

# 4-Mbit (256K × 18) Pipelined Sync SRAM

## Features

- Registered inputs and outputs for pipelined operation
- 256K × 18 common I/O Architecture
- 3.3 V core power supply ( $V_{DD}$ )
- 2.5 V I/O power supply ( $V_{DDQ}$ )
- Fast clock-to-output times
  - 3.5 ns (for 166-MHz device)
- Provide high performance 3-1-1-1 access rate
- User-selectable burst counter supporting Intel® Pentium® interleaved or linear burst sequences
- Separate processor and controller address strobes
- Synchronous self-timed writes
- Asynchronous output enable
- Offered in Pb-free 100-pin TQFP package
- “ZZ” sleep mode option

## Functional Description

The CY7C1327G SRAM integrates 256K × 18 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 ( $\overline{CE}_1$ ), depth-expansion chip enables ( $\overline{CE}_2$  and  $\overline{CE}_3$ ), burst control inputs (ADSC, ADSP, and ADV), write enables ( $BW_{[A:B]}$ , and BWE), and global write (GW). Asynchronous inputs include the output enable ( $\overline{OE}$ ) and the ZZ pin.

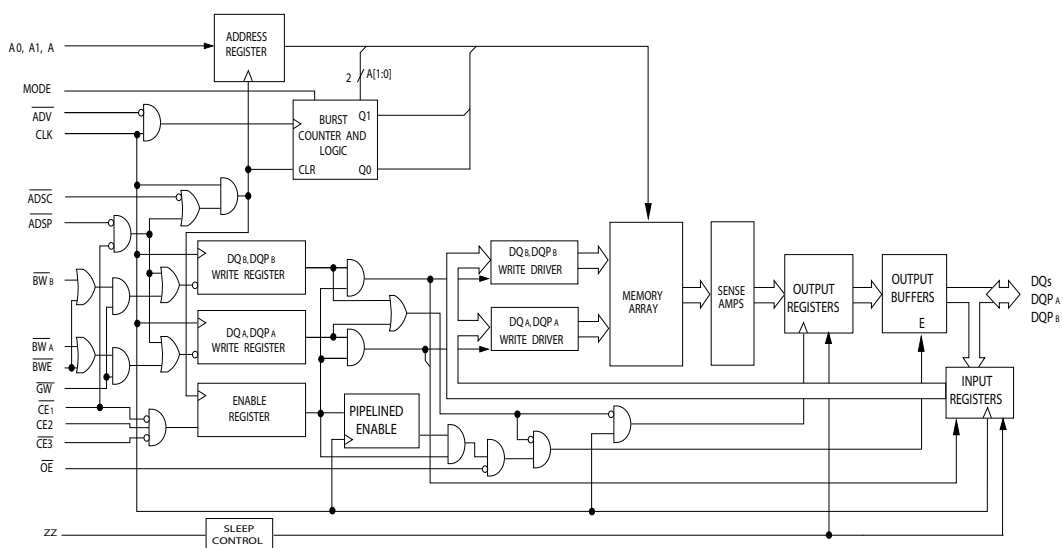
Addresses and chip enables are registered at rising edge of clock when either address strobe processor (ADSP) or address strobe controller (ADSC) are active. Subsequent burst addresses can be internally generated as controlled by the advance pin (ADV).

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 two bytes wide as controlled by the byte write control inputs. GW when active LOW causes all bytes to be written.

The CY7C1327G operates from a +3.3 V core power supply while all outputs also operate with a +3.3 V or a +2.5 V supply. All inputs and outputs are JEDEC-standard JESD8-5-compatible.

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

## Logic Block



**Errata:** For information on silicon errata, see "Errata" on page 21. Details include trigger conditions, devices affected, and proposed workaround.

## Contents

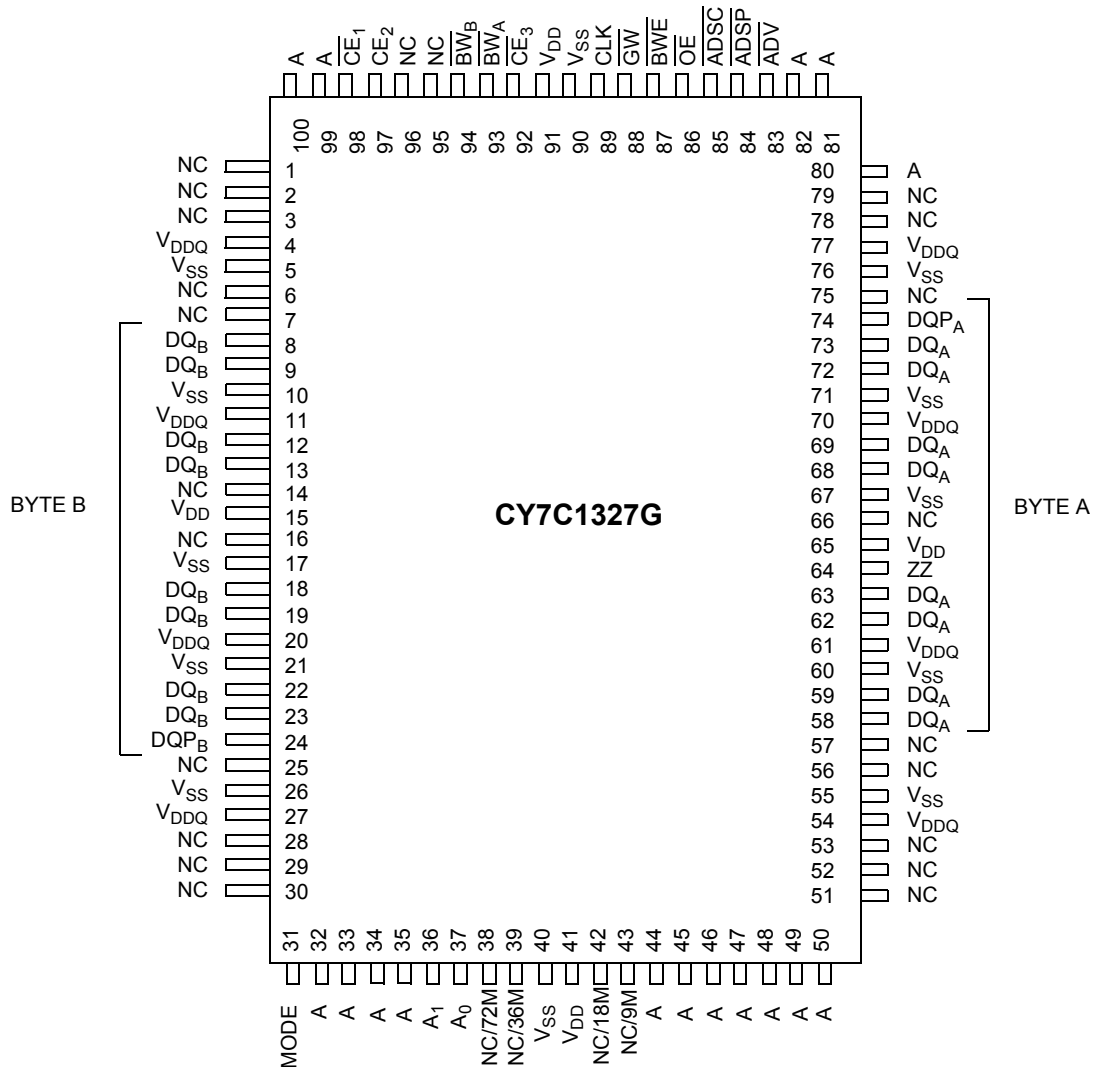
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## Selection Guide

Description	166 MHz	133 MHz	Unit
Maximum access time	3.5	4.0	ns
Maximum operating current	240	225	mA
Maximum CMOS standby current	40	40	mA

## Pin Configurations

Figure 1. 100-pin TQFP pinout [1]



### Note

- Errata:** The ZZ pin (Pin 64) needs to be externally connected to ground. For more information, see "Errata" on page 21.

## Pin Definitions

Name	I/O	Description
A <sub>0</sub> , A <sub>1</sub> , A	Input-synchronous	<b>Address inputs used to select one of the 256 K address locations.</b> Sampled at the rising edge of the CLK if ADSP or ADSC is active LOW, and CE <sub>1</sub> , CE <sub>2</sub> , and CE <sub>3</sub> are sampled active. A <sub>1</sub> , A <sub>0</sub> feed the 2-bit counter.
BW <sub>A</sub> , BW <sub>B</sub>	Input-synchronous	<b>Byte write select inputs, active LOW.</b> Qualified with BWE to conduct byte writes to the SRAM. Sampled on the rising edge of CLK.
GW	Input-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 BW <sub>[A:B]</sub> and BWE).
BWE	Input-synchronous	<b>Byte write enable input, active LOW.</b> Sampled on the rising edge of CLK. This signal must be 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.
CE <sub>1</sub>	Input-synchronous	<b>Chip enable 1 input, active LOW.</b> Sampled on the rising edge of CLK. Used in conjunction with CE <sub>2</sub> and CE <sub>3</sub> to select/deselect the device. ADSP is ignored if CE <sub>1</sub> is HIGH. CE <sub>1</sub> is sampled only when a new external address is loaded.
CE <sub>2</sub>	Input-synchronous	<b>Chip enable 2 input, active HIGH.</b> Sampled on the rising edge of CLK. Used in conjunction with CE <sub>1</sub> and CE <sub>3</sub> to select/deselect the device. CE <sub>2</sub> is sampled only when a new external address is loaded.
CE <sub>3</sub>	Input-synchronous	<b>Chip enable 3 input, active LOW.</b> Sampled on the rising edge of CLK. Used in conjunction with CE <sub>1</sub> and CE <sub>2</sub> to select/deselect the device. CE <sub>3</sub> is sampled only when a new external address is loaded.
OE	Input-asynchronous	<b>Output enable, asynchronous input, active LOW.</b> Controls the direction of the I/O pins. When LOW, the I/O pins behave as outputs. When deasserted HIGH, I/O pins are tristated, and act as input data pins. OE is masked during the first clock of a read cycle when emerging from a deselected state.
ADV	Input-synchronous	<b>Advance input signal, sampled on the rising edge of CLK, active LOW.</b> When asserted, it automatically increments the address in a burst cycle.
ADSP	Input-synchronous	<b>Address strobe from processor, sampled on the rising edge of CLK, active LOW.</b> When asserted LOW, A is captured in the address registers. A <sub>1</sub> :A <sub>0</sub> are also loaded into the burst counter. When ADSP and ADSC are both asserted, only ADSP is recognized. ADSP is ignored when CE <sub>1</sub> is deasserted HIGH.
ZZ <sup>[2]</sup>	Input-asynchronous	<b>ZZ “sleep” input, active HIGH.</b> This input, when High places the device in a non-time-critical “sleep” condition with data integrity preserved. During normal operation, this pin has to be low or left floating. ZZ pin has an internal pull-down.

### Note

2. **Errata:** The ZZ pin (Pin 64) needs to be externally connected to ground. For more information, see “Errata” on page 21.

## Pin Definitions *(continued)*

Name	I/O	Description
ADSC	Input-synchronous	<b>Address strobe from controller, sampled on the rising edge of CLK, active LOW.</b> When asserted LOW, A is captured in the address registers. A1:A0 are also loaded into the burst counter. When ADSP and ADSC are both asserted, only ADSP is recognized.
DQ <sub>A</sub> , DQ <sub>B</sub> , DQP <sub>A</sub> , DQP <sub>B</sub>	I/O-synchronous	<b>Bidirectional data I/O 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 "A" 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 and DQP <sub>[A:B]</sub> are placed in a tristate condition.
V <sub>DD</sub>	Power supply	<b>Power supply inputs to the core of the device.</b>
V <sub>SS</sub>	Ground	<b>Ground for the device.</b>
V <sub>DDQ</sub>	I/O ground	<b>Ground for the I/O circuitry.</b>
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 should remain static during device operation. Mode Pin has an internal pull-up.
NC, NC/9M, NC/18M, NC/72M, NC/144M, NC/288M, NC/576M, NC/1G	—	<b>No connects.</b> Not internally connected to the die. NC/9M, NC/18M, NC/72M, NC/144M, NC/288M, NC/576M and NC/1G are address expansion pins are not internally connected to the die.

## 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 CY7C1327G 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<sub>[A:B]</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>,  $\overline{CE}_3$ ) and an asynchronous output enable ( $\overline{OE}$ ) provide for easy bank selection and output tristate control. ADSP is ignored if CE<sub>1</sub> 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)  $\overline{CE}_1$ , CE<sub>2</sub>, CE<sub>3</sub> are all asserted active, and (3) the write signals (GW, BWE) are all deserialized HIGH. ADSP is ignored if CE<sub>1</sub> is HIGH. The address presented to the address inputs (A) is stored into the address advancement logic and the address register while being presented to the memory array. 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<sub>CO</sub> if  $\overline{OE}$  is active LOW. The only exception occurs when the SRAM is emerging from a deselected state to a selected state, its outputs are always tristated during the first cycle of the access. After the first cycle of the access, the outputs are controlled by the  $\overline{OE}$  signal. Consecutive single read cycles are supported. Once the SRAM is deselected at clock rise by the chip select and either ADSP or ADSC signals, its output will tristate immediately.

### 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)  $\overline{CE}_1$ , CE<sub>2</sub>, CE<sub>3</sub> are all asserted active. The address presented to A is loaded into the address register and the address advancement logic while being delivered to the memory array. The Write signals (GW, BWE, and BW<sub>[A:B]</sub>) 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 DQ inputs is written into the corresponding address location in the memory array. If GW is HIGH, then the

Write operation is controlled by  $\overline{BWE}$  and  $\overline{BW}_{[A:B]}$  signals. The CY7C1327G provides byte write capability that is described in the Write Cycle Descriptions table. Asserting the byte write enable input ( $\overline{BWE}$ ) with the selected byte write ( $\overline{BW}_{[A:B]}$ ) 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 CY7C1327G is a common I/O device, the output enable ( $\overline{OE}$ ) must be deserialized HIGH before presenting data to the DQ inputs. Doing so will tristate the output drivers. As a safety precaution, DQs are automatically tristated whenever a Write cycle is detected, regardless of the state of  $\overline{OE}$ .

### 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 deserialized HIGH, (3) CE<sub>1</sub>, CE<sub>2</sub>, CE<sub>3</sub> are all asserted active, and (4) the appropriate combination of the write inputs (GW, BWE, and  $\overline{BW}_{[A:B]}$ ) 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 to A is loaded into the address register and the address advancement logic while being delivered to the memory array. The ADV input is ignored during this cycle. If a global write is conducted, the data presented to DQ 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 CY7C1327G is a common I/O device, the output enable ( $\overline{OE}$ ) must be deserialized HIGH before presenting data to the DQ inputs. Doing so will tristate the output drivers. As a safety precaution, DQs are automatically tristated whenever a Write cycle is detected, regardless of the state of  $\overline{OE}$ .

### Burst Sequences

The CY7C1327G provides a two-bit wraparound counter, fed by A1:A0, 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.

Asserting  $\overline{ADV}$  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. CE<sub>1</sub>, CE<sub>2</sub>, CE<sub>3</sub>, ADSP, and ADSC must remain inactive for the duration of t<sub>ZZREC</sub> after the ZZ input returns 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

### ZZ Mode Electrical Characteristics

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

## Truth Table

The Truth Table for CY7C1327G follows. [3, 4, 5, 6, 7]

Next Cycle	Add. Used	$\overline{CE}_1$	$CE_2$	$\overline{CE}_3$	ZZ	$\overline{ADSP}$	$\overline{ADSC}$	$\overline{ADV}$	$\overline{WRITE}$	$\overline{OE}$	CLK	DQ
Deselect cycle, power-down	None	H	X	X	L	X	L	X	X	X	L-H	Tristate
Deselect cycle, power-down	None	L	L	X	L	L	X	X	X	X	L-H	Tristate
Deselect cycle, power-down	None	L	X	H	L	L	X	X	X	X	L-H	Tristate
Deselect cycle, power-down	None	L	L	X	L	H	L	X	X	X	L-H	Tristate
Deselect cycle, power-down	None	L	X	H	L	H	L	X	X	X	L-H	Tristate
Snooze mode, power-down	None	X	X	X	H	X	X	X	X	X	X	Tristate
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	Tristate
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	Tristate
Read Cycle, Continue Burst	Next	X	X	X	L	H	H	L	H	H	L-H	Tristate
Read Cycle, Continue Burst	Next	X	X	X	L	H	H	L	H	L	L-H	Q
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	Tristate
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	Tristate
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	Tristate
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 = "Don't Care." H = Logic HIGH, L = Logic LOW.
- $\overline{WRITE}$  = L when any one or more byte write enable signals ( $\overline{BW}_A$ ,  $\overline{BW}_B$ ) and  $\overline{BWE}$  = L or  $\overline{GW}$  = L.  $\overline{WRITE}$  = H when all byte write enable signals ( $\overline{BW}_A$ ,  $\overline{BW}_B$ ),  $\overline{BWE}$ ,  $\overline{GW}$  = 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  $\overline{BW}_{[A:B]}$ . Writes may occur only on subsequent clocks after the  $\overline{ADSP}$  or with the assertion of  $\overline{ADSC}$ . As a result,  $\overline{OE}$  must be driven HIGH prior to the start of the write cycle to allow the outputs to tristate.  $\overline{OE}$  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 tristate 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/Write

The Truth Table for Read/Write follows. <sup>[8]</sup>

Function	$\overline{GW}$	$\overline{BWE}$	$\overline{BW}_B$	$\overline{BW}_A$
Read	H	H	X	X
Read	H	L	H	H
Write byte A – (DQ <sub>A</sub> and DQP <sub>A</sub> )	H	L	H	L
Write byte B – (DQ <sub>B</sub> and DQP <sub>B</sub> )	H	L	L	H
Write bytes B, A	H	L	L	L
Write all bytes	H	L	L	L
Write all bytes	L	X	X	X

**Note**

8. X = "Don't Care." H = Logic HIGH, L = Logic LOW.

## Maximum Ratings

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

Storage temperature ..... -65 °C to +150 °C

Ambient temperature with power applied ..... -55 °C to +125 °C

Supply voltage on  $V_{DD}$  relative to GND ..... -0.5 V to +4.6 V

Supply voltage on  $V_{DDQ}$  relative to GND ..... -0.5 V to + $V_{DD}$

DC voltage applied to outputs in tristate ..... -0.5 V to  $V_{DDQ} + 0.5$  V

DC input voltage ..... -0.5 V to  $V_{DD} + 0.5$  V

Current into outputs (LOW) ..... 20 mA

Static discharge voltage (per MIL-STD-883, method 3015) ..... > 2001 V

Latch-up current ..... > 200 mA

## Operating Range

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

## Neutron Soft Error Immunity

Parameter	Description	Test Conditions	Typ	Max*	Unit
LSBU	Logical single-bit upsets	25 °C	361	394	FIT/Mb
LMBU	Logical multi-bit upsets	25 °C	0	0.01	FIT/Mb
SEL	Single event latch-up	85 °C	0	0.1	FIT/Dev

\* No LMBU or SEL events occurred during testing; this column represents a statistical  $\chi^2$ , 95% confidence limit calculation. For more details refer to Application Note AN54908 "Accelerated Neutron SER Testing and Calculation of Terrestrial Failure Rates".

## Electrical Characteristics

Over the Operating Range

Parameter <sup>[9, 10]</sup>	Description	Test Conditions	Min	Max	Unit
$V_{DD}$	Power supply voltage		3.135	3.6	V
$V_{DDQ}$	I/O supply voltage		2.375	$V_{DD}$	V
$V_{OH}$	Output HIGH voltage	for 3.3 V I/O, $I_{OH} = -4.0$ mA	2.4	–	V
		for 2.5 V I/O, $I_{OH} = -1.0$ mA	2.0	–	V
$V_{OL}$	Output LOW voltage	for 3.3 V I/O, $I_{OL} = 8.0$ mA	–	0.4	V
		for 2.5 V I/O, $I_{OL} = 1.0$ mA	–	0.4	V
$V_{IH}$	Input HIGH voltage <sup>[9.]</sup>	for 3.3 V I/O	2.0	$V_{DD} + 0.3$ V	V
		for 2.5 V I/O	1.7	$V_{DD} + 0.3$ V	V
$V_{IL}$	Input LOW voltage <sup>[9.]</sup>	for 3.3 V I/O	-0.3	0.8	V
		for 2.5 V I/O	-0.3	0.7	V
$I_X$	Input leakage current except ZZ and MODE	$GND \leq V_I \leq V_{DDQ}$	-5	5	$\mu$ A
	Input current of MODE	Input = $V_{SS}$	-30	–	$\mu$ A
		Input = $V_{DD}$	–	5	$\mu$ A
	Input current of ZZ	Input = $V_{SS}$	-5	–	$\mu$ A
		Input = $V_{DD}$	–	30	$\mu$ A
$I_{OZ}$	Output leakage current	$GND \leq V_I \leq V_{DDQ}$ , output disabled	-5	5	$\mu$ A

### Notes

9. Overshoot:  $V_{IH(AC)} < V_{DD} + 1.5$  V (Pulse width less than  $t_{CYC}/2$ ), undershoot:  $V_{IL(AC)} > -2$  V (Pulse width less than  $t_{CYC}/2$ ).

10.  $T_{Power-up}$ : Assumes a linear ramp from 0 V to  $V_{DD(min)}$  within 200 ms. During this time  $V_{IH} < V_{DD}$  and  $V_{DDQ} \leq V_{DD}$ .

## Electrical Characteristics *(continued)*

Over the Operating Range

Parameter <sup>[9, 10]</sup>	Description	Test Conditions		Min	Max	Unit
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>	6 ns cycle, 166 MHz	–	240	mA
			7.5 ns cycle, 133 MHz	–	225	mA
I <sub>SB1</sub>	Automatic CE power-down current – TTL inputs	V <sub>DD</sub> = Max, device deselected, V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>IL</sub> , f = f <sub>MAX</sub> = 1/t <sub>CYC</sub>	6 ns cycle, 166 MHz	–	100	mA
			7.5 ns cycle, 133 MHz	–	90	mA
I <sub>SB2</sub>	Automatic CE power-down current – CMOS inputs	V <sub>DD</sub> = Max, device deselected, V <sub>IN</sub> ≤ 0.3 V or V <sub>IN</sub> ≥ V <sub>DDQ</sub> – 0.3 V, f = 0	All speeds	–	40	mA
I <sub>SB3</sub>	Automatic CE power-down current – CMOS inputs	V <sub>DD</sub> = Max, device deselected, V <sub>IN</sub> ≤ 0.3 V or V <sub>IN</sub> ≥ V <sub>DDQ</sub> – 0.3 V, f = f <sub>MAX</sub> = 1/t <sub>CYC</sub>	6 ns cycle, 166 MHz	–	85	mA
			7.5 ns cycle, 133 MHz	–	75	mA
I <sub>SB4</sub>	Automatic CE power-down current – TTL inputs	V <sub>DD</sub> = Max, device deselected, V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>IL</sub> , f = 0	All speeds	–	45	mA

## Capacitance

Parameter <sup>[11]</sup>	Description	Test Conditions	100-pin TQFP Max	Unit
$C_{IN}$	Input capacitance	$T_A = 25^\circ\text{C}$ , $f = 1 \text{ MHz}$ , $V_{DD} = 3.3 \text{ V}$ , $V_{DDQ} = 3.3 \text{ V}$	5	pF
$C_{CLK}$	Clock input capacitance		5	pF
$C_{I/O}$	Input/output capacitance		5	pF

## Thermal Resistance

Parameter <sup>[11]</sup>	Description	Test Conditions	100-pin TQFP Package	Unit
$\theta_{JA}$	Thermal resistance (junction to ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51.	30.32	$^\circ\text{C/W}$
$\theta_{JC}$	Thermal resistance (junction to case)		6.85	$^\circ\text{C/W}$

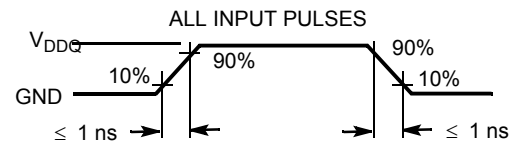
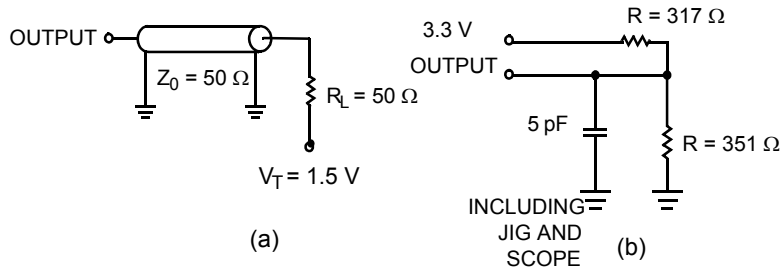
### Note

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

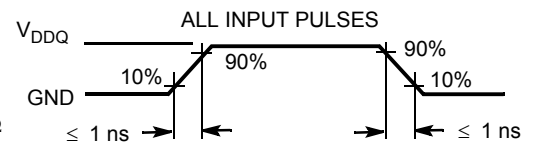
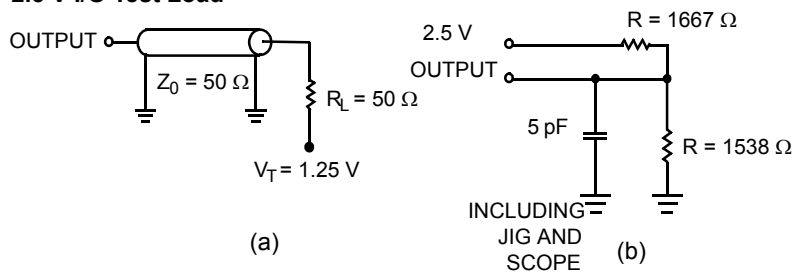
## AC Test Loads and Waveforms

**Figure 2. AC Test Loads and Waveforms**

### 3.3 V I/O Test Load



### 2.5 V I/O Test Load



## Switching Characteristics

Over the Operating Range

Parameter <sup>[12, 13]</sup>	Description	-166		-133		Unit
		Min	Max	Min	Max	
t <sub>POWER</sub>	V <sub>DD</sub> (typical) to the first access <sup>[14]</sup>	1	–	1	–	ms
<b>Clock</b>						
t <sub>CYC</sub>	Clock cycle time	6.0	–	7.5	–	ns
t <sub>CH</sub>	Clock HIGH	2.5	–	3.0	–	ns
t <sub>CL</sub>	Clock LOW	2.5	–	3.0	–	ns
<b>Output Times</b>						
t <sub>CO</sub>	Data output valid after CLK rise	–	3.5	–	4.0	ns
t <sub>DOH</sub>	Data output hold after CLK rise	1.5	–	1.5	–	ns
t <sub>CLZ</sub>	Clock to low Z <sup>[15, 16, 17]</sup>	0	–	0	–	ns
t <sub>CHZ</sub>	Clock to high Z <sup>[15, 16, 17]</sup>	–	3.5	–	4.0	ns
t <sub>OE<sub>V</sub></sub>	$\overline{\text{OE}}$ LOW to output valid	–	3.5	–	4.5	ns
t <sub>OE<sub>LZ</sub></sub>	$\overline{\text{OE}}$ LOW to output low Z <sup>[15, 16, 17]</sup>	0	–	0	–	ns
t <sub>OE<sub>HZ</sub></sub>	$\overline{\text{OE}}$ HIGH to output high Z <sup>[15, 16, 17]</sup>	–	3.5	–	4.0	ns
<b>Set-up Times</b>						
t <sub>AS</sub>	Address set-up before CLK rise	1.5	–	1.5	–	ns
t <sub>ADS</sub>	ADSC, ADSP setup before CLK rise	1.5	–	1.5	–	ns
t <sub>ADVS</sub>	ADV setup before CLK rise	1.5	–	1.5	–	ns
t <sub>WES</sub>	GW, BWE, BW <sub>X</sub> setup before CLK rise	1.5	–	1.5	–	ns
t <sub>DS</sub>	Data input setup before CLK rise	1.5	–	1.5	–	ns
t <sub>CES</sub>	Chip enable setup before CLK rise	1.5	–	1.5	–	ns
<b>Hold Times</b>						
t <sub>AH</sub>	Address hold after CLK rise	0.5	–	0.5	–	ns
t <sub>ADH</sub>	ADSP, ADSC hold after CLK rise	0.5	–	0.5	–	ns
t <sub>ADVH</sub>	ADV hold after CLK rise	0.5	–	0.5	–	ns
t <sub>WEH</sub>	GW, BWE, BW <sub>X</sub> hold after CLK rise	0.5	–	0.5	–	ns
t <sub>DH</sub>	Data input hold after CLK rise	0.5	–	0.5	–	ns
t <sub>CEH</sub>	Chip enable hold after CLK rise	0.5	–	0.5	–	ns

### Notes

12. Timing references level is 1.5 V when V<sub>DDQ</sub> = 3.3 V and is 1.25 V when V<sub>DDQ</sub> = 2.5 V on all data sheets.

13. Test conditions shown in (a) of Figure 2 on page 12 unless otherwise noted.

14. This part has a voltage regulator internally; t<sub>POWER</sub> is the time that the power needs to be supplied above V<sub>DD(minimum)</sub> initially before a read or write operation can be initiated.

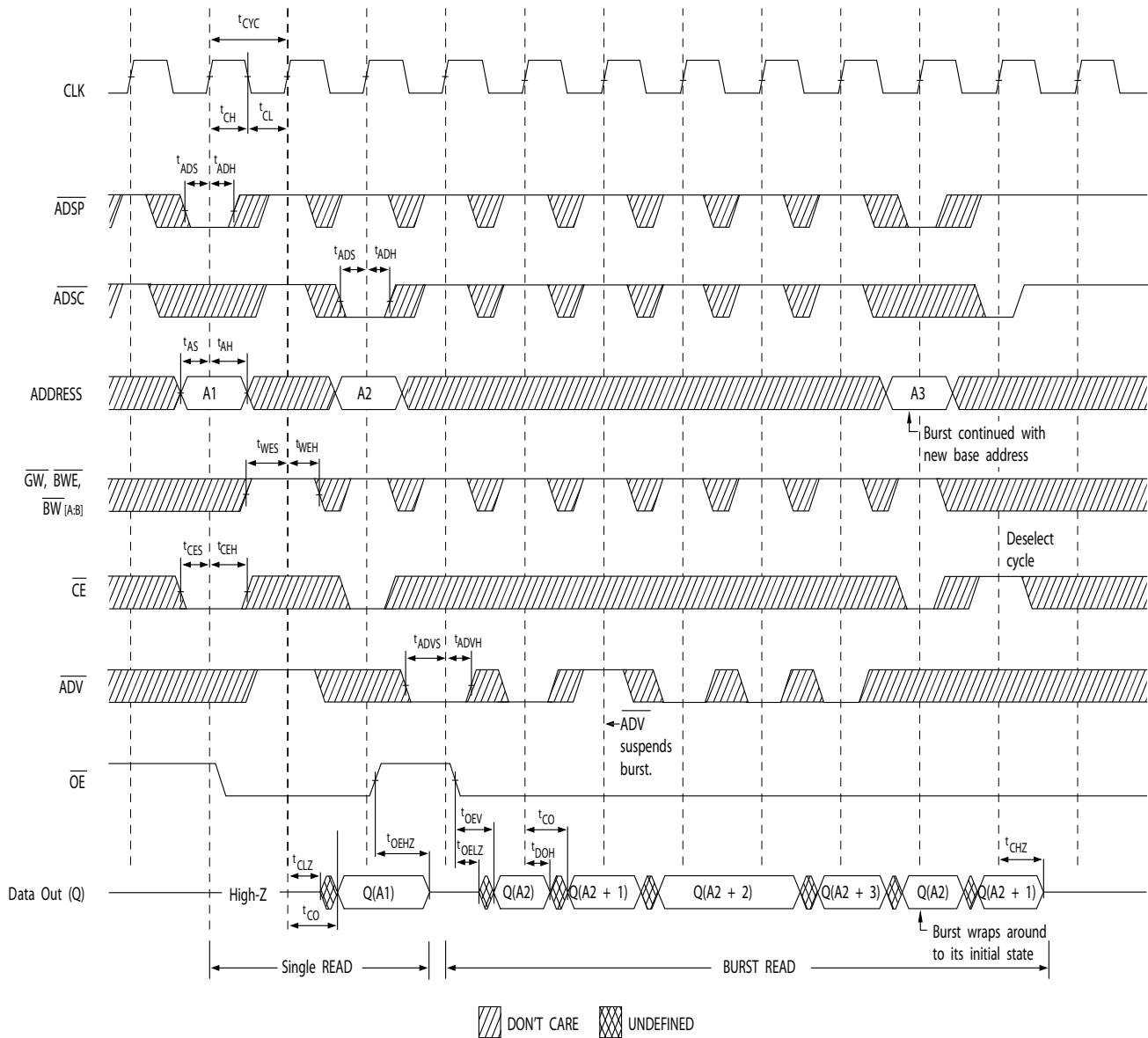
15. t<sub>CHZ</sub>, t<sub>CLZ</sub>, t<sub>OE<sub>LZ</sub></sub>, and t<sub>OE<sub>HZ</sub></sub> are specified with AC test conditions shown in part (b) of Figure 2 on page 12. Transition is measured ±200 mV from steady-state voltage.

16. At any given voltage and temperature, t<sub>OE<sub>HZ</sub></sub> is less than t<sub>OE<sub>LZ</sub></sub> and t<sub>CHZ</sub> is less than t<sub>CLZ</sub> 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.

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

## Switching Waveforms

**Figure 3. Read Cycle Timing** [18]

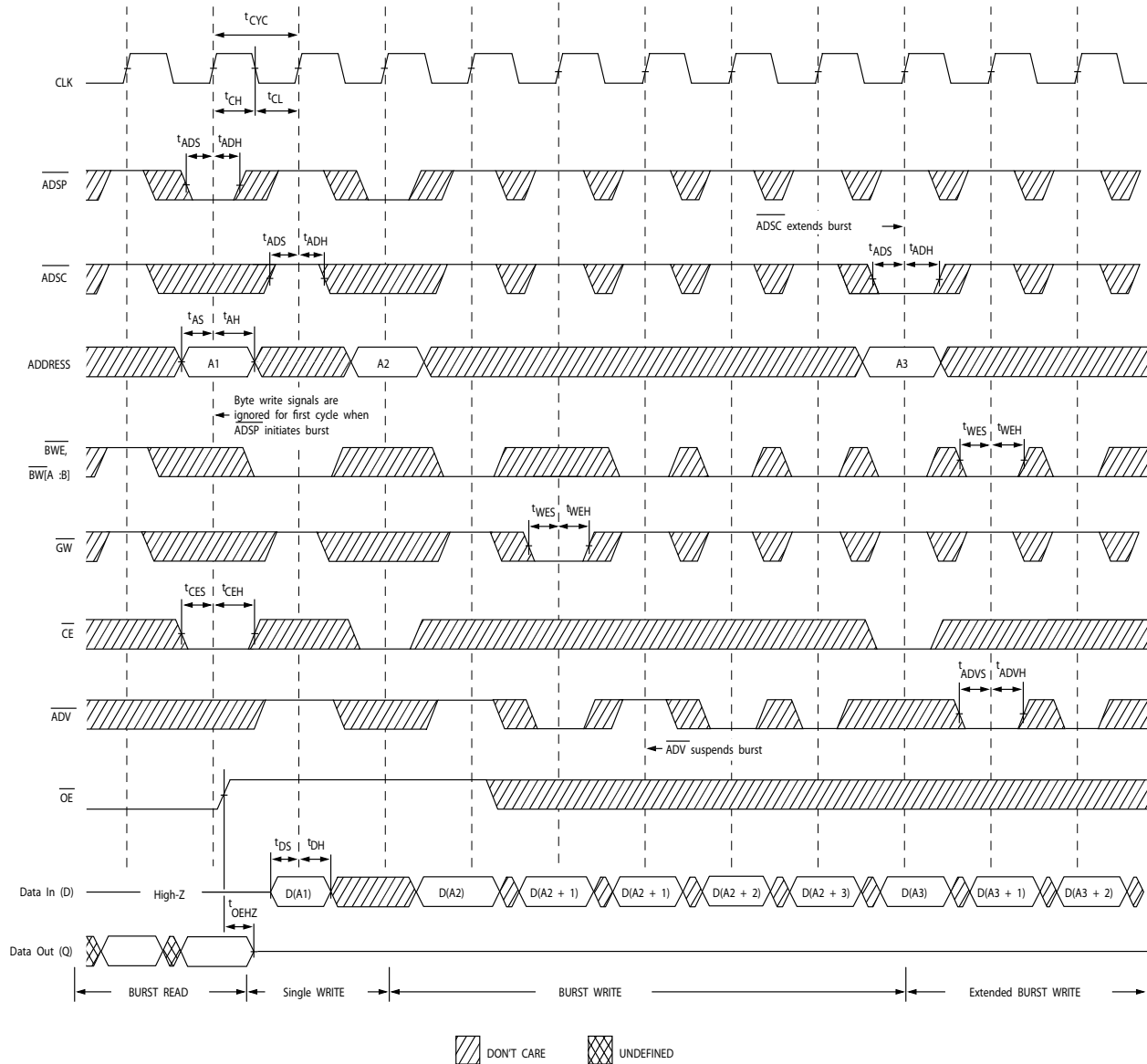


**Note**

18. On this diagram, when  $\overline{CE}$  is LOW:  $\overline{CE}_1$  is LOW,  $\overline{CE}_2$  is HIGH and  $\overline{CE}_3$  is LOW. When  $\overline{CE}$  is HIGH:  $\overline{CE}_1$  is HIGH or  $\overline{CE}_2$  is LOW or  $\overline{CE}_3$  is HIGH.

## Switching Waveforms (continued)

**Figure 4. Write Cycle Timing** [19, 20]

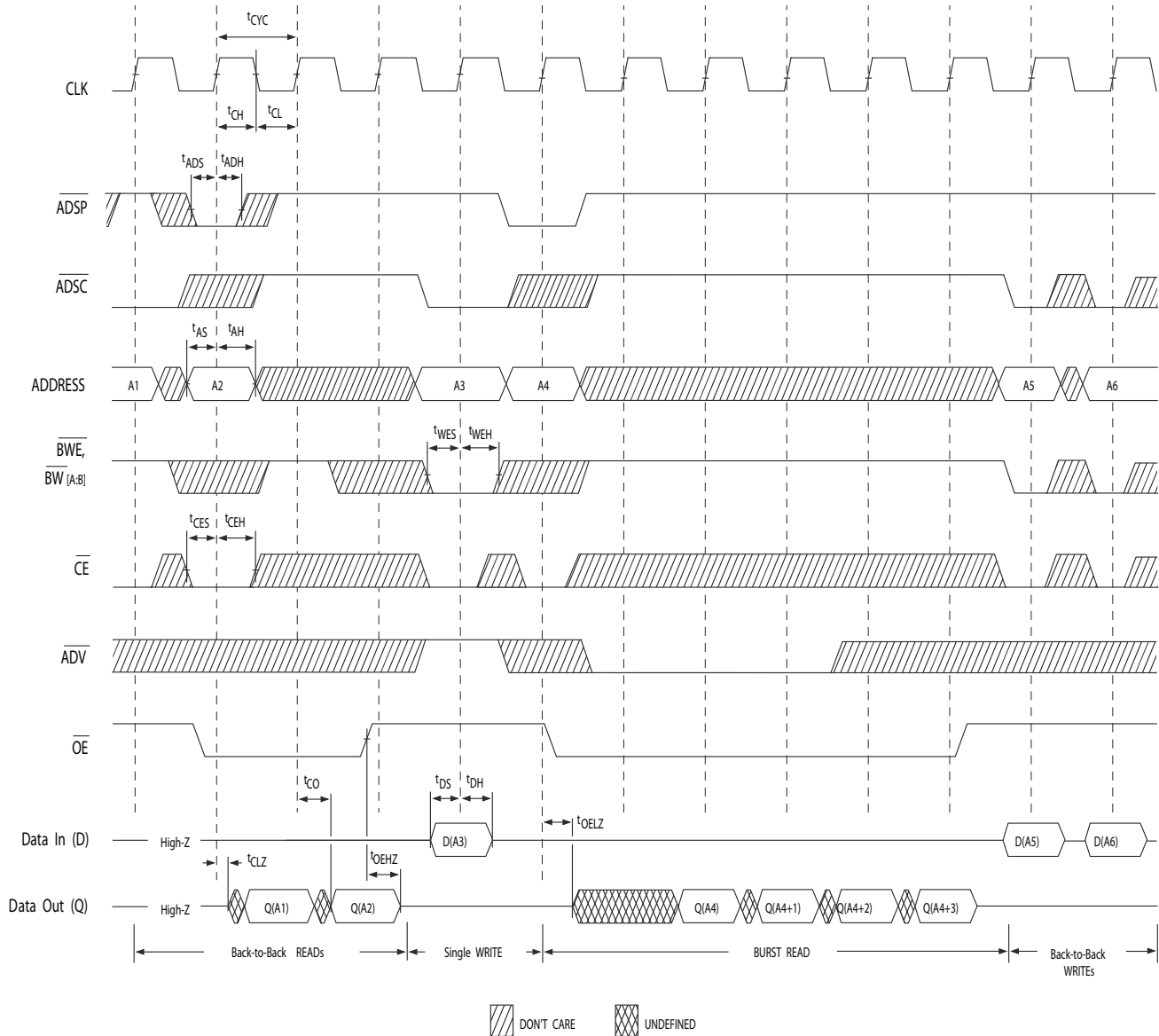


### Notes

19. 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.  
 20. Full width write can be initiated by either  $\overline{GW}$  LOW; or by  $\overline{GW}$  HIGH,  $\overline{BWE}$  LOW and  $BW_{[A:B]}$  LOW.

## Switching Waveforms (continued)

**Figure 5. Read/Write Cycle Timing** [21, 22, 23]



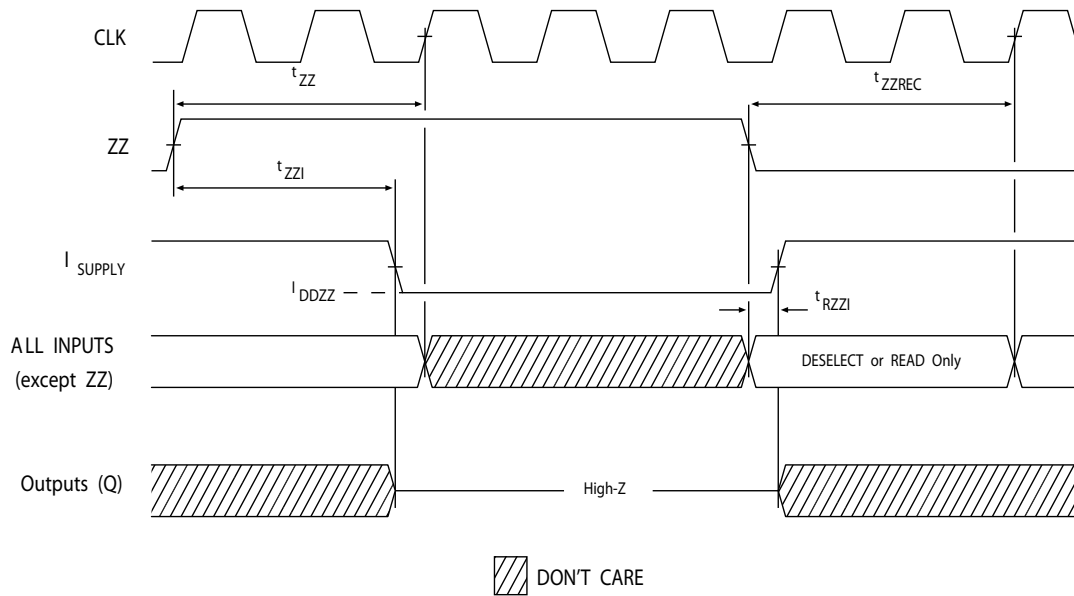
### Notes

21. On this diagram, when  $\overline{CE}$  is LOW:  $\overline{CE}_1$  is LOW,  $\overline{CE}_2$  is HIGH and  $\overline{CE}_3$  is LOW. When  $\overline{CE}$  is HIGH:  $\overline{CE}_1$  is HIGH or  $\overline{CE}_2$  is LOW or  $\overline{CE}_3$  is HIGH.  
 22. The data bus (Q) remains in high Z following a WRITE cycle, unless a new read access is initiated by ADSP or ADSC.  
 23. GW is HIGH.



## Switching Waveforms *(continued)*

**Figure 6. ZZ Mode Timing** [24, 25]



### Notes

24. Device must be deselected when entering ZZ mode. See Cycle Descriptions table for all possible signal conditions to deselect the device.  
25. DQs are in high Z when exiting ZZ sleep mode.



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Speed (MHz)	Ordering Code	Package Diagram	Package Type	Operating Range
133	CY7C1327G-133AXI	51-85050	100-pin TQFP (14 × 20 × 1.4 mm) Pb-free	Industrial
166	CY7C1327G-166AXC	51-85050	100-pin TQFP (14 × 20 × 1.4 mm) Pb-free	Commercial

Temperature range: X = C or I  
C = Commercial; I = Industrial

Pb-free

Package Type:  
A = 100-pin TQFP

Speed Grade: XXX = 133 MHz or 166 MHz

Process Technology: G ≥ 90 nm

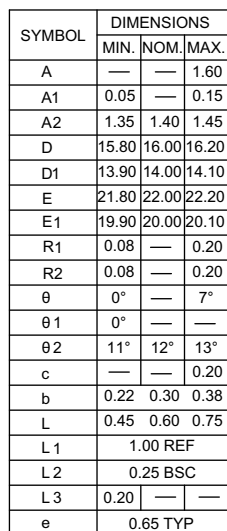
1327 = SCD, 256 K × 18 (4 Mb)

Technology Code: C = CMOS

Marketing Code: 7 = SRAM

Company ID: CY = Cypress

**Figure 7. 100-pin TQFP (16 × 22 × 1.6 mm) A100RA Package Outline, 51-85050**



1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. BODY LENGTH DIMENSION DOES NOT INCLUDE MOLD PROTRUSION/END FLASH. MOLD PROTRUSION/END FLASH SHALL NOT EXCEED 0.0098 in (0.25 mm) PER SIDE. BODY LENGTH DIMENSIONS ARE MAX PLASTIC BODY SIZE INCLUDING MOLD MISMATCH.
3. JEDEC SPECIFICATION NO. REF: MS-026.

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## Acronyms

Acronym	Description
CE	Chip Enable
CMOS	Complementary Metal Oxide Semiconductor
EIA	Electronic Industries Alliance
I/O	Input/Output
JEDEC	Joint Electron Devices Engineering Council
LMBU	Logical Multi-Bit Upsets
LSBU	Logical Single-Bit Upsets
OE	Output Enable
SEL	Single Event Latch-Up
SRAM	Static Random Access Memory
TQFP	Thin Quad Flat Pack
TTL	Transistor-Transistor Logic

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
μA	microampere
mA	milliampere
ms	millisecond
mm	millimeter
mV	millivolt
nm	nanometer
ns	nanosecond
Ω	ohm
%	percent
pF	picofarad
V	volt
W	watt

## Errata

This section describes the Ram9 Sync ZZ pin issue. Details include trigger conditions, the devices affected, proposed workaround and silicon revision applicability. Please contact your local Cypress sales representative if you have further questions.

### Part Numbers Affected

Density & Revision	Package Type	Operating Range
4Mb-Ram9 Synchronous SRAMs: CY7C132*G	100-pin TQFP	Commercial/ Industrial

### Product Status

All of the devices in the Ram9 4Mb Sync family are qualified and available in production quantities.

### Ram9 Sync ZZ Pin Issues Errata Summary

The following table defines the errata applicable to available Ram9 4Mb Sync family devices.

Item	Issues	Description	Device	Fix Status
1.	ZZ Pin	When asserted HIGH, the ZZ pin places device in a "sleep" condition with data integrity preserved. The ZZ pin currently does not have an internal pull-down resistor and hence cannot be left floating externally by the user during normal mode of operation.	4M-Ram9 (90nm)	For the 4M Ram9 (90 nm) devices, there is no plan to fix this issue.

#### 1. ZZ Pin Issue

##### ■ PROBLEM DEFINITION

The problem occurs only when the device is operated in the normal mode with ZZ pin left floating. The ZZ pin on the SRAM device does not have an internal pull-down resistor. Switching noise in the system may cause the SRAM to recognize a HIGH on the ZZ input, which may cause the SRAM to enter sleep mode. This could result in incorrect or undesirable operation of the SRAM.

##### ■ TRIGGER CONDITIONS

Device operated with ZZ pin left floating.

##### ■ SCOPE OF IMPACT

When the ZZ pin is left floating, the device delivers incorrect data.

##### ■ WORKAROUND

Tie the ZZ pin externally to ground.

##### ■ FIX STATUS

For the 4M Ram9 (90 nm) devices, there is no plan to fix this issue.

## Document History Page

Document Title: CY7C1327G, 4-Mbit (256K × 18) Pipelined Sync SRAM Document Number: 38-05519				
Rev.	ECN No.	Submission Date	Orig. of Change	Description of Change
**	224367	See ECN	RKF	New data sheet.
*A	278513	See ECN	VBL	Updated <a href="#">Ordering Information</a> (Updated part numbers (Changed TQFP to Pb-free TQFP, added PB-free BGA packages)).
*B	332895	See ECN	SYT	Updated <a href="#">Features</a> (Removed 225 MHz, 100 MHz frequencies related information). Updated <a href="#">Selection Guide</a> (Removed 225 MHz, 100 MHz frequencies related information). Updated <a href="#">Pin Configurations</a> (Modified Address Expansion balls in the pinouts for 100-pin TQFP and 119-ball BGA Packages as per JEDEC standards). Updated <a href="#">Pin Definitions</a> . Updated <a href="#">Electrical Characteristics</a> (Removed 225 MHz, 100 MHz frequencies related information, updated Test Conditions of $V_{OL}$ and $V_{OH}$ parameters). Updated <a href="#">Thermal Resistance</a> (Replaced values of $\Theta_{JA}$ and $\Theta_{JC}$ parameters from TBD to respective Thermal Values for all packages). Updated <a href="#">Switching Characteristics</a> (Removed 225 MHz, 100 MHz frequencies related information). Updated <a href="#">Ordering Information</a> (By shading and unshading MPNs as per availability, removed comment on the availability of BGA lead-free package).
*C	351194	See ECN	PCI	Updated <a href="#">Ordering Information</a> (Updated part numbers).
*D	366728	See ECN	PCI	Updated <a href="#">Electrical Characteristics</a> (Added test conditions for $V_{DD}$ and $V_{DDQ}$ parameters, updated Note 10 (Replaced $V_{IH} \leq V_{DD}$ with $V_{IH} < V_{DD}$ )).
*E	419256	See ECN	R XU	Changed status from Preliminary to Final. Changed address of Cypress Semiconductor Corporation from "3901 North First Street" to "198 Champion Court". Updated <a href="#">Electrical Characteristics</a> (Changed "Input Load Current except ZZ and MODE" to "Input Leakage Current except ZZ and MODE" in the description of $I_X$ parameter). Updated <a href="#">Ordering Information</a> (Updated part numbers, replaced Package Name column with Package Diagram in the Ordering Information table). Updated <a href="#">Package Diagrams</a> (spec 51-85050 (changed revision from *A to *B)).
*F	480124	See ECN	VKN	Updated <a href="#">Maximum Ratings</a> (Added the Maximum Rating for Supply Voltage on $V_{DDQ}$ Relative to GND). Updated <a href="#">Ordering Information</a> (Updated part numbers).
*G	2756340	08/26/2009	VKN/AESA	Added <a href="#">Neutron Soft Error Immunity</a> . Updated <a href="#">Ordering Information</a> (By including parts that are available, and modified the disclaimer for the Ordering information).
*H	3044512	10/01/2010	NJY	Added <a href="#">Ordering Code Definitions</a> . Updated <a href="#">Package Diagrams</a> . Added <a href="#">Acronyms</a> and <a href="#">Units of Measure</a> . Minor edits. Updated to new template.
*I	3363203	09/05/2011	PRIT	Updated <a href="#">Package Diagrams</a> . Updated in new template.

**Document History Page** (continued)

Document Title: CY7C1327G, 4-Mbit (256K × 18) Pipelined Sync SRAM Document Number: 38-05519				
Rev.	ECN No.	Submission Date	Orig. of Change	Description of Change
*J	3612268	05/09/2012	PRIT	Updated <a href="#">Features</a> (Removed 250 MHz, 200 MHz frequencies related information, removed 119-ball BGA package related information). Updated <a href="#">Functional Description</a> (Removed the Note “For best practices recommendations, refer to the Cypress application note <i>System Design Guidelines</i> on <a href="http://www.cypress.com">www.cypress.com</a> .” and its reference). Updated <a href="#">Selection Guide</a> (Removed 250 MHz, 200 MHz frequencies related information). Updated <a href="#">Pin Configurations</a> (Removed 119-ball BGA package related information). Updated <a href="#">Electrical Characteristics</a> (Removed 250 MHz, 200 MHz frequencies related information). Updated <a href="#">Capacitance</a> (Removed 119-ball BGA package related information). Updated <a href="#">Thermal Resistance</a> (Removed 119-ball BGA package related information). Updated <a href="#">Switching Characteristics</a> (Removed 250 MHz, 200 MHz frequencies related information).
*K	3749841	09/20/2012	PRIT	No technical updates. Completing Sunset Review.
*L	3984870	05/02/2013	PRIT	Added <a href="#">Errata</a> .
*M	4039228	06/25/2013	PRIT	Added Errata Footnotes (Note 1, 2). Updated <a href="#">Pin Configurations</a> : Added Note 1 and referred the same note in <a href="#">Figure 1</a> . Updated <a href="#">Pin Definitions</a> : Added Note 2 and referred the same note in ZZ pin. Updated to new template.
*N	4077099	07/25/2013	PRIT	Updated <a href="#">Truth Table</a> .
*O	4150660	10/08/2013	PRIT	Updated <a href="#">Errata</a> .
*P	4574263	11/19/2014	PRIT	Updated <a href="#">Functional Description</a> : Added “For a complete list of related documentation, click <a href="#">here</a> .” at the end. Updated <a href="#">Package Diagrams</a> : spec 51-85050 – Changed revision from *D to *E.
*Q	5510101	11/04/2016	PRIT	Updated <a href="#">Package Diagrams</a> : spec 51-85050 – Changed revision from *E to *F. Updated to new template. Completing Sunset Review.

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