counter or control logic and presented to the memory core. If the  $\overline{OE}$  input is asserted LOW, the requested data is available at the data outputs a maximum to t<sub>CDV</sub> after clock rise. ADSP is ignored if  $\overline{CE}_1$  is HIGH.

**Single Write Accesses Initiated by  $\overline{ADSP}$**

Single write access is initiated when the following conditions are satisfied at clock rise:

1.  $\overline{CE}_1$ , CE<sub>2</sub>, and  $\overline{CE}_3$  are all asserted active
2.  $\overline{ADSP}$  is asserted LOW.

The addresses presented are loaded into the address register and the burst inputs (GW, BWE, and BW<sub>x</sub>) are ignored during this first clock cycle. If the write inputs are asserted active (see **Write Cycle Descriptions table** for appropriate states that indicate a write) on the next clock rise, the appropriate data is latched and written into the device. Byte writes are allowed. During byte writes,  $\overline{BW}_A$  controls DQ<sub>A</sub> and  $\overline{BW}_B$  controls DQ<sub>B</sub>,  $\overline{BW}_C$  controls DQ<sub>C</sub>, and  $\overline{BW}_D$  controls DQ<sub>D</sub>. All IOs are tri-stated during a byte write. Since this is a common IO device, the asynchronous  $\overline{OE}$  input signal is deasserted and the IOs are tri-stated prior to the presentation of data to DQ<sub>s</sub>. As a safety precaution, the data lines are tri-stated once a write cycle is detected, regardless of the state of  $\overline{OE}$ .

**Single Write Accesses Initiated by ADSC**

This write access is initiated when the following conditions are satisfied at clock rise:

1.  $\overline{CE}_1$ , CE<sub>2</sub>, and  $\overline{CE}_3$  are all asserted active.
2. ADSC is asserted LOW.
3.  $\overline{ADSP}$  is deasserted HIGH
4. The write input signals ( $\overline{GW}$ ,  $\overline{BWE}$ , and  $\overline{BW}_x$ ) indicate a write access. ADSC is ignored if ADSP is active LOW.

The addresses presented are loaded into the address register and the burst counter or control logic and delivered to the memory core. The information presented to DQ<sub>[D:A]</sub> is written into the specified address location. Byte writes are allowed. During byte writes,  $\overline{BW}_A$  controls DQ<sub>A</sub>,  $\overline{BW}_B$  controls DQ<sub>B</sub>,  $\overline{BW}_C$  controls DQ<sub>C</sub>, and  $\overline{BW}_D$  controls DQ<sub>D</sub>. All IOs and even a byte write are tri-stated when a write is detected. Since this is a common IO device, the asynchronous  $\overline{OE}$  input signal is deasserted and the IOs are tri-stated prior to the presentation of data to DQs. As a safety precaution, the data lines are tri-stated once a write cycle is detected, regardless of the state of  $\overline{OE}$ .

**Burst Sequences**

The CY7C1345G provides an on-chip two-bit wrap around burst counter inside the SRAM. The burst counter is fed by  $A_{[1:0]}$  and follows either a linear or interleaved burst order. The burst order is determined by the state of the MODE input. A LOW on MODE selects a linear burst sequence. A HIGH on MODE selects an interleaved burst order. Leaving MODE unconnected causes the device to default to a interleaved burst sequence.

**Table 1. Interleaved Burst Address Table (MODE = Floating or  $V_{DD}$ )**

| First Address<br>$A_1, A_0$ | Second Address<br>$A_1, A_0$ | Third Address<br>$A_1, A_0$ | Fourth Address<br>$A_1, A_0$ |
|-----------------------------|------------------------------|-----------------------------|------------------------------|
| 00                          | 01                           | 10                          | 11                           |
| 01                          | 00                           | 11                          | 10                           |
| 10                          | 11                           | 00                          | 01                           |
| 11                          | 10                           | 01                          | 00                           |

**Table 2. Linear Burst Address Table (MODE = GND)**

| First Address<br>$A_1, A_0$ | Second Address<br>$A_1, A_0$ | Third Address<br>$A_1, A_0$ | Fourth Address<br>$A_1, A_0$ |
|-----------------------------|------------------------------|-----------------------------|------------------------------|
| 00                          | 01                           | 10                          | 11                           |
| 01                          | 10                           | 11                          | 00                           |
| 10                          | 11                           | 00                          | 01                           |
| 11                          | 00                           | 01                          | 10                           |

**Sleep Mode**

The ZZ input pin is an asynchronous input. Asserting ZZ places the SRAM in a power conservation sleep mode. Two clock cycles are required to enter into or exit from this sleep mode. In this mode, data integrity is guaranteed. Accesses pending when entering the sleep mode are not considered valid nor is the completion of the operation guaranteed. The device is deselected prior to entering the sleep mode. CEs, ADSP, and ADSC must remain inactive for the duration of  $t_{ZZREC}$  after the ZZ input returns LOW.

**ZZ Mode Electrical Characteristics**

| Parameter   | Description                       | Test Conditions           | Min        | Max        | Unit |
|-------------|-----------------------------------|---------------------------|------------|------------|------|
| $I_{DDZZ}$  | Sleep mode standby current        | $ZZ \geq V_{DD} - 0.2V$   |            | 40         | mA   |
| $t_{ZZS}$   | Device operation to ZZ            | $ZZ \geq V_{DD} - 0.2V$   |            | $2t_{CYC}$ | ns   |
| $t_{ZZREC}$ | ZZ recovery time                  | $ZZ \leq 0.2V$            | $2t_{CYC}$ |            | ns   |
| $t_{ZZI}$   | ZZ Active to sleep current        | This parameter is sampled |            | $2t_{CYC}$ | ns   |
| $t_{RZZI}$  | ZZ Inactive to exit sleep current | This parameter is sampled | 0          |            | ns   |

### Truth Table

The truth table for CY7C1345G follows. [1, 2, 3, 4, 5]

| Cycle Description            | Address Used | $\overline{CE}_1$ | $CE_2$ | $\overline{CE}_3$ | ZZ | $\overline{ADSP}$ | $\overline{ADSC}$ | $\overline{ADV}$ | $\overline{WRITE}$ | $\overline{OE}$ | CLK | DQ        |
|------------------------------|--------------|-------------------|--------|-------------------|----|-------------------|-------------------|------------------|--------------------|-----------------|-----|-----------|
| Deselected Cycle, Power down | None         | H                 | X      | X                 | L  | X                 | L                 | X                | X                  | X               | L-H | Tri-State |
| Deselected Cycle, Power down | None         | L                 | L      | X                 | L  | L                 | X                 | X                | X                  | X               | L-H | Tri-State |
| Deselected Cycle, Power down | None         | L                 | X      | H                 | L  | L                 | X                 | X                | X                  | X               | L-H | Tri-State |
| Deselected Cycle, Power down | None         | L                 | L      | X                 | L  | H                 | L                 | X                | X                  | X               | L-H | Tri-State |
| Deselected Cycle, Power down | None         | X                 | X      | X                 | L  | H                 | L                 | X                | X                  | X               | L-H | Tri-State |
| Sleep Mode, Power down       | None         | X                 | X      | X                 | H  | X                 | X                 | X                | X                  | X               | X   | Tri-State |
| Read Cycle, Begin Burst      | External     | L                 | H      | L                 | L  | L                 | X                 | X                | X                  | L               | L-H | Q         |
| Read Cycle, Begin Burst      | External     | L                 | H      | L                 | L  | L                 | X                 | X                | X                  | H               | L-H | Tri-State |
| Write Cycle, Begin Burst     | External     | L                 | H      | L                 | L  | H                 | L                 | X                | L                  | X               | L-H | D         |
| Read Cycle, Begin Burst      | External     | L                 | H      | L                 | L  | H                 | L                 | X                | H                  | L               | L-H | Q         |
| Read Cycle, Begin Burst      | External     | L                 | H      | L                 | L  | H                 | L                 | X                | H                  | H               | L-H | Tri-State |
| Read Cycle, Continue Burst   | Next         | X                 | X      | X                 | L  | H                 | H                 | L                | H                  | L               | L-H | Q         |
| Read Cycle, Continue Burst   | Next         | X                 | X      | X                 | L  | H                 | H                 | L                | H                  | H               | L-H | Tri-State |
| Read Cycle, Continue Burst   | Next         | H                 | X      | X                 | L  | X                 | H                 | L                | H                  | L               | L-H | Q         |
| Read Cycle, Continue Burst   | Next         | H                 | X      | X                 | L  | X                 | H                 | L                | H                  | H               | L-H | Tri-State |
| Write Cycle, Continue Burst  | Next         | X                 | X      | X                 | L  | H                 | H                 | L                | L                  | X               | L-H | D         |
| Write Cycle, Continue Burst  | Next         | H                 | X      | X                 | L  | X                 | H                 | L                | L                  | X               | L-H | D         |
| Read Cycle, Suspend Burst    | Current      | X                 | X      | X                 | L  | H                 | H                 | H                | H                  | L               | L-H | Q         |
| Read Cycle, Suspend Burst    | Current      | X                 | X      | X                 | L  | H                 | H                 | H                | H                  | H               | L-H | Tri-State |
| Read Cycle, Suspend Burst    | Current      | H                 | X      | X                 | L  | X                 | H                 | H                | H                  | L               | L-H | Q         |
| Read Cycle, Suspend Burst    | Current      | H                 | X      | X                 | L  | X                 | H                 | H                | H                  | H               | L-H | Tri-State |
| Write Cycle, Suspend Burst   | Current      | X                 | X      | X                 | L  | H                 | H                 | H                | L                  | X               | L-H | D         |
| Write Cycle, Suspend Burst   | Current      | H                 | X      | X                 | L  | X                 | H                 | H                | L                  | X               | L-H | D         |

**Notes**

- X = "Do Not Care," H = Logic HIGH, and L = Logic LOW.
- $\overline{WRITE} = L$  when any one or more Byte Write enable signals ( $\overline{BW}_A, \overline{BW}_B, \overline{BW}_C, \overline{BW}_D$ ) and  $\overline{BWE} = L$  or  $\overline{GW} = L$ .  $\overline{WRITE} = H$  when all Byte write enable signals ( $\overline{BW}_A, \overline{BW}_B, \overline{BW}_C, \overline{BW}_D$ ),  $\overline{BWE}$ ,  $\overline{GW} = H$ .
- The DQ pins are controlled by the current cycle and the  $\overline{OE}$  signal.  $\overline{OE}$  is asynchronous and is not sampled with the clock.
- The SRAM always initiates a read cycle when  $\overline{ADSP}$  is asserted, regardless of the state of  $\overline{GW}$ ,  $\overline{BWE}$ , or  $\overline{BW}_{[A:D]}$ . Writes may occur only on subsequent clocks after the  $\overline{ADSP}$  or with the assertion of  $\overline{ADSC}$ . As a result,  $\overline{OE}$  is driven HIGH prior to the start of the write cycle to enable the outputs to tri-state.  $\overline{OE}$  is a "Do Not Care" for the remainder of the write cycle.
- $\overline{OE}$  is asynchronous and is not sampled with the clock rise. It is masked internally during write cycles. During a read cycle all data bits are tri-state when  $\overline{OE}$  is inactive or when the device is deselected, and all data bits behave as output when  $\overline{OE}$  is active (LOW).



### Truth Table for Read or Write

The partial truth table for read or write follows. [1, 6]

| Function   | $\overline{GW}$ | $\overline{BWE}$ | $\overline{BW_D}$ | $\overline{BW_C}$ | $\overline{BW_B}$ | $\overline{BW_A}$ |
|--|-----------------|------------------|-------------------|-------------------|-------------------|-------------------|
| Read   | H               | H                | X                 | X                 | X                 | X                 |
| Read   | H               | L                | H                 | H                 | H                 | H                 |
| Write Byte (A, DQP <sub>A</sub> )  | H               | L                | H                 | H                 | H                 | L                 |
| Write Byte (B, DQP <sub>B</sub> )  | H               | L                | H                 | H                 | L                 | H                 |
| Write Bytes (B, A, DQP <sub>A</sub> , DQP <sub>B</sub> )                       | H               | L                | H                 | H                 | L                 | L                 |
| Write Byte (C, DQP <sub>C</sub> )  | H               | L                | H                 | L                 | H                 | H                 |
| Write Bytes (C, A, DQP <sub>C</sub> , DQP <sub>A</sub> )                       | H               | L                | H                 | L                 | H                 | L                 |
| Write Bytes (C, B, DQP <sub>C</sub> , DQP <sub>B</sub> )                       | H               | L                | H                 | L                 | L                 | H                 |
| Write Bytes (C, B, A, DQP <sub>C</sub> , DQP <sub>B</sub> , DQP <sub>A</sub> ) | H               | L                | H                 | L                 | L                 | L                 |
| Write Byte (D, DQP <sub>D</sub> )  | H               | L                | L                 | H                 | H                 | H                 |
| Write Bytes (D, A, DQP <sub>D</sub> , DQP <sub>A</sub> )                       | H               | L                | L                 | H                 | H                 | L                 |
| Write Bytes (D, B, DQP <sub>D</sub> , DQP <sub>A</sub> )                       | H               | L                | L                 | H                 | L                 | H                 |
| Write Bytes (D, B, A, DQP <sub>D</sub> , DQP <sub>B</sub> , DQP <sub>A</sub> ) | H               | L                | L                 | H                 | L                 | L                 |
| Write Bytes (D, B, DQP <sub>D</sub> , DQP <sub>B</sub> )                       | H               | L                | L                 | L                 | H                 | H                 |
| Write Bytes (D, B, A, DQP <sub>D</sub> , DQP <sub>C</sub> , DQP <sub>A</sub> ) | H               | L                | L                 | L                 | H                 | L                 |
| Write Bytes (D, C, A, DQP <sub>D</sub> , DQP <sub>B</sub> , DQP <sub>A</sub> ) | H               | L                | L                 | L                 | L                 | H                 |
| Write All Bytes  | H               | L                | L                 | L                 | L                 | L                 |
| Write All Bytes  | L               | X                | X                 | X                 | X                 | X                 |

**Note**

6. This table is only a partial listing of the byte write combinations. Any combination of  $\overline{BW_x}$  is valid. Appropriate write is done based on the active byte write.

### Maximum Ratings

Exceeding the maximum ratings may shorten the battery 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>DD</sub> Relative to GND ..... -0.5V to +4.6V
- Supply Voltage on V<sub>DDQ</sub> Relative to GND ..... -0.5V to +V<sub>DD</sub>
- DC Voltage Applied to Outputs in tri-state ..... -0.5V to V<sub>DDQ</sub> + 0.5V

- DC Input Voltage ..... -0.5V to V<sub>DD</sub> + 0.5V
- Current into Outputs (LOW) ..... 20 mA
- Static Discharge Voltage (MIL-STD-883, Method 3015) ..... >2001V
- Latch up Current ..... >200 mA

### Operating Range

| Range      | Ambient Temperature | V <sub>DD</sub> | V <sub>DDQ</sub>            |
|------------|---------------------|-----------------|-----------------------------|
| Commercial | 0°C to +70°C        | 3.3V            | 2.5V -5% to V <sub>DD</sub> |
| Industrial | -40°C to +85°C      | -5%/+10%        |                             |

### Electrical Characteristics

Over the Operating Range [7, 8]

| Parameter               | Description                                 | Test Conditions   | Min                   | Max                    | Unit |    |
|-------------------------|---|---|-----------------------|------------------------|------|----|
| V <sub>DD</sub>         | Power Supply Voltage                        |   | 3.135                 | 3.6                    | V    |    |
| V <sub>DDQ</sub>        | IO Supply Voltage                           |   | 2.375                 | V <sub>DD</sub>        | V    |    |
| V <sub>OH</sub>         | Output HIGH Voltage                         | for 3.3V IO, I <sub>OH</sub> = -4.0 mA  | 2.4                   |                        | V    |    |
|                         |   | for 2.5V IO, I <sub>OH</sub> = -1.0 mA  | 2.0                   |                        | V    |    |
| V <sub>OL</sub>         | Output LOW Voltage                          | for 3.3V IO, I <sub>OL</sub> = 8.0 mA   |                       | 0.4                    | V    |    |
|                         |   | for 2.5V IO, I <sub>OL</sub> = 1.0 mA   |                       | 0.4                    | V    |    |
| V <sub>IH</sub>         | Input HIGH Voltage                          | for 3.3V IO   | 2.0                   | V <sub>DD</sub> + 0.3V | V    |    |
|                         |   | for 2.5V IO   | 1.7                   | V <sub>DD</sub> + 0.3V | V    |    |
| V <sub>IL</sub>         | Input LOW Voltage <sup>[7]</sup>            | for 3.3V IO   | -0.3                  | 0.8                    | V    |    |
|                         |   | for 2.5V IO   | -0.3                  | 0.7                    | V    |    |
| I <sub>X</sub>          | Input Leakage Current except ZZ and MODE    | GND ≤ V <sub>I</sub> ≤ V <sub>DDQ</sub>   | -5                    | 5                      | μA   |    |
|                         | Input Current of MODE                       | Input = V <sub>SS</sub>   | -30                   |                        | μA   |    |
|                         |   | Input = V <sub>DD</sub>   |                       | 5                      | μA   |    |
|                         | Input Current of ZZ                         | Input = V <sub>SS</sub>   | -5                    |                        | μA   |    |
| Input = V <sub>DD</sub> |   |   | 30                    | μA                     |      |    |
| I <sub>OZ</sub>         | Output Leakage Current                      | GND ≤ V <sub>I</sub> ≤ V <sub>DDQ</sub> , Output Disabled   | -5                    | 5                      | μA   |    |
| I <sub>DD</sub>         | V <sub>DD</sub> Operating Supply Current    | V <sub>DD</sub> = Max, I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub> = 1/t <sub>CYC</sub>   | 7.5 ns cycle, 133 MHz |                        | 225  | mA |
|                         |   |   | 10 ns cycle, 100 MHz  |                        | 205  | mA |
| I <sub>SB1</sub>        | Automatic CE Power down Current—TTL Inputs  | Max V <sub>DD</sub> , Device Deselected, V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>IL</sub> , f = f <sub>MAX</sub> , inputs switching | 7.5 ns cycle, 133 MHz |                        | 90   | mA |
|                         |   |   | 10 ns cycle, 100 MHz  |                        | 80   | mA |
| I <sub>SB2</sub>        | Automatic CE Power down Current—CMOS Inputs | Max V <sub>DD</sub> , Device Deselected, V <sub>IN</sub> ≥ V <sub>DD</sub> - 0.3V or V <sub>IN</sub> ≤ 0.3V, f = 0, inputs static                         |                       |                        | 40   | mA |
| I <sub>SB3</sub>        | Automatic CE Power down Current—CMOS Inputs | Max V <sub>DD</sub> , Device Deselected, V <sub>IN</sub> ≥ V <sub>DDQ</sub> - 0.3V or V <sub>IN</sub> ≤ 0.3V, f = f <sub>MAX</sub> , inputs switching     | 7.5 ns cycle, 133 MHz |                        | 75   | mA |
|                         |   |   | 10 ns cycle, 100 MHz  |                        | 65   | mA |
| I <sub>SB4</sub>        | Automatic CE Power down Current—TTL Inputs  | Max V <sub>DD</sub> , Device Deselected, V <sub>IN</sub> ≥ V <sub>DD</sub> - 0.3V or V <sub>IN</sub> ≤ 0.3V, f = 0, inputs static                         |                       |                        | 45   | mA |

**Notes**

- 7. Overshoot: V<sub>IH</sub>(AC) < V<sub>DD</sub> + 1.5V (Pulse width less than t<sub>CYC</sub>/2), undershoot: V<sub>IL</sub>(AC) > -2V (Pulse width less than t<sub>CYC</sub>/2).
- 8. T<sub>Power up</sub>: Assumes a linear ramp from 0V to V<sub>DD</sub>(min) within 200 ms. During this time V<sub>IH</sub> < V<sub>DD</sub> and V<sub>DDQ</sub> ≤ V<sub>DD</sub>.

### Capacitance

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

| Parameter        | Description                 | Test Conditions   | 100 TQFP Max | 119 BGA Max | Unit |
|------------------|-----------------------------|---|--------------|-------------|------|
| C <sub>IN</sub>  | Input Capacitance           | T <sub>A</sub> = 25°C, f = 1 MHz,<br>V <sub>DD</sub> = 3.3V,<br>V <sub>DDQ</sub> = 3.3V | 5            | 5           | pF   |
| C <sub>CLK</sub> | Clock Input Capacitance     |   | 5            | 5           | pF   |
| C <sub>IO</sub>  | Input or Output Capacitance |   | 5            | 7           | pF   |

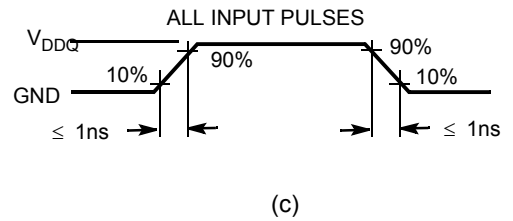
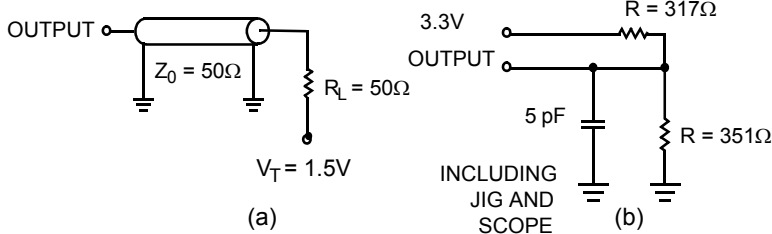
### Thermal Resistance

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

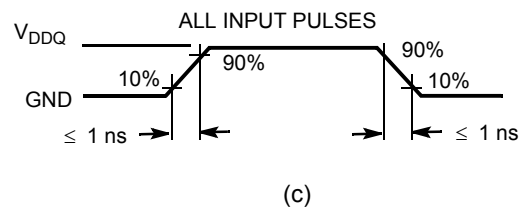
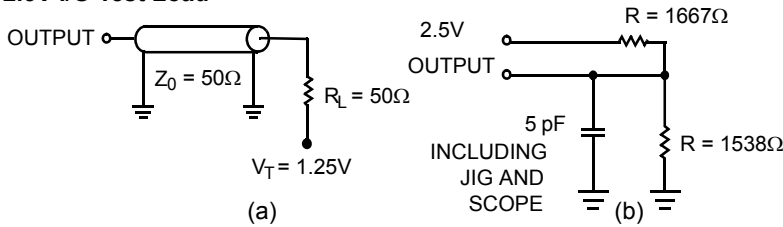
| Parameter       | Description                              | Test Conditions  | 100 TQFP Package | 119 BGA Package | Unit |
|-----------------|--|--|------------------|-----------------|------|
| Θ <sub>JA</sub> | Thermal Resistance (Junction to Ambient) | Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51. | 30.32            | 34.1            | °C/W |
| Θ <sub>JC</sub> | Thermal Resistance (Junction to Case)    |  | 6.85             | 14.0            | °C/W |

### AC Test Loads and Waveforms

#### 3.3V I/O Test Load



#### 2.5V I/O Test Load



## Switching Characteristics

Over the Operating Range [9, 10]

| Parameter           | Description  | -133 |     | -100 |     | Unit |
|---------------------|--|------|-----|------|-----|------|
|                     |  | Min  | Max | Min  | Max |      |
| $t_{POWER}$         | $V_{DD}$ (Typical) to the first Access <sup>[11]</sup>                       | 1    |     | 1    |     | ms   |
| <b>Clock</b>        |  |      |     |      |     |      |
| $t_{CYC}$           | Clock Cycle Time   | 7.5  |     | 10   |     | ns   |
| $t_{CH}$            | Clock HIGH   | 2.5  |     | 4.0  |     | ns   |
| $t_{CL}$            | Clock LOW  | 2.5  |     | 4.0  |     | ns   |
| <b>Output Times</b> |  |      |     |      |     |      |
| $t_{CDV}$           | Data Output Valid After CLK Rise   |      | 6.5 |      | 8.0 | ns   |
| $t_{DOH}$           | Data Output Hold After CLK Rise  | 2.0  |     | 2.0  |     | ns   |
| $t_{CLZ}$           | Clock to Low Z <sup>[12, 13, 14]</sup>                                       | 0    |     | 0    |     | ns   |
| $t_{CHZ}$           | Clock to High Z <sup>[12, 13, 14]</sup>                                      |      | 3.5 |      | 3.5 | ns   |
| $t_{OEV}$           | $\overline{OE}$ LOW to Output Valid  |      | 3.5 |      | 3.5 | ns   |
| $t_{OELZ}$          | $\overline{OE}$ LOW to Output Low Z <sup>[12, 13, 14]</sup>                  | 0    |     | 0    |     | ns   |
| $t_{OEZH}$          | $\overline{OE}$ HIGH to Output High Z <sup>[12, 13, 14]</sup>                |      | 3.5 |      | 3.5 | ns   |
| <b>Setup Times</b>  |  |      |     |      |     |      |
| $t_{AS}$            | Address Setup Before CLK Rise  | 1.5  |     | 2.0  |     | ns   |
| $t_{ADS}$           | $\overline{ADSP}$ , $\overline{ADSC}$ Setup Before CLK Rise                  | 1.5  |     | 2.0  |     | ns   |
| $t_{ADVS}$          | $\overline{ADV}$ Setup Before CLK Rise                                       | 1.5  |     | 2.0  |     | ns   |
| $t_{WES}$           | $\overline{GW}$ , $\overline{BWE}$ , $\overline{BW}_x$ Setup Before CLK Rise | 1.5  |     | 2.0  |     | ns   |
| $t_{DS}$            | Data Input Setup Before CLK Rise   | 1.5  |     | 2.0  |     | ns   |
| $t_{CES}$           | Chip Enable Setup  | 1.5  |     | 2.0  |     | ns   |
| <b>Hold Times</b>   |  |      |     |      |     |      |
| $t_{AH}$            | Address Hold After CLK Rise  | 0.5  |     | 0.5  |     | ns   |
| $t_{ADH}$           | $\overline{ADSP}$ , $\overline{ADSC}$ Hold After CLK Rise                    | 0.5  |     | 0.5  |     | ns   |
| $t_{WEH}$           | $\overline{GW}$ , $\overline{BWE}$ , $\overline{BW}_x$ Hold After CLK Rise   | 0.5  |     | 0.5  |     | ns   |
| $t_{ADVH}$          | $\overline{ADV}$ Hold After CLK Rise   | 0.5  |     | 0.5  |     | ns   |
| $t_{DH}$            | Data Input Hold After CLK Rise   | 0.5  |     | 0.5  |     | ns   |
| $t_{CEH}$           | Chip Enable Hold After CLK Rise  | 0.5  |     | 0.5  |     | ns   |

### Notes

 9. Timing reference level is 1.5V when  $V_{DDQ} = 3.3V$  and is 1.25V when  $V_{DDQ} = 2.5V$ .

10. Test conditions shown in (a) of Latch up Current &gt;200 mA unless otherwise noted.

 11. This part has a voltage regulator internally;  $t_{POWER}$  is the time that the power needs to be supplied above  $V_{DD}$ (minimum) initially before a read or write operation is initiated.

 12.  $t_{CHLZ}$ ,  $t_{CLZ}$ ,  $t_{OELZ}$ , and  $t_{OEZH}$  are specified with AC test conditions shown in (b) of AC Test Loads. Transition is measured  $\pm 200$  mV from steady state voltage.

 13. At any voltage and temperature,  $t_{OEZH}$  is less than  $t_{OELZ}$  and  $t_{CHZ}$  is less than  $t_{CLZ}$  to eliminate bus contention between SRAMs when sharing the same data bus.

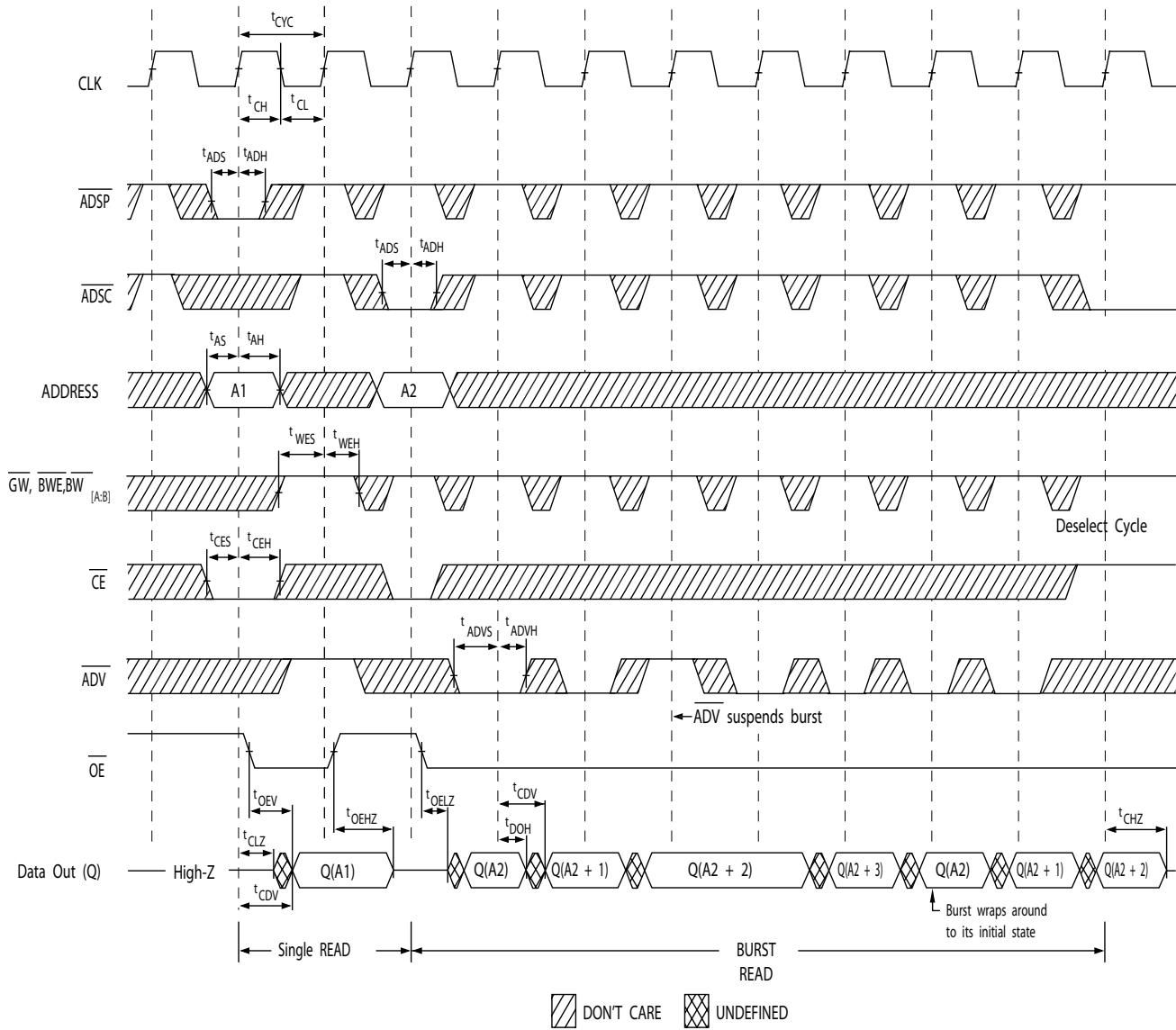
These specifications do not imply a bus contention condition, but reflect parameters guaranteed over worst case user conditions. Device is designed to achieve High Z prior to Low Z under the same system conditions.

14. This parameter is sampled and not 100% tested.

## Timing Diagrams

Figure 1 shows the read cycle timing. [15]

Figure 1. Read Cycle Timing



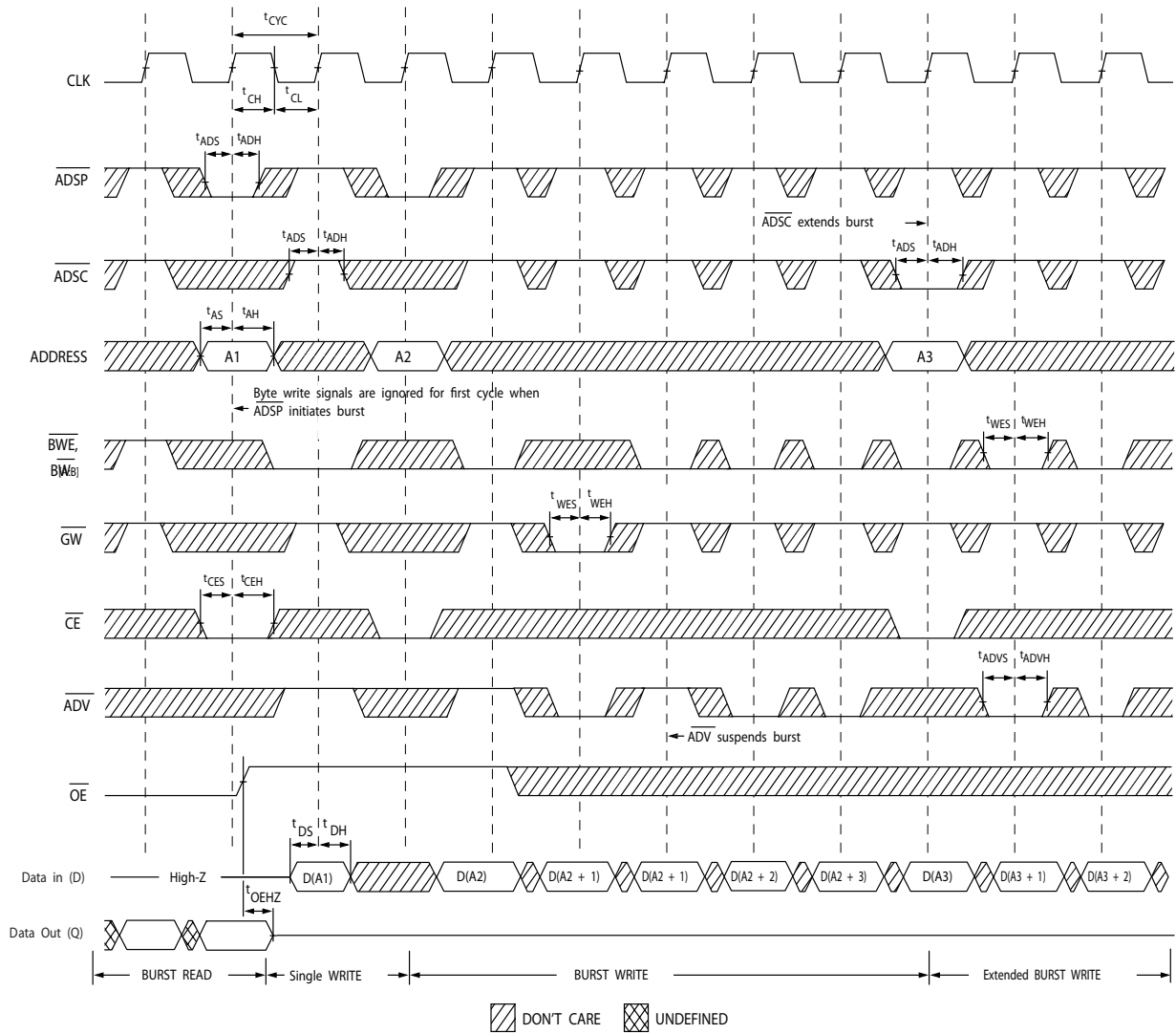
**Note:**

15. On this diagram, when  $\overline{CE}$  is LOW:  $\overline{CE}_1$  is LOW,  $CE_2$  is HIGH and  $\overline{CE}_3$  is LOW. When  $\overline{CE}$  is HIGH:  $\overline{CE}_1$  is HIGH or  $CE_2$  is LOW or  $\overline{CE}_3$  is HIGH.

Timing Diagrams (continued)

Figure 2 shows the write cycle timing. [15, 16]

Figure 2. Write Cycle Timing

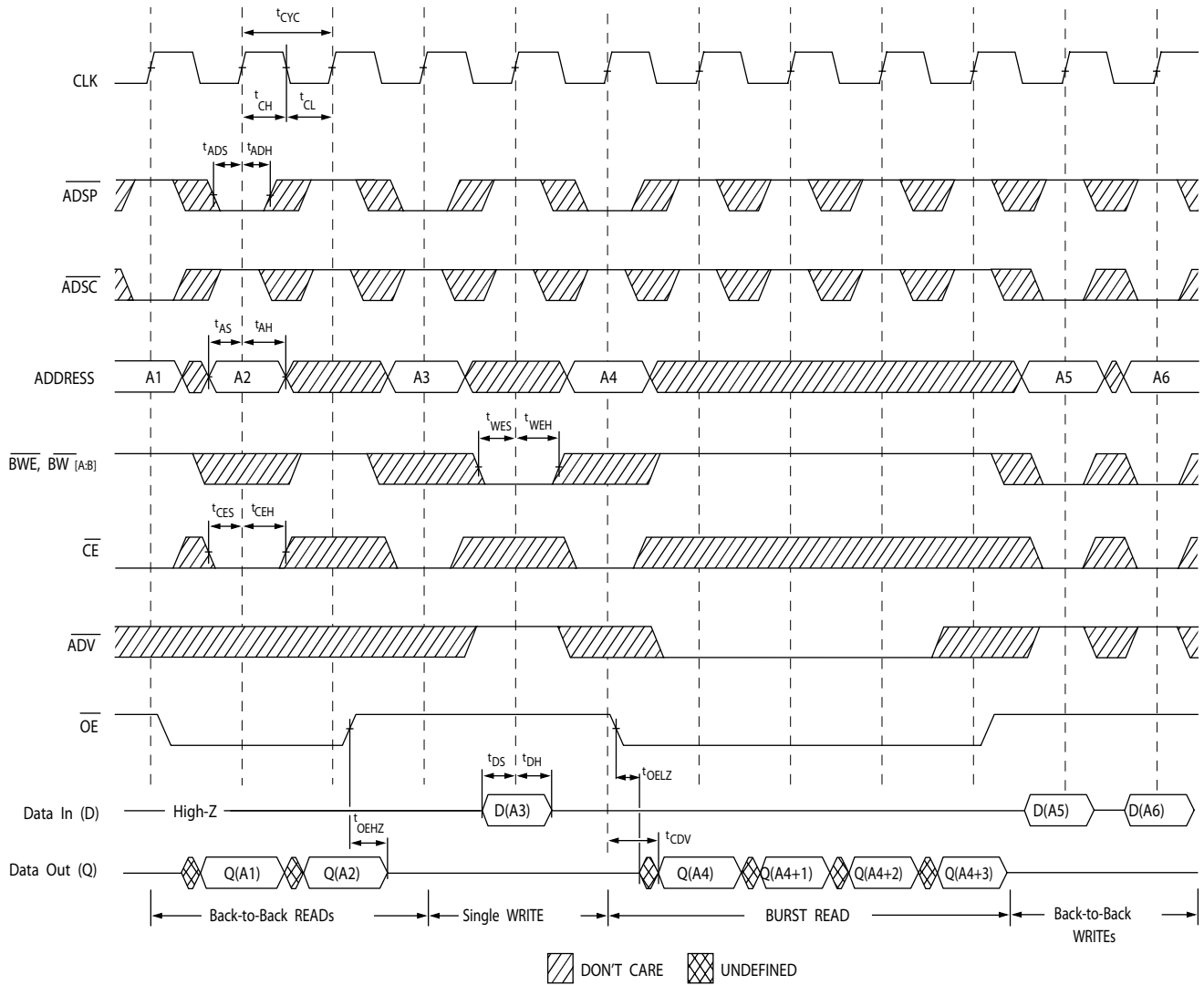


**Note:**  
16. Full width write can be initiated by either  $\overline{GW}$  LOW; or by  $\overline{GW}$  HIGH,  $\overline{BWE}$  LOW and  $\overline{BWB}_x$  LOW.

Timing Diagrams (continued)

Figure 3 shows the read and write timing. [16, 17, 18]

Figure 3. Read/Write Timing



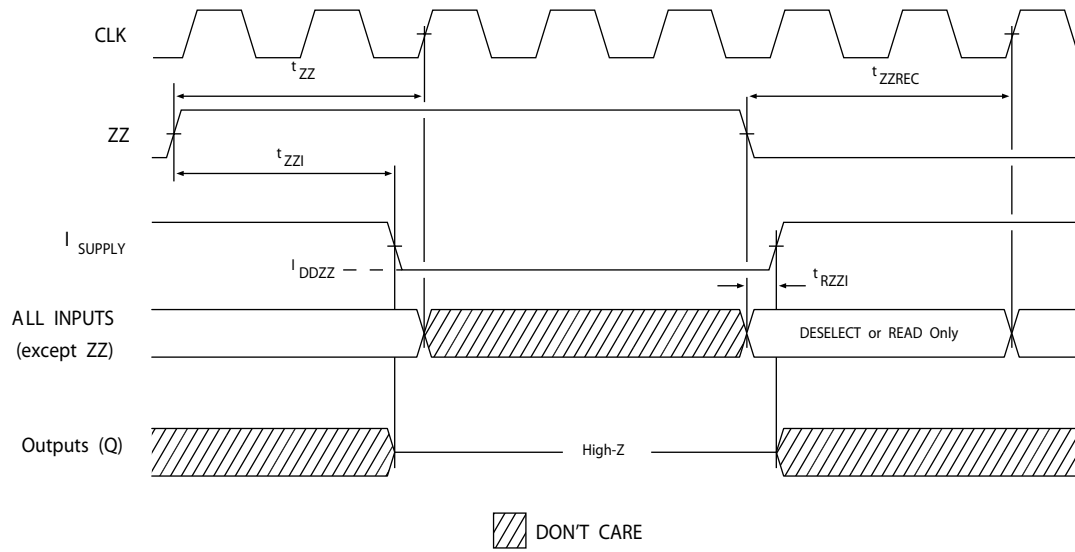
Notes:

- 17. The data bus (Q) remains in high-Z following a WRITE cycle, unless a new read access is initiated by  $\overline{\text{ADSP}}$  or  $\overline{\text{ADSC}}$ .
- 18.  $\overline{\text{GW}}$  is HIGH.

Timing Diagrams (continued)

Figure 4 shows the ZZ mode timing. [19, 20]

Figure 4. ZZ Mode Timing



Notes:

- 19. Device must be deselected when entering ZZ mode. See "Truth Table" on page 8 for all possible signal conditions to deselect the device.
- 20. DQs are in high-Z when exiting ZZ sleep mode.



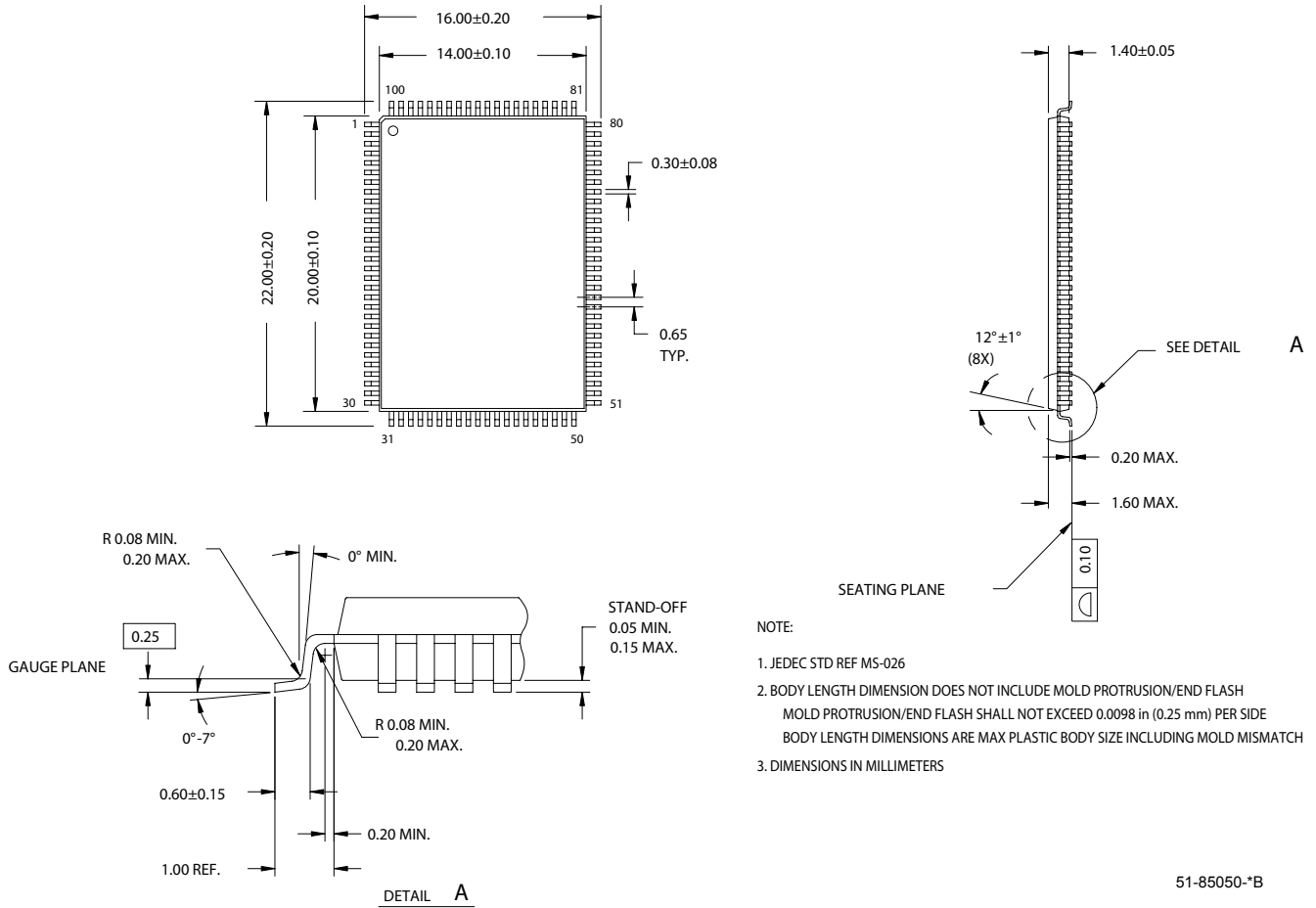
**Ordering Information**

Not all of the speed, package and temperature ranges are available. Please contact your local sales representative or visit [www.cypress.com](http://www.cypress.com) for actual products offered.

| Speed (MHz) | Ordering Code     | Package Diagram | Part and Package Type                                  | Operating Range |
|-------------|-------------------|-----------------|--|-----------------|
| 133         | CY7C1345G-133AXC  | 51-85050        | 100-Pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-Free | Commercial      |
|             | CY7C1345G-133BGC  | 51-85115        | 119-Ball Grid Array (14 x 22 x 2.4 mm)                 |                 |
|             | CY7C1345G-133BGXC |                 | 119-Ball Grid Array (14 x 22 x 2.4 mm) Pb-Free         |                 |
|             | CY7C1345G-133AXI  | 51-85050        | 100-Pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-Free | Industrial      |
|             | CY7C1345G-133BGI  | 51-85115        | 119-Ball Grid Array (14 x 22 x 2.4 mm)                 |                 |
|             | CY7C1345G-133BGXI |                 | 119-Ball Grid Array (14 x 22 x 2.4 mm) Pb-Free         |                 |
| 100         | CY7C1345G-100AXC  | 51-85050        | 100-Pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-Free | Commercial      |
|             | CY7C1345G-100BGC  | 51-85115        | 119-Ball Grid Array (14 x 22 x 2.4 mm)                 |                 |
|             | CY7C1345G-100BGXC |                 | 119-Ball Grid Array (14 x 22 x 2.4 mm) Pb-Free         |                 |
|             | CY7C1345G-100AXI  | 51-85050        | 100-Pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-Free | Industrial      |
|             | CY7C1345G-100BGI  | 51-85115        | 119-Ball Grid Array (14 x 22 x 2.4 mm)                 |                 |
|             | CY7C1345G-100BGXI |                 | 119-Ball Grid Array (14 x 22 x 2.4 mm) Pb-Free         |                 |

Package Diagrams

Figure 5. 100-Pin Thin Plastic Quad Flatpack (14 x 20 x 1.4 mm), 51-85050



51-85050-\*B



Document History Page

| Document Title: CY7C1345G, 4-Mbit (128K x 36) Flow Through Sync SRAM |         |            |                 |   |
|--|---------|------------|-----------------|---|
| Document Number: 38-05517  |         |            |                 |   |
| REV.   | ECN NO. | Issue Date | Orig. of Change | Description of Change   |
| **   | 224365  | See ECN    | RKF             | New datasheet   |
| *A   | 278513  | See ECN    | VBL             | Deleted 66 MHz<br>Changed TQFP package to Pb-free TQFP in Ordering Information section<br>Added BG Pb-free package  |
| *B   | 333626  | See ECN    | SYT             | Modified Address Expansion balls in the pinouts for 100 TQFP and 119 BGA Packages as per JEDEC standards and updated the Pin Definitions accordingly<br>Modified $V_{OL}$ , $V_{OH}$ test conditions<br>Replaced 'Snooze' with 'Sleep'<br>Removed 117 MHz speed bin<br>Replaced TBDs for $\theta_{JA}$ and $\theta_{JC}$ to their respective values on the Thermal Resistance table<br>Removed comment on the availability of BG Pb-free package<br>Updated the Ordering Information by shading and unshading MPNs as per availability  |
| *C   | 418633  | See ECN    | R XU            | Converted from Preliminary to Final<br>Changed address of Cypress Semiconductor Corporation on Page# 1 from "3901 North First Street" to "198 Champion Court"<br>Modified test condition from $V_{IH} \leq V_{DD}$ to $V_{IH} < V_{DD}$ .<br>Modified test condition from $V_{DDQ} < V_{DD}$ to $V_{DDQ} \leq V_{DD}$<br>Modified Input Load to Input Leakage Current except ZZ and MODE in the Electrical Characteristics Table<br>Replaced Package Name column with Package Diagram in the Ordering Information table<br>Replaced Package Diagram of 51-85050 from *A to *B<br>Updated the Ordering Information |
| *D   | 480124  | See ECN    | VKN             | Added the Maximum Rating for Supply Voltage on $V_{DDQ}$ Relative to GND<br>Updated the Ordering Information table.   |
| *E   | 1274724 | See ECN    | VKN             | Corrected Write Cycle timing waveform   |

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