

9-Mbit (256K x 32) Pipelined DCD Sync SRAM

Features

- Registered inputs and outputs for pipelined operation
- Optimal for performance (Double-Cycle deselect)
 - Depth expansion without wait state
- 256K x 32-bit common I/O architecture
- 3.3V core power supply (V_{DD})
- 2.5V/3.3V I/O power supply (V_{DDQ})
- Fast clock-to-output times
 - 2.8 ns (for 250-MHz device)
- Provide high-performance 3-1-1 access rate
- User-selectable burst counter supporting Intel® Pentium® interleaved or linear burst sequences
- Multiple chip enables for depth expansion: Three chip enables for A package version and Two chip enables for AJ package version
- Separate processor and controller address strobes
- Synchronous self-timed writes
- Asynchronous Output Enable
- Available in JEDEC-standard lead-free 100-Pin TQFP package
- “ZZ” Sleep Mode option

Functional Description^[1]

The CY7C1368C SRAM integrates 256K x 32 SRAM cells with advanced synchronous peripheral circuitry and a two-bit counter for internal burst operation. 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 ^[2]), Burst Control inputs (ADSC, ADSP, and ADV), Write Enables (BW_A , BW_B , BW_C , BW_D , and BW_E), and Global Write (GW). Asynchronous inputs include the Output Enable (OE) and the ZZ pin.

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

Address, data inputs, and write controls are registered on-chip to initiate a self-timed Write cycle. This part supports Byte Write operations (see Pin Descriptions and Truth Table for further details). Write cycles can be one to four bytes wide as controlled by the byte write control inputs. \overline{GW} active LOW causes all bytes to be written. This device incorporates an additional pipelined enable register which delays turning off the output buffers an additional cycle when a deselect is executed. This feature allows depth expansion without penalizing system performance.

The CY7C1368C operates from a +3.3V core power supply while all outputs may operate with either a +2.5 or +3.3V supply. All inputs and outputs are JEDEC-standard JESD8-5-compatible.

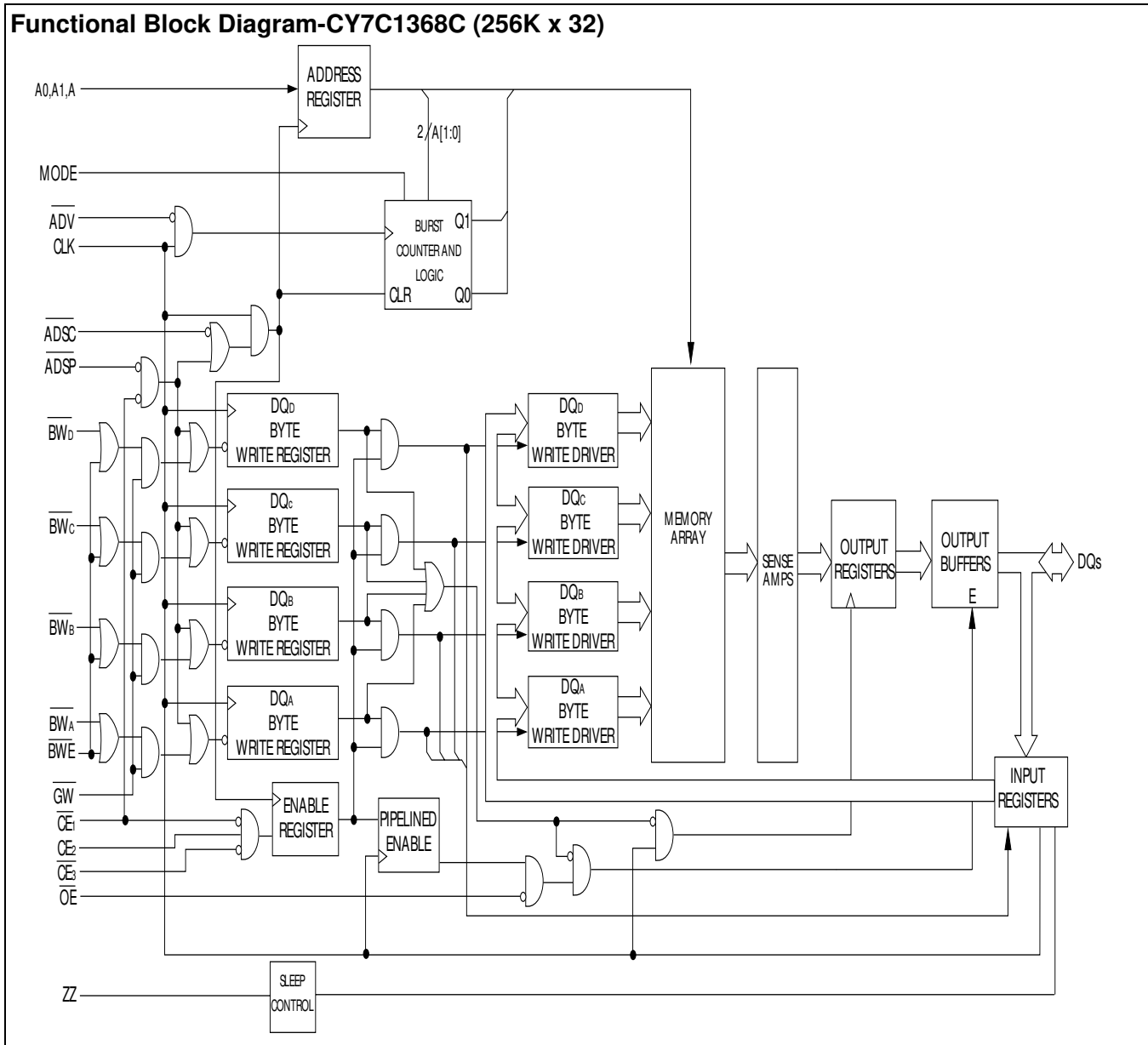
Selection Guide

| | 250 MHz | 200 MHz | 166 MHz | Unit |
|------------------------------|---------|---------|---------|------|
| Maximum Access Time | 2.8 | 3.0 | 3.5 | ns |
| Maximum Operating Current | 250 | 220 | 180 | mA |
| Maximum CMOS Standby Current | 40 | 40 | 40 | mA |

Notes:

1. For best-practice recommendations, please refer to the Cypress application note *System Design Guidelines* on <http://www.cypress.com>.
2. CE_3 is for A version (3 Chip enable option) only.

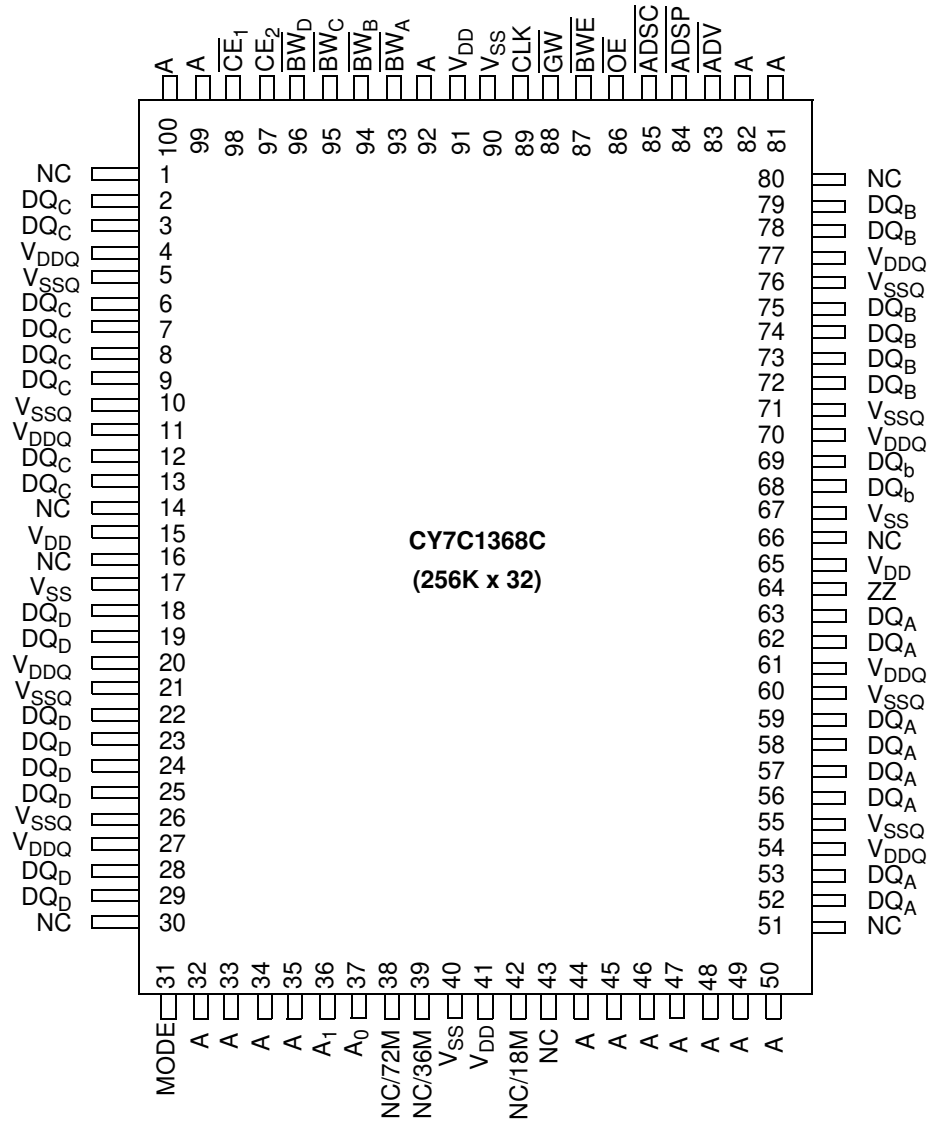
Functional Block Diagram-CY7C1368C (256K x 32)



Pin Configurations

100-Pin TQFP Pinout (2-Chip Enable) (AJ version)

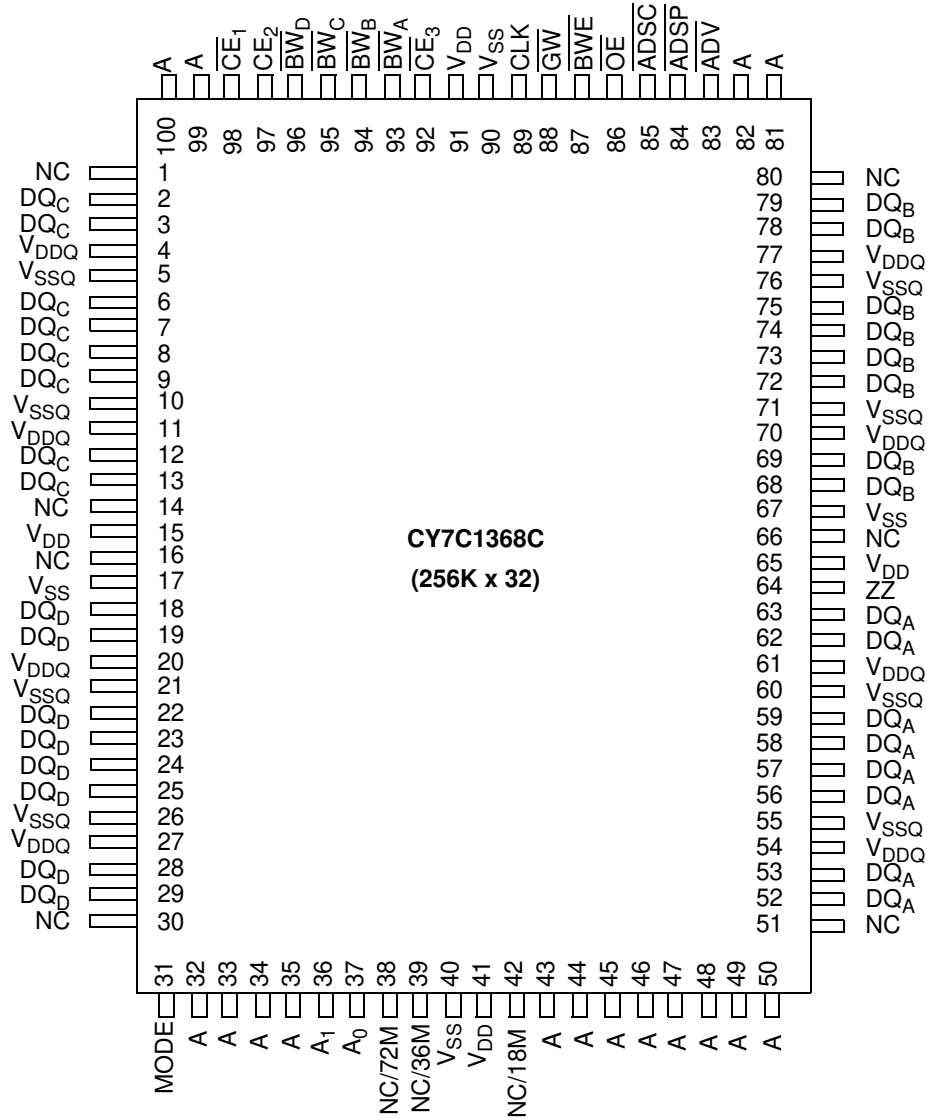
Top View



Pin Configurations (continued)

100-Pin TQFP Pinout (3-Chip Enable) (A version)

Top View



Pin Descriptions

| Pin | TQFP | Type | Description |
|---|--|--------------------|--|
| A ₀ , A ₁ , A | 37, 36, 32, 33, 34, 35, 44, 45, 46, 47, 48, 49, 50, 80, 81, 82, 99, 100, 92 (AJC), 43 (AC) | Input-Synchronous | Address Inputs used to select one of the 256K address locations. Sampled at the rising edge of the CLK if ADSP or ADSC is active LOW, and CE ₁ , CE ₂ , and CE ₃ ^[2] are sampled active. A _[1:0] are fed to the two-bit counter. |
| \overline{BW}_A , \overline{BW}_B , \overline{BW}_C , \overline{BW}_D | 93, 94 | Input-Synchronous | Byte Write Select Inputs, active LOW. Qualified with \overline{BWE} to conduct byte writes to the SRAM. Sampled on the rising edge of CLK. |
| \overline{GW} | 88 | Input-Synchronous | Global Write Enable Input, active LOW. When asserted LOW on the rising edge of CLK, a global write is conducted (ALL bytes are written, regardless of the values on $\overline{BW}_{[A:D]}$ and BWE). |
| \overline{BWE} | 87 | Input-Synchronous | Byte Write Enable Input, active LOW. Sampled on the rising edge of CLK. This signal must be asserted LOW to conduct a byte write. |
| CLK | 89 | Input-Clock | Clock Input. 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. |
| CE ₁ | 98 | Input-Synchronous | Chip Enable 1 Input, active LOW. Sampled on the rising edge of CLK. Used in conjunction with CE ₂ and CE ₃ to select/deselect the device. ADSP is ignored if CE ₁ is HIGH. CE ₁ is sampled only when a new external address is loaded. |
| CE ₂ | 97 | Input-Synchronous | Chip Enable 2 Input, active HIGH. Sampled on the rising edge of CLK. Used in conjunction with CE ₁ and CE ₃ to select/deselect the device. CE ₂ is sampled only when a new external address is loaded. |
| CE ₃ ^[2] | 92 | Input-Synchronous | Chip Enable 3 Input, active LOW. Sampled on the rising edge of CLK. Used in conjunction with CE ₁ and CE ₂ to select/deselect the device. Not available for AJ package version. CE ₃ ^[2] is assumed active throughout this document for BGA. CE ₃ is sampled only when a new external address is loaded. |
| OE | 86 | Input-Asynchronous | Output Enable, asynchronous input, active LOW. Controls the direction of the I/O pins. When LOW, the I/O pins behave as outputs. When deasserted HIGH, I/O pins are tri-stated, and act as input data pins. OE is masked during the first clock of a read cycle when emerging from a deselected state. |
| ADV | 83 | Input-Synchronous | Advance Input signal, sampled on the rising edge of CLK, active LOW. When asserted, it automatically increments the address in a burst cycle. |
| ADSP | 84 | Input-Synchronous | Address Strobe from Processor, sampled on the rising edge of CLK, active LOW. 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 ADSP and ADSC are both asserted, only ADSP is recognized. ADSP is ignored when CE ₁ is deasserted HIGH. |
| ADSC | 85 | Input-Synchronous | Address Strobe from Controller, sampled on the rising edge of CLK, active LOW. 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 ADSP and ADSC are both asserted, only ADSP is recognized. |
| ZZ | 64 | Input-Asynchronous | ZZ “sleep” Input, active HIGH. When asserted HIGH places the device in a non-time-critical “sleep” condition with data integrity preserved. For normal operation, this pin has to be LOW or left floating. ZZ pin has an internal pull-down. |
| DQs | 2, 3, 6, 7, 8, 9, 12, 13, 18, 19, 22, 23, 24, 25, 28, 29, 52, 53, 56, 57, 58, 59, 62, 63, 68, 69, 72, 73, 74, 75, 78, 79 | I/O-Synchronous | Bidirectional Data I/O lines. 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 OE. When OE is asserted LOW, the pins behave as outputs. When HIGH, DQs are placed in a tri-state condition. |
| V _{DD} | 15, 41, 65, 91 | Power Supply | Power supply inputs to the core of the device. |
| V _{SS} | 17, 40, 67, 90 | Ground | Ground for the core of the device. |

Pin Descriptions (continued)

| Pin | TQFP | Type | Description |
|------------------|--|------------------|---|
| V _{DDQ} | 4, 11, 20, 27, 54, 61, 70, 77 | I/O Power Supply | Power supply for the I/O circuitry. |
| V _{SSQ} | 5, 10, 21, 26, 55, 60, 71, 76 | I/O Ground | Ground for the I/O circuitry. |
| MODE | 31 | Input-Static | Selects Burst Order. When tied to GND selects linear burst sequence. When tied to V _{DD} or left floating selects interleaved burst sequence. This is a strap pin and should remain static during device operation. Mode Pin has an internal pull-up. |
| NC | 1, 16, 30, 38, 39, 42, 43(AJC), 51, 66, 80 | | No Connects. Not internally connected to the die. NC/(18M,36M, 72M, 144M, 288M, 576M, 1G) These pins are not connected. They will be used for expansion to the 18M, 36M, 72M, 144M, 288M, 576M and 1G densities. |

Functional Overview

All synchronous inputs pass through input registers controlled by the rising edge of the clock. All data outputs pass through output registers controlled by the rising edge of the clock.

The CY7C1368C supports secondary cache in systems utilizing 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 utilize a linear burst sequence. The burst order is user selectable, and is determined by sampling the MODE input. Accesses can be 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 wraparound 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_[A:D]) 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.

Synchronous Chip Selects \overline{CE}_1 , CE₂, \overline{CE}_3 and an asynchronous Output Enable (OE) provide for easy bank selection and output tri-state control. ADSP is ignored if CE₁ is HIGH.

Single Read Accesses

This access is initiated when the following conditions are satisfied at clock rise: (1) ADSP or ADSC is asserted LOW, (2) chip selects are all asserted active, and (3) the write signals (GW, BWE) are all deasserted HIGH. ADSP is ignored if CE₁ is HIGH. The address presented to the address inputs is stored into the address advancement logic and the Address Register while being presented to the memory core. The corresponding data is allowed to propagate to the input of the Output Registers. At the rising edge of the next clock the data is allowed to propagate through the output register and onto the data bus within t_{co} if OE is active LOW. The only exception occurs when the SRAM is emerging from a deselected state to a selected state, its outputs are always tri-stated during the first cycle of the access. After the first cycle of the access, the outputs are controlled by the OE signal. Consecutive single read cycles are supported.

The CY7C1368C is a double-cycle deselect part. Once the SRAM is deselected at clock rise by the chip select and either ADSP or ADSC signals, its output will tri-state immediately after the next clock rise.

Single Write Accesses Initiated by ADSP

This access is initiated when both of the following conditions are satisfied at clock rise: (1) ADSP is asserted LOW, and (2) chip select is asserted active. The address presented is loaded into the address register and the address advancement logic while being delivered to the memory core. The write signals (GW, BWE, and BW_[A:D]) and ADV inputs are ignored during this first cycle.

ADSP triggered write accesses require two clock cycles to complete. If GW is asserted LOW on the second clock rise, the data presented to the DQx inputs is written into the corresponding address location in the memory core. If GW is HIGH, then the write operation is controlled by BWE and BW_[A:D] signals. The CY7C1368C provides byte write capability that is described in the Write Cycle Description table. Asserting the Byte Write Enable input (BWE) with the selected Byte Write input will selectively write to only the desired bytes. Bytes not selected during a byte write operation will remain unaltered. A synchronous self-timed write mechanism has been provided to simplify the write operations.

Because the CY7C1368C is a common I/O device, the Output Enable (OE) must be deasserted HIGH before presenting data to the DQ inputs. Doing so will tri-state the output drivers. As a safety precaution, DQs are automatically tri-stated whenever a write cycle is detected, regardless of the state of OE.

Single Write Accesses Initiated by ADSC

ADSC write accesses are initiated when the following conditions are satisfied: (1) ADSC is asserted LOW, (2) ADSP is deasserted HIGH, (3) chip select is asserted active, and (4) the appropriate combination of the write inputs (GW, BWE, and BW_[A:D]) are asserted active to conduct a write to the desired byte(s). ADSC triggered write accesses require a single clock cycle to complete. The address presented is loaded into the address register and the address advancement logic while being delivered to the memory core. The ADV input is ignored during this cycle. If a global write is conducted, the data presented to the DQx is written into the corresponding address location in the memory core. If a byte write is conducted, only the selected bytes are written. Bytes not selected during a byte write operation will remain

unaltered. A synchronous self-timed write mechanism has been provided to simplify the write operations.

Because the CY7C1368C is a common I/O device, the Output Enable (OE) must be deasserted HIGH before presenting data to the DQ_X inputs. Doing so will tri-state the output drivers. As a safety precaution, DQ_X are automatically tri-stated whenever a write cycle is detected, regardless of the state of OE.

Burst Sequences

The CY7C1368C provides a two-bit wraparound counter, fed by A_[1:0], that implements either an interleaved or linear burst sequence. The interleaved burst sequence is designed specifically to support Intel Pentium applications. The linear burst sequence is designed to support processors that follow a linear burst sequence. The burst sequence is user selectable through the MODE input. Both read and write burst operations are supported

Asserting ADV LOW at clock rise will automatically increment the burst counter to the next address in the burst sequence. Both read and write burst operations are supported.

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. While 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 must be 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.

Truth Table^[3, 4, 5, 6, 7]

| Operation | Address Used | \overline{CE}_1 | \overline{CE}_3 | CE ₂ | 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 | X | L | L | L | X | X | X | X | L-H | Tri-state |
| Deselected Cycle, Power-down | None | L | H | X | L | L | X | X | X | X | L-H | Tri-state |
| Deselected Cycle, Power-down | None | L | X | L | L | H | L | X | X | X | L-H | Tri-state |
| Deselected Cycle, Power-down | None | L | H | X | L | H | L | X | X | X | L-H | Tri-state |
| ZZ Mode, Power-down | None | X | X | X | H | X | X | X | X | X | X | Tri-state |
| Read Cycle, Begin Burst | External | L | L | H | L | L | X | X | X | L | L-H | Q |
| Read Cycle, Begin Burst | External | L | L | H | L | L | X | X | X | H | L-H | Tri-state |
| Write Cycle, Begin Burst | External | L | L | H | L | H | L | X | L | X | L-H | D |
| Read Cycle, Begin Burst | External | L | L | H | L | H | L | X | H | L | L-H | Q |
| Read Cycle, Begin Burst | External | L | L | H | 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 |

Notes:

- X = “Don’t Care.” H = Logic HIGH, 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 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 ADSP or with the assertion of ADSC. As a result, \overline{OE} must be driven HIGH prior to the start of the write cycle to allow the outputs to tri-state. \overline{OE} is a don’t 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 OE is active (LOW).

Interleaved Burst Address Table

(MODE = Floating or V_{DD})

| First Address A1, A0 | Second Address A1, A0 | Third Address A1, A0 | Fourth Address A1, A0 |
|----------------------|-----------------------|----------------------|-----------------------|
| 00 | 01 | 10 | 11 |
| 01 | 00 | 11 | 10 |
| 10 | 11 | 00 | 01 |
| 11 | 10 | 01 | 00 |

Linear Burst Address Table (MODE = GND)

| First Address A1, A0 | Second Address A1, A0 | Third Address A1, A0 | Fourth Address A1, A0 |
|----------------------|-----------------------|----------------------|-----------------------|
| 00 | 01 | 10 | 11 |
| 01 | 10 | 11 | 00 |
| 10 | 11 | 00 | 01 |
| 11 | 00 | 01 | 10 |

Truth Table^[3, 4, 5, 6, 7] (continued)

| Operation | Address Used | \overline{CE}_1 | \overline{CE}_3 | CE_2 | ZZ | \overline{ADSP} | \overline{ADSC} | \overline{ADV} | \overline{WRITE} | \overline{OE} | CLK | DQ |
|-----------------------------|--------------|-------------------|-------------------|--------|----|-------------------|-------------------|------------------|--------------------|-----------------|-----|-----------|
| 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 |

Truth Table for Read/Write^[3, 4]

| Function | \overline{GW} | \overline{BWE} | \overline{BW}_A | \overline{BW}_B | \overline{BW}_C | \overline{BW}_D |
|--|-----------------|------------------|-------------------|-------------------|-------------------|-------------------|
| Read | H | H | X | X | X | X |
| Read | H | L | H | H | H | H |
| Write byte A - (DQ _A and DQP _A) | H | L | L | H | H | H |
| Write byte B - (DQ _B and DQP _B) | H | L | H | L | H | H |
| Write byte C - (DQ _C and DQP _C) | H | L | H | H | L | H |
| Write byte D - (DQ _D and DQP _D) | H | L | H | H | H | L |
| Write all bytes | H | L | L | L | L | L |
| Write all bytes | L | X | X | X | X | X |

ZZ Mode Electrical Characteristics

| Parameter | Description | Test Conditions | Min. | Max. | Unit |
|-------------|-----------------------------------|---------------------------|------------|------------|------|
| I_{DDZZ} | sleep mode standby current | $ZZ \geq V_{DD} - 0.2V$ | | 50 | 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 recovery time | This parameter is sampled | | $2t_{CYC}$ | ns |
| t_{RZZI} | ZZ inactive to exit sleep current | This parameter is sampled | 0 | | ns |

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature -65°C to +150°
 Ambient Temperature with Power Applied.....-55°C to +125°C
 Supply Voltage on V_{DD} Relative to GND..... -0.5V to +4.6V
 Supply Voltage on V_{DDQ} Relative to GND -0.5V to +V_{DD}
 DC Voltage Applied to Outputs in Tri-State -0.5V to V_{DDQ} +0.5V

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

Operating Range

| Range | Ambient Temperature | V _{DD} | V _{DDQ} |
|------------|---------------------|-----------------|------------------------------|
| Commercial | 0°C to +70°C | 3.3V – 5%/+10% | 2.5V – 5% to V _{DD} |
| Industrial | -40°C to +85°C | | |

Electrical Characteristics Over the Operating Range^[8, 9]

| Parameter | Description | Test Conditions | Min. | Max. | Unit |
|-------------------------|---|---|---------------------|------------------------|------|
| V _{DD} | Power Supply Voltage | | 3.135 | 3.6 | V |
| V _{DDQ} | I/O Supply Voltage | for 3.3V I/O | 3.135 | V _{DD} | V |
| | | for 2.5V I/O | 2.375 | 2.625 | V |
| V _{OH} | Output HIGH Voltage | for 3.3V I/O, I _{OH} = -4.0 mA | 2.4 | | V |
| | | for 2.5V I/O, I _{OH} = -1.0 mA | 2.0 | | V |
| V _{OL} | Output LOW Voltage | for 3.3V I/O, I _{OL} = 8.0 mA | | 0.4 | V |
| | | for 2.5V I/O, I _{OL} = 1.0 mA | | 0.4 | V |
| V _{IH} | Input HIGH Voltage ^[8] | for 3.3V I/O | 2.0 | V _{DD} + 0.3V | V |
| | | for 2.5V I/O | 1.7 | V _{DD} + 0.3V | V |
| V _{IL} | Input LOW Voltage ^[8] | for 3.3V I/O | -0.3 | 0.8 | V |
| | | for 2.5V I/O | -0.3 | 0.7 | V |
| I _X | Input Leakage Current except ZZ and MODE | GND ≤ V _I ≤ V _{DDQ} | -5 | 5 | μA |
| | Input Current of MODE | Input = V _{SS} | -30 | | μA |
| | | Input = V _{DD} | | 5 | μA |
| | Input Current of ZZ | Input = V _{SS} | -5 | | μA |
| Input = V _{DD} | | | 30 | μA | |
| I _{OZ} | Output Leakage Current | GND ≤ V _I ≤ V _{DDQ} , Output Disabled | -5 | 5 | μA |
| I _{DD} | V _{DD} Operating Supply Current | V _{DD} = Max., I _{OUT} = 0 mA, f = f _{MAX} = 1/t _{CYC} | 4-ns cycle, 250 MHz | 250 | mA |
| | | | 5-ns cycle, 200 MHz | 220 | mA |
| | | | 6-ns cycle, 166 MHz | 180 | mA |
| I _{SB1} | Automatic CE Power-down Current—TTL Inputs | V _{DD} = Max., Device Deselected, V _{IN} ≥ V _{IH} or V _{IN} ≤ V _{IL} , f = f _{MAX} = 1/t _{CYC} | 4-ns cycle, 250 MHz | 130 | mA |
| | | | 5-ns cycle, 200 MHz | 120 | |
| | | | 6-ns cycle, 166 MHz | 110 | |
| I _{SB2} | Automatic CE Power-down Current—CMOS Inputs | V _{DD} = Max., Device Deselected, V _{IN} ≤ 0.3V or V _{IN} ≥ V _{DDQ} - 0.3V, f = 0 | All speeds | 40 | mA |
| I _{SB3} | Automatic CE Power-down Current—CMOS Inputs | V _{DD} = Max., Device Deselected, or V _{IN} ≤ 0.3V or V _{IN} ≥ V _{DDQ} - 0.3V, f = f _{MAX} = 1/t _{CYC} | 4-ns cycle, 250 MHz | 120 | mA |
| | | | 5-ns cycle, 200 MHz | 110 | |
| | | | 6-ns cycle, 166 MHz | 100 | |
| I _{SB4} | Automatic CE Power-down Current—TTL Inputs | V _{DD} = Max., Device Deselected, V _{IN} ≥ V _{IH} or V _{IN} ≤ V _{IL} , f = 0 | All speeds | 40 | mA |

Notes:

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

Capacitance^[10]

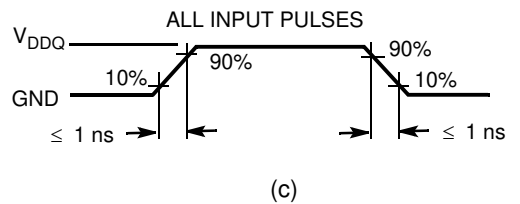
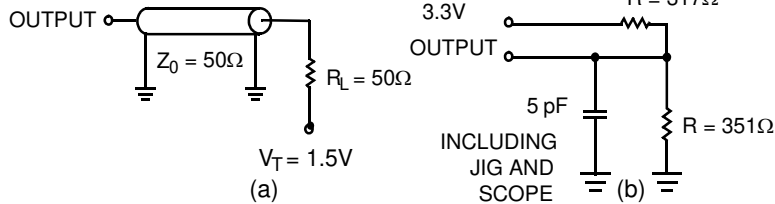
| Parameter | Description | Test Conditions | 100 TQFP Max. | Unit |
|------------------|--------------------------|--|---------------|------|
| C _{IN} | Input Capacitance | T _A = 25°C, f = 1 MHz, V _{DD} = 3.3V V _{DDQ} = 2.5V | 4 | pF |
| C _{CLK} | Clock Input Capacitance | | 4 | pF |
| C _{I/O} | Input/Output Capacitance | | 4 | pF |

Thermal Characteristics^[10]

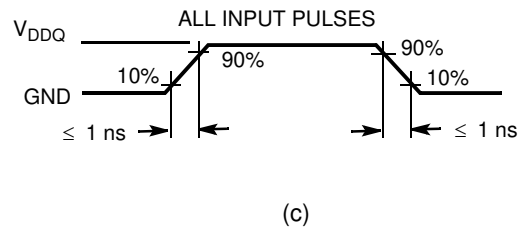
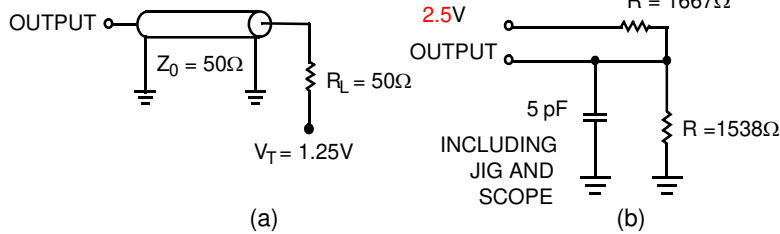
| Parameter | Description | Test Conditions | 100 TQFP Package | Unit |
|-----------------|--|---|------------------|------|
| θ _{JA} | Thermal Resistance (Junction to Ambient) | Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51 | 29.41 | °C/W |
| θ _{JC} | Thermal Resistance (Junction to case) | | 6.13 | °C/W |

AC Test Loads and Waveforms

3.3V I/O Test Load



2.5V I/O Test Load



Note:

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

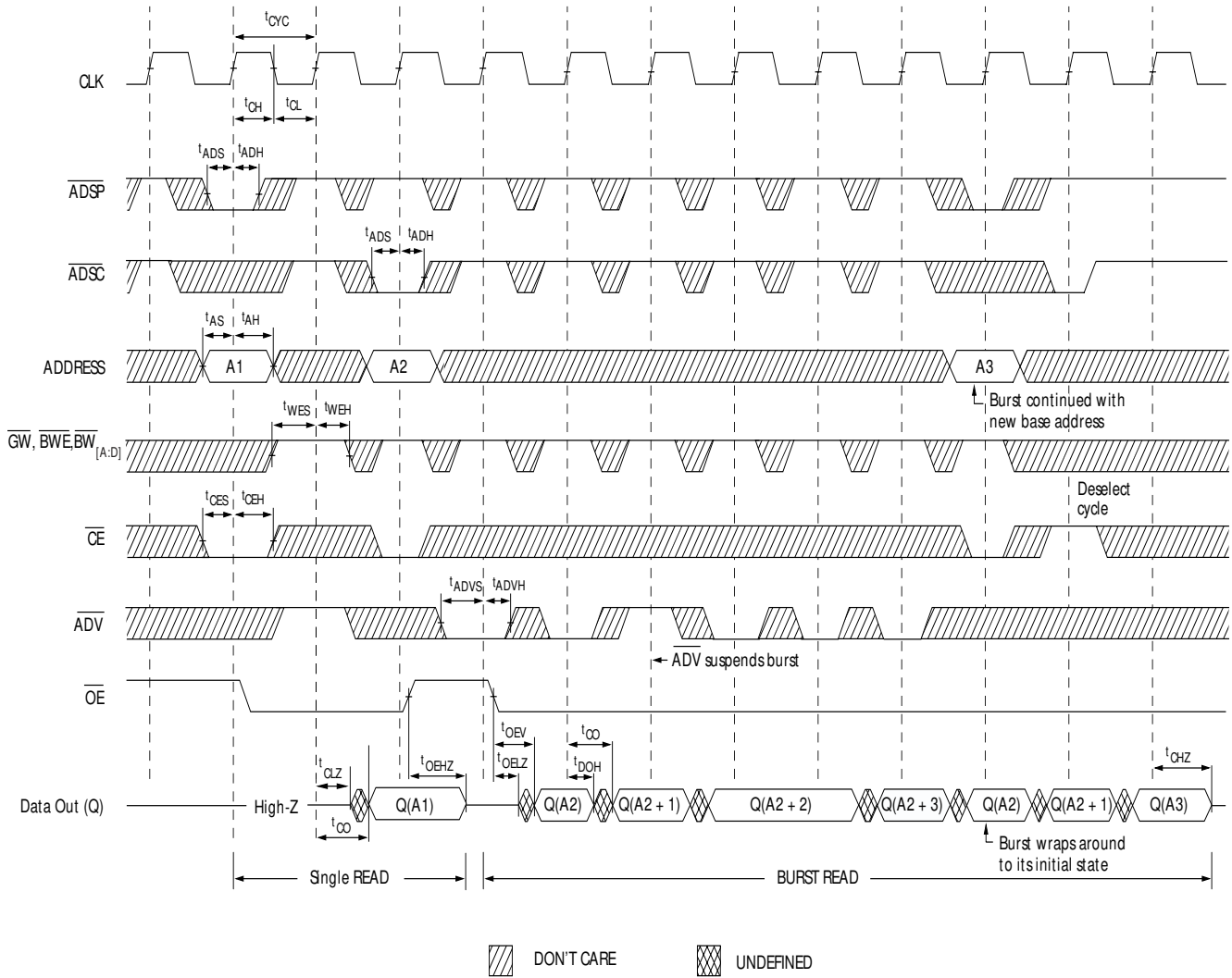
Switching Characteristics Over the Operating Range [15, 16]

| Parameter | Description | -250 | | -200 | | -166 | | Unit |
|---------------------|--|------|------|------|------|------|------|------|
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| t _{POWER} | V _{DD} (Typical) to the first Access ^[11] | 1 | | 1 | | 1 | | ms |
| Clock | | | | | | | | |
| t _{CYC} | Clock Cycle Time | 4.0 | | 5.0 | | 6.0 | | ns |
| t _{CH} | Clock HIGH | 1.8 | | 2.0 | | 2.4 | | ns |
| t _{CL} | Clock LOW | 1.8 | | 2.0 | | 2.4 | | ns |
| Output Times | | | | | | | | |
| t _{CO} | Data Output Valid After CLK Rise | | 2.8 | | 3.0 | | 3.5 | ns |
| t _{DOH} | Data Output Hold After CLK Rise | 1.25 | | 1.25 | | 1.25 | | ns |
| t _{CLZ} | Clock to Low-Z ^[12, 13, 14] | 1.25 | | 1.25 | | 1.25 | | ns |
| t _{CHZ} | Clock to High-Z ^[12, 13, 14] | 1.25 | 2.8 | 1.25 | 3.0 | 1.25 | 3.5 | ns |
| t _{OEV} | \overline{OE} LOW to Output Valid | | 2.8 | | 3.0 | | 3.5 | ns |
| t _{OELZ} | \overline{OE} LOW to Output Low-Z ^[12, 13, 14] | 0 | | 0 | | 0 | | ns |
| t _{OEHZ} | \overline{OE} HIGH to Output High-Z ^[12, 13, 14] | | 2.8 | | 3.0 | | 3.5 | ns |
| Set-up Times | | | | | | | | |
| t _{AS} | Address Set-up Before CLK Rise | 1.4 | | 1.5 | | 1.5 | | ns |
| t _{ADS} | \overline{ADSC} , \overline{ADSP} Set-up Before CLK Rise | | | 1.5 | | 1.5 | | ns |
| t _{ADVS} | \overline{ADV} Set-up Before CLK Rise | 1.4 | | 1.5 | | 1.5 | | ns |
| t _{WES} | \overline{GW} , \overline{OE} , $\overline{BW}_{[A:D]}$ Set-up Before CLK Rise | 1.4 | | 1.5 | | 1.5 | | ns |
| t _{DS} | Data Input Set-up Before CLK Rise | 1.4 | | 1.5 | | 1.5 | | ns |
| t _{CES} | Chip Enable Set-up Before CLK Rise | 1.4 | | 1.5 | | 1.5 | | ns |
| Hold Times | | | | | | | | |
| t _{AH} | Address Hold After CLK Rise | 0.4 | | 0.5 | | 0.5 | | ns |
| t _{ADH} | \overline{ADSP} , \overline{ADSC} Hold After CLK Rise | 0.4 | | 0.5 | | 0.5 | | ns |
| t _{ADVH} | \overline{ADV} Hold After CLK Rise | 0.4 | | 0.5 | | 0.5 | | ns |
| t _{WEH} | \overline{GW} , \overline{BWE} , $\overline{BW}_{[A:D]}$ Hold After CLK Rise | 0.4 | | 0.5 | | 0.5 | | ns |
| t _{DH} | Data Input Hold After CLK Rise | 0.4 | | 0.5 | | 0.5 | | ns |
| t _{CEH} | Chip Enable Hold After CLK Rise | 0.4 | | 0.5 | | 0.5 | | ns |

Notes:

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 can be initiated.
12. t_{CHZ}, t_{CLZ}, t_{OELZ}, and t_{OEHZ} are specified with AC test conditions shown in part (b) of AC Test Loads. Transition is measured ± 200 mV from steady-state voltage.
13. At any given voltage and temperature, t_{OEHZ} 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.
15. Timing reference level is 1.5V when V_{DDQ} = 3.3V and is 1.25 V when V_{DDQ} = 2.5 V.
16. Test conditions shown in (a) of AC Test Loads unless otherwise noted.

Switching Waveforms
Read Timing^[17]

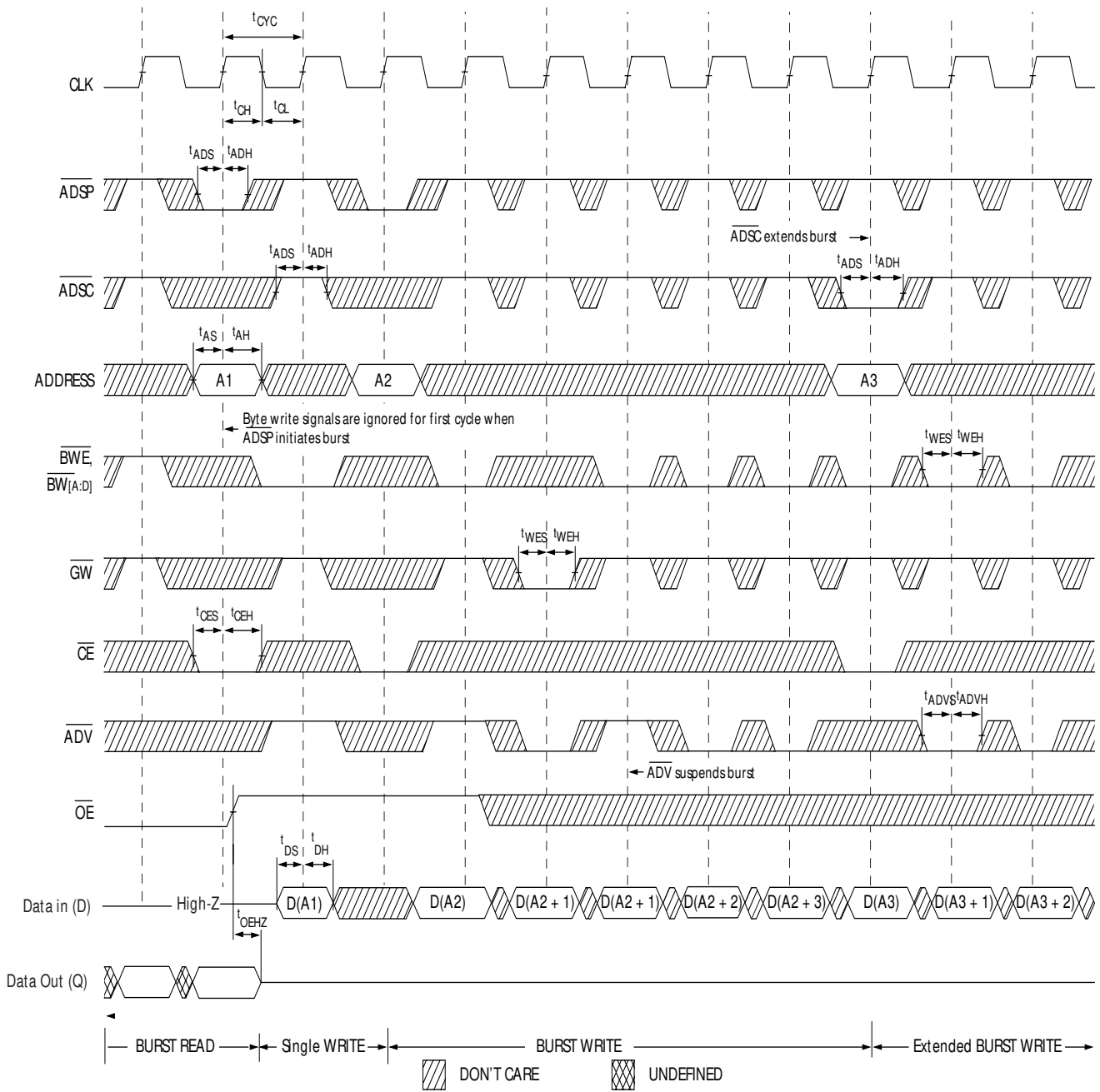


Note:

17. 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.

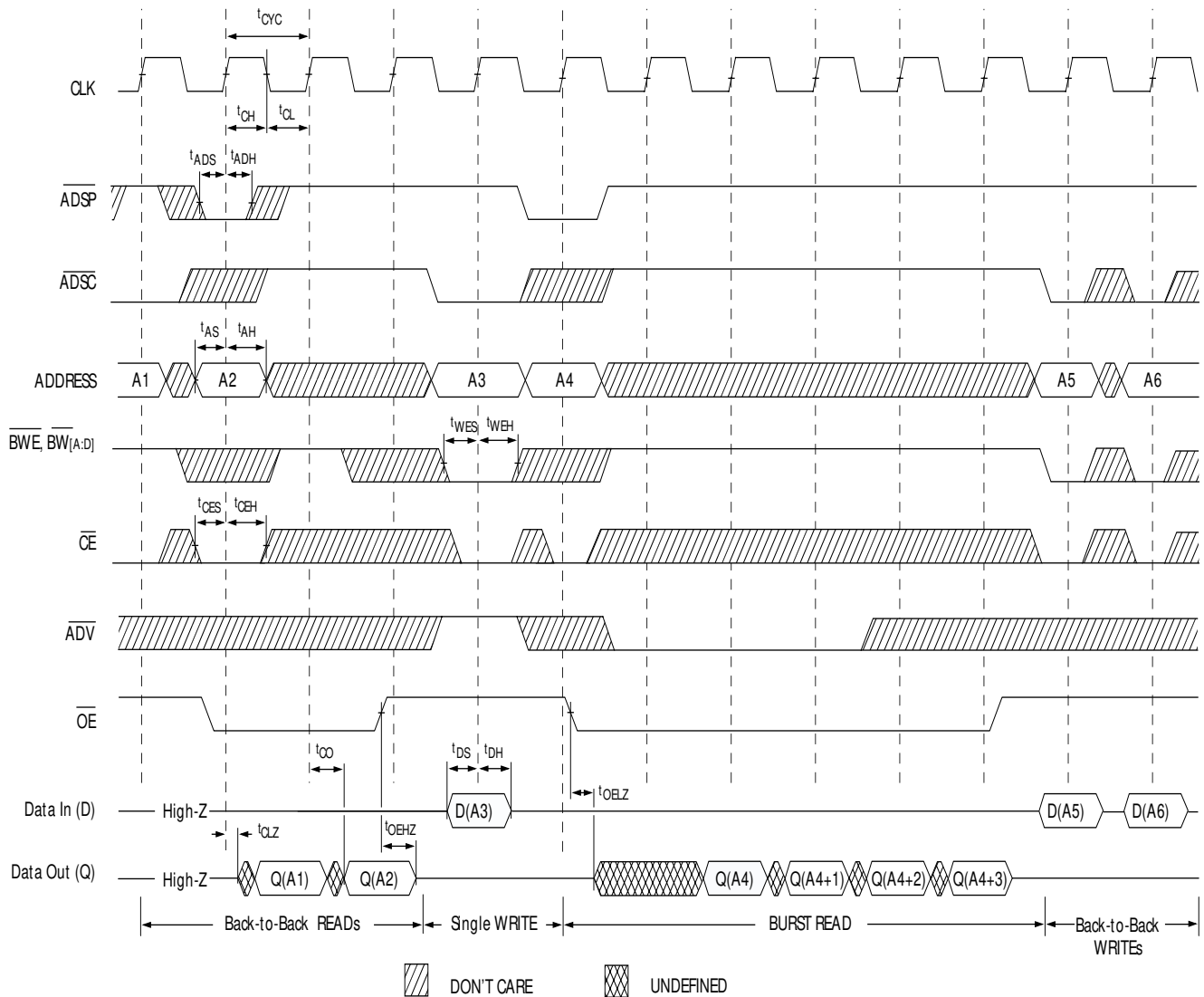
Switching Waveforms (continued)

Write Timing^[17, 18]



Note:

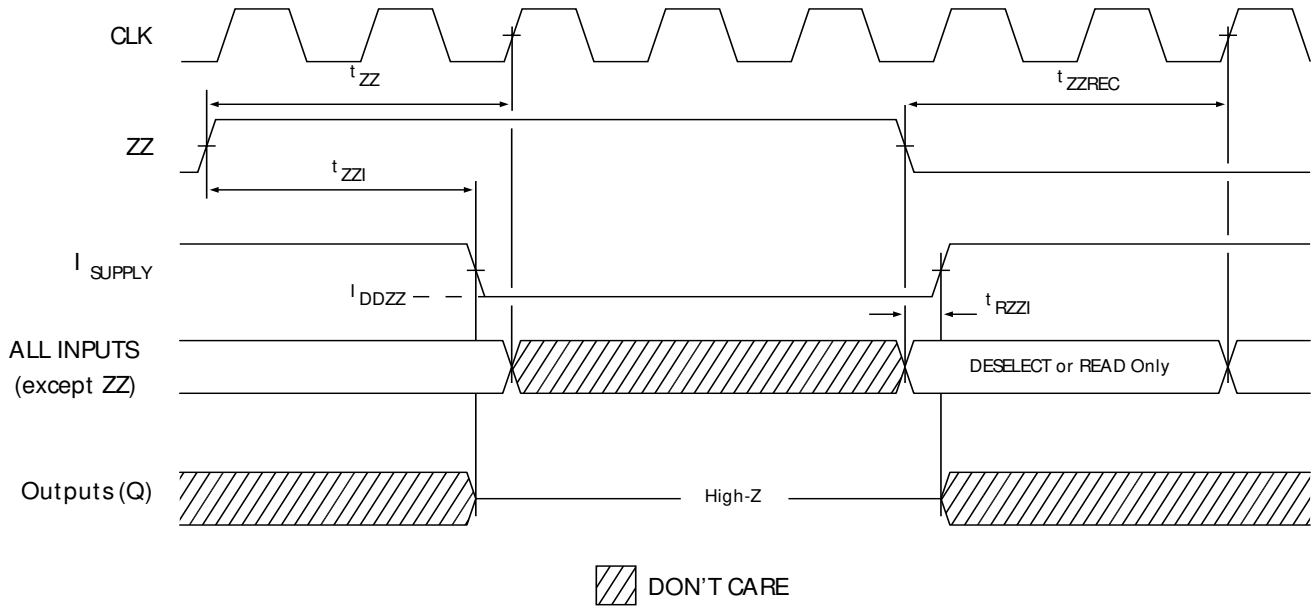
18. Full width write can be initiated by either \overline{GW} LOW; or by \overline{GW} HIGH, \overline{BWE} LOW and $\overline{BW}_{[A:D]}$ LOW.

Switching Waveforms (continued)
Read/Write Timing^[17, 19, 20]

Notes:

- 19. The data bus (Q) remains in tri-state following a WRITE cycle unless a new read access is initiated by \overline{ADSP} or \overline{ADSC} .
- 20. GW is HIGH.

Switching Waveforms (continued)

ZZ Mode Timing [21, 22.]



Notes:

- 21. Device must be deselected when entering ZZ mode. See truth table for all possible signal conditions to deselect the device.
- 22. DQs are in tri-state when exiting ZZ sleep mode.

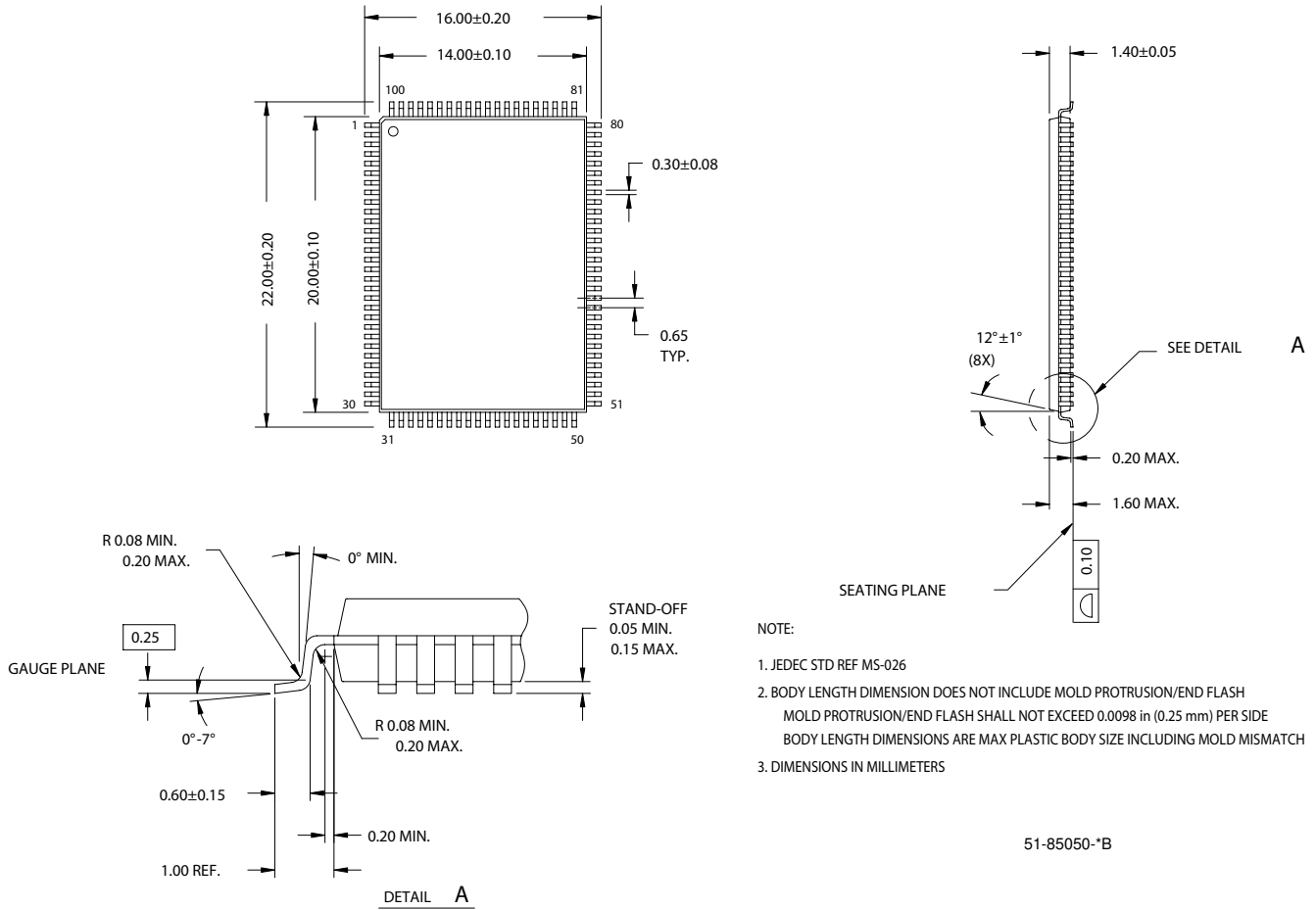
Ordering Information

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

| Speed (MHz) | Ordering Code | Package Diagram | Part and Package Type | Operating Range |
|-------------|-------------------|-----------------|--|-----------------|
| 166 | CY7C1368C-166AXC | 51-85050 | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (3 Chip enable) | Commercial |
| | CY7C1368C-166AJXC | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (2 Chip enable) | |
| | CY7C1368C-166AXI | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (3 Chip enable) | Industrial |
| | CY7C1368C-166AJXI | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (2 Chip enable) | |
| 200 | CY7C1368C-200AXC | 51-85050 | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (3 Chip enable) | Commercial |
| | CY7C1368C-200AJXC | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (2 Chip enable) | |
| | CY7C1368C-200AXI | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (3 Chip enable) | Industrial |
| | CY7C1368C-200AJXI | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (2 Chip enable) | |
| 250 | CY7C1368C-250AXC | 51-85050 | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (3 Chip enable) | Commercial |
| | CY7C1368C-250AJXC | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (2 Chip enable) | |
| | CY7C1368C-250AXI | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (3 Chip enable) | Industrial |
| | CY7C1368C-250AJXI | | 100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Lead-Free (2 Chip enable) | |

Package Diagram

100-Pin TQFP (14 x 20 x 1.4 mm) (51-85050)



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Document History Page

| Document Title: CY7C1368C 9-Mbit (256K x 32) Pipelined DCD Sync SRAM | | | | |
|---|----------------|-------------------|------------------------|--|
| Document Number: 38-05686 | | | | |
| REV. | ECN NO. | Issue Date | Orig. of Change | Description of Change |
| ** | 286269 | See ECN | PCI | New data sheet |
| *A | 323636 | See ECN | PCI | Changed frequency of 225 MHz to 250 MHz Added t_{CYC} to 4.0 ns for 250 MHz Changed θ_{JA} and θ_{JC} for TQFP Package from 25 and 9 °C/W to 29.41 and 6.13 °C/W respectively Added Industrial temperature range Replaced Snooze with Sleep in the ZZ Mode Electrical Characteristics Added 3 chip enable and 2 chip enable for AX and AJX packages in the ordering information table |
| *B | 332879 | See ECN | PCI | Shaded 250 MHz speed bin in the AC/DC Table and Selection Guide Added Address Expansion pins in the Pin Definition Table Modified V_{OL} , V_{OH} test conditions Corrected V_{DDQ} from (2.5V – 5% to V_{DD}) to (3.3V –5%/+10%) on page# 9 Updated Ordering Information Table |
| *C | 377095 | See ECN | PCI | Changed I_{SB2} from 30 to 40 mA Modified test condition in note# 9 from $V_{IH} \leq V_{DD}$ to $V_{IH} < V_{DD}$ |
| *D | 408725 | See ECN | R XU | Changed address of Cypress Semiconductor Corporation on Page# 1 from “3901 North First Street” to “198 Champion Court” Converted from Preliminary to Final Replaced Package Name column with Package Diagram in the Ordering Information table Updated the ordering information |
| *E | 429278 | See ECN | NXR | Added 2.5V/O option Updated Ordering Information Table |
| *F | 501828 | See ECN | VKN | Added the Maximum Rating for Supply Voltage on V_{DDQ} Relative to GND Updated the Ordering Information table. |