

4-Mbit (128 K × 32) Flow-through Sync SRAM

Features

- 128 K × 32 common I/O
- 3.3 V core power supply (V_{DD})
- 2.5 V or 3.3 V I/O 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
- Offered in Pb-free 100-pin TQFP package, Pb-free and non Pb-free 119-ball BGA package
- “ZZ” sleep mode option

Functional Description^[1]

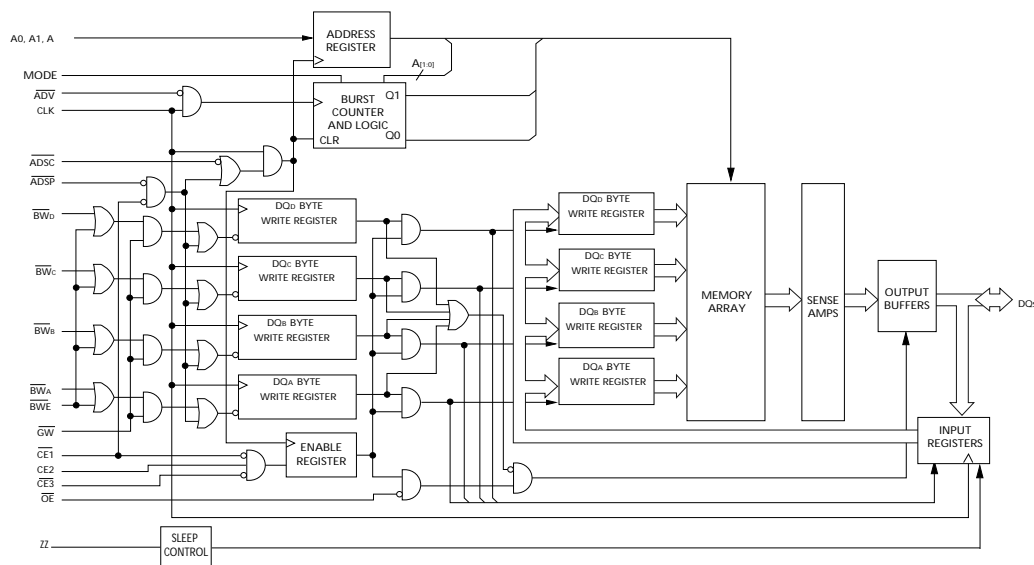
The CY7C1338G is a 128 K × 32 synchronous cache RAM designed to interface with high-speed microprocessors with minimum glue logic. Maximum access delay from clock rise is 6.5 ns (133-MHz version). A 2-bit on-chip counter captures the first address in a burst and increments the address automatically for 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 (\overline{CE}_1), depth-expansion chip enables (\overline{CE}_2 and \overline{CE}_3), burst control inputs (ADSC, ADSP, and ADV), write enables ($BW_{[A:D]}$, and BWE), and global write (GW). Asynchronous inputs include the output enable (\overline{OE}) and the ZZ pin.

The CY7C1338G allows 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 can be initiated with the processor address strobe (ADSP) or the cache controller address strobe (ADSC) inputs. Address advancement is controlled by the address advancement (ADV) input.

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).

The CY7C1338G operates from a +3.3 V core power supply while all outputs may operate with either a +2.5 or +3.3 V supply. All inputs and outputs are JEDEC-standard JESD8-5-compatible.

Logic Block Diagram



Note

1. For best-practices recommendations, please refer to the Cypress application note *System Design Guidelines* on www.cypress.com.

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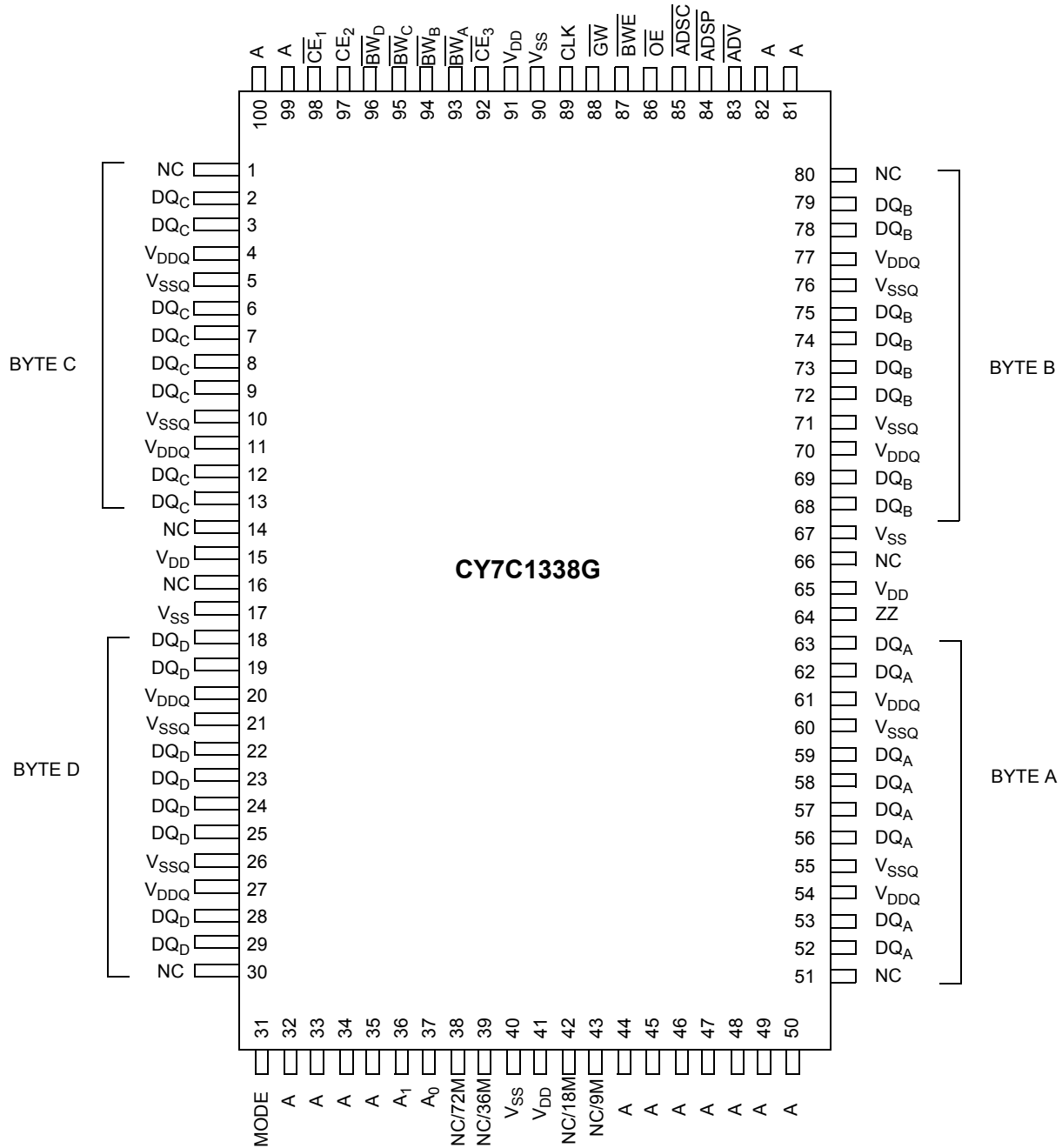
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Selection Guide

	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

Pin Configurations

100-pin TQFP Pinout



Pin Configurations *(continued)*
119-ball BGA Pinout

	1	2	3	4	5	6	7
A	V _{DDQ}	A	A	$\overline{\text{ADSP}}$	A	A	V _{DDQ}
B	NC/288M	CE ₂	A	$\overline{\text{ADSC}}$	A	NC/9M	NC/576M
C	NC/144M	A	A	V _{DD}	A	A	NC/1G
D	DQ _C	NC	V _{SS}	NC	V _{SS}	NC	DQ _B
E	DQ _C	DQ _C	V _{SS}	$\overline{\text{CE}}_1$	V _{SS}	DQ _B	DQ _B
F	V _{DDQ}	DQ _C	V _{SS}	$\overline{\text{OE}}$	V _{SS}	DQ _B	V _{DDQ}
G	DQ _C	DQ _C	$\overline{\text{BW}}_C$	$\overline{\text{ADV}}$	$\overline{\text{BW}}_B$	DQ _B	DQ _B
H	DQ _C	DQ _C	V _{SS}	$\overline{\text{GW}}$	V _{SS}	DQ _B	DQ _B
J	V _{DDQ}	V _{DD}	NC	V _{DD}	NC	V _{DD}	V _{DDQ}
K	DQ _D	DQ _D	V _{SS}	CLK	V _{SS}	DQ _A	DQ _A
L	DQ _D	DQ _D	$\overline{\text{BW}}_D$	NC	$\overline{\text{BW}}_A$	DQ _A	DQ _A
M	V _{DDQ}	DQ _D	V _{SS}	$\overline{\text{BWE}}$	V _{SS}	DQ _A	V _{DDQ}
N	DQ _D	DQ _D	V _{SS}	A1	V _{SS}	DQ _A	DQ _A
P	DQ _D	NC	V _{SS}	A0	V _{SS}	NC	DQ _A
R	NC	A	MODE	V _{DD}	NC	A	NC
T	NC	NC/72M	A	A	A	NC/36M	ZZ
U	V _{DDQ}	NC	NC	NC	NC	NC	V _{DDQ}

Pin Definitions

Name	I/O	Description
A0, A1, A	Input-synchronous	Address inputs used to select one of the 128 K address locations. Sampled at the rising edge of the CLK if ADSP or ADSC is active LOW, and $\overline{\text{CE}}_1$, CE ₂ , and CE ₃ are sampled active. A _[1:0] feed the 2-bit counter.
$\overline{\text{BW}}_A$, $\overline{\text{BW}}_B$ $\overline{\text{BW}}_C$, $\overline{\text{BW}}_D$	Input-synchronous	Byte write select inputs, active LOW. Qualified with $\overline{\text{BWE}}$ to conduct byte writes to the SRAM. Sampled on the rising edge of CLK.
$\overline{\text{GW}}$	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 $\overline{\text{BW}}_{[A:D]}$ and BWE).
$\overline{\text{BWE}}$	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	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.
$\overline{\text{CE}}_1$	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	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.
$\overline{\text{CE}}_3$	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. CE ₃ is sampled only when a new external address is loaded.
$\overline{\text{OE}}$	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.

Pin Definitions *(continued)*

Name	I/O	Description
ADV	Input-synchronous	Advance input signal, sampled on the rising edge of CLK. When asserted, it automatically increments the address in a burst cycle.
ADSP	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. ASDP is ignored when \overline{CE}_1 is deasserted HIGH.
ADSC	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	Input-asynchronous	ZZ “sleep” input, active HIGH. When asserted 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.
DQs	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}	Power supply	Power supply inputs to the core of the device.
V_{SS}	Ground	Ground for the core of the device.
V_{DDQ}	I/O power supply	Power supply for the I/O circuitry.
V_{SSQ}	I/O ground	Ground for the I/O circuitry.
MODE	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		No connects. Not Internally connected to the die.
NC/9M, NC/18M, NC/36M, NC/72M, NC/144M, NC/288M, NC/576M, NC/1G	–	No connects. 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 that 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_{CO}) is 6.5 ns (133-MHz device).

The CY7C1338G 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.

Three synchronous chip selects (\overline{CE}_1 , CE_2 , \overline{CE}_3) and an asynchronous output enable (OE) provide for easy bank selection and output tri-state control. ADSP is ignored if CE_1 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_2 , and \overline{CE}_3 are all asserted active, and (2) ADSP or ADSC is asserted LOW (if the access is initiated by ADSC, the write inputs must be deasserted during this first cycle). The address presented to the address inputs is latched into the address register and the burst counter/control logic and presented to the memory core. If the OE input is asserted LOW, the requested data will be

available at the data outputs a maximum to t_{CDV} after clock rise. ADSP is ignored if CE_1 is HIGH.

Single Write Accesses Initiated by ADSP

This access is initiated when the following conditions are satisfied at clock rise: (1) CE_1 , CE_2 , CE_3 are all asserted active, and (2) ADSP is asserted LOW. The addresses presented are loaded into the address register and the burst inputs (GW, BWE, and $BW_{[A:D]}$) 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 will be latched and written into the device. Byte writes are allowed. During byte writes, BW_A controls DQ_A and BW_B controls DQ_B . BW_C controls DQ_C , and BW_D controls DQ_D . All I/Os are tri-stated during a byte write. Since this is a common I/O device, the asynchronous OE input signal must be deasserted and the I/Os must be 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 OE.

Single Write Accesses Initiated by ADSC

This write access is initiated when the following conditions are satisfied at clock rise: (1) CE_1 , CE_2 , and CE_3 are all asserted active, (2) ADSC is asserted LOW, (3) ADSP is deasserted HIGH, and (4) the write input signals (GW, BWE, and $BW_{[A:D]}$) 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/control logic and delivered to the memory core. The information presented to $DQ_{[A:D]}$ will be written into the specified address location. Byte writes are allowed. During byte writes, BW_A controls DQ_A , BW_B controls DQ_B , BW_C controls DQ_C , and BW_D controls DQ_D . All I/Os are tri-stated when a write is detected, even a byte write. Since this is a common I/O device, the asynchronous OE input signal must be deasserted and the I/Os must be 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 OE.

ZZ Mode Electrical Characteristics

Parameter	Description	Test Conditions	Min	Max	Unit
I_{DDZZ}	Sleep mode standby current	$ZZ \geq V_{DD} - 0.2 V$	–	40	mA
t_{ZZS}	Device operation to ZZ	$ZZ \geq V_{DD} - 0.2 V$	–	$2t_{CYC}$	ns
t_{ZZREC}	ZZ recovery time	$ZZ \leq 0.2 V$	$2t_{CYC}$	–	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

Burst Sequences

The CY7C1338G provides an on-chip two-bit wraparound burst counter inside the SRAM. The burst counter is fed by $A[1:0]$, and can follow either a linear or interleaved burst order. The burst order is determined by the state of the MODE input. A LOW on MODE will select a linear burst sequence. A HIGH on MODE will select an interleaved burst order. Leaving MODE unconnected will cause the device to default to a interleaved burst sequence.

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_s , ADSP, and ADSC must remain inactive for the duration of t_{ZZREC} after the ZZ input returns LOW.

Interleaved Burst Address Table (MODE = Floating or V_{DD})

First Address A_1, A_0	Second Address A_1, A_0	Third Address A_1, A_0	Fourth Address A_1, A_0
00	01	10	11
01	00	11	10
10	11	00	01
11	10	01	00

Linear Burst Address Table (MODE = GND)

First Address A_1, A_0	Second Address A_1, A_0	Third Address A_1, A_0	Fourth Address A_1, A_0
00	01	10	11
01	10	11	00
10	11	00	01
11	00	01	10

Truth Table [2, 3, 4, 5, 6]

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 = "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 \overline{ADSP} is asserted, regardless of the state of \overline{GW} , \overline{BWE} , or \overline{BW}_x . 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 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 \overline{OE} is active (LOW).

Partial Truth Table for Read/Write^[7, 8]

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	H	L	H	H	H	L
Write byte B	H	L	H	H	L	H
Write bytes B, A	H	L	H	H	L	L
Write byte C	H	L	H	L	H	H
Write bytes C, A	H	L	H	L	H	L
Write bytes C, B	H	L	H	L	L	H
Write bytes C, B, A	H	L	H	L	L	L
Write byte D	H	L	L	H	H	H
Write bytes D, A	H	L	L	H	H	L
Write bytes D, B	H	L	L	H	L	H
Write bytes D, B, A	H	L	L	H	L	L
Write bytes D, B	H	L	L	L	H	H
Write bytes D, B, A	H	L	L	L	H	L
Write bytes D, C, A	H	L	L	L	L	H
Write all bytes	H	L	L	L	L	L
Write all bytes	L	X	X	X	X	X

Notes

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

8. Table only lists a partial listing of the byte write combinations. Any combination of \overline{BW}_x is valid. Appropriate write will be done based on which byte write is active.

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, 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 tri-state	-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	> 2001 V (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	3.3 V – 5% / + 10%	2.5 V – 5% to V _{DD}
Industrial	-40 °C to +85 °C		

Electrical Characteristics

Over the Operating Range [9, 10]

Parameter	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	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 ^[9]	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 ≤ 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}	7.5-ns cycle, 133 MHz	-	225	mA
			10-ns cycle, 100 MHz	-	205	mA
I _{SB1}	Automatic CE power-down current—TTL inputs	Max V _{DD} , device deselected, V _{IN} ≥ V _{IH} or V _{IN} ≤ V _{IL} , f = f _{MAX} , inputs switching	7.5-ns cycle, 133 MHz	-	90	mA
			10-ns cycle, 100 MHz	-	80	mA
I _{SB2}	Automatic CE power-down current—CMOS inputs	Max V _{DD} , device deselected, V _{IN} ≥ V _{DD} - 0.3 V or V _{IN} ≤ 0.3 V, f = 0, inputs static	-	40	mA	
I _{SB3}	Automatic CE power-down current—CMOS inputs	Max V _{DD} , device deselected, V _{IN} ≥ V _{DDQ} - 0.3 V or V _{IN} ≤ 0.3 V, f = f _{MAX} , inputs switching	7.5-ns cycle, 133 MHz	-	75	mA
			10-ns cycle, 100 MHz	-	65	mA
I _{SB4}	Automatic CE power-down current—TTL inputs	Max V _{DD} , device deselected, V _{IN} ≥ V _{DD} - 0.3 V or V _{IN} ≤ 0.3 V, f = 0, inputs static	-	45	mA	

Notes

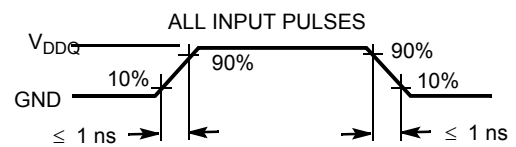
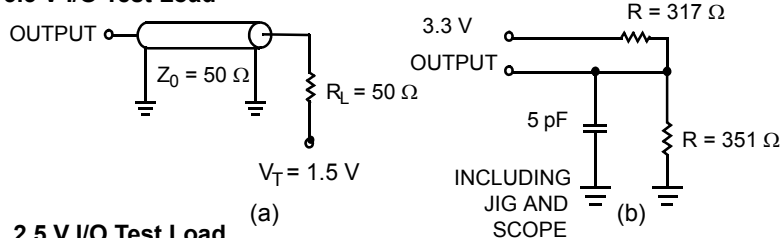
- Overshoot: V_{IH}(AC) < V_{DD} + 1.5 V (pulse width less than t_{CYC}/2), undershoot: V_{IL}(AC) > -2 V (Pulse width less than t_{CYC}/2).
- T_{Power-up}: Assumes a linear ramp from 0 V to V_{DD}(min) within 200 ms. During this time V_{IH} < V_{DD} and V_{DDQ} ≤ V_{DD}.

Capacitance^[11]

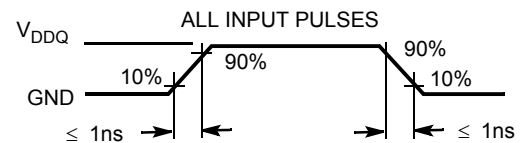
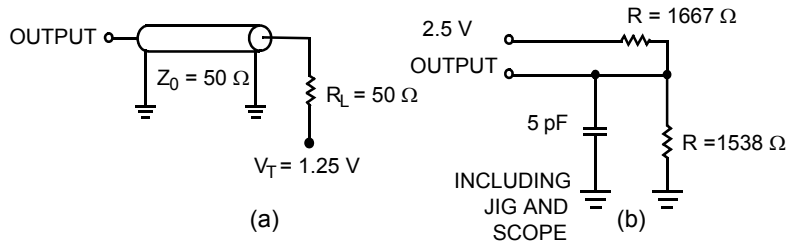
Parameter	Description	Test Conditions	100 TQFP Max	119 BGA Max	Unit
C_{IN}	Input capacitance	$T_A = 25\text{ }^\circ\text{C}$, $f = 1\text{ MHz}$, $V_{DD} = 3.3\text{ V}$, $V_{DDQ} = 3.3\text{ V}$	5	5	pF
C_{CLK}	Clock input capacitance		5	5	pF
$C_{I/O}$	Input/output capacitance		5	7	pF

Thermal Resistance^[11]

Parameter	Description	Test Conditions	100 TQFP Package	119 BGA Package	Unit
Θ_{JA}	Thermal resistance (junction to ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51.	30.32	34.1	$^\circ\text{C/W}$
Θ_{JC}	Thermal resistance (junction to case)		6.85	14.0	$^\circ\text{C/W}$

AC Test Loads and Waveforms
3.3 V I/O Test Load


(c)

2.5 V I/O Test Load


(c)

Note

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

Switching Characteristics

Over the Operating Range [12, 13, 14, 15, 16, 17]

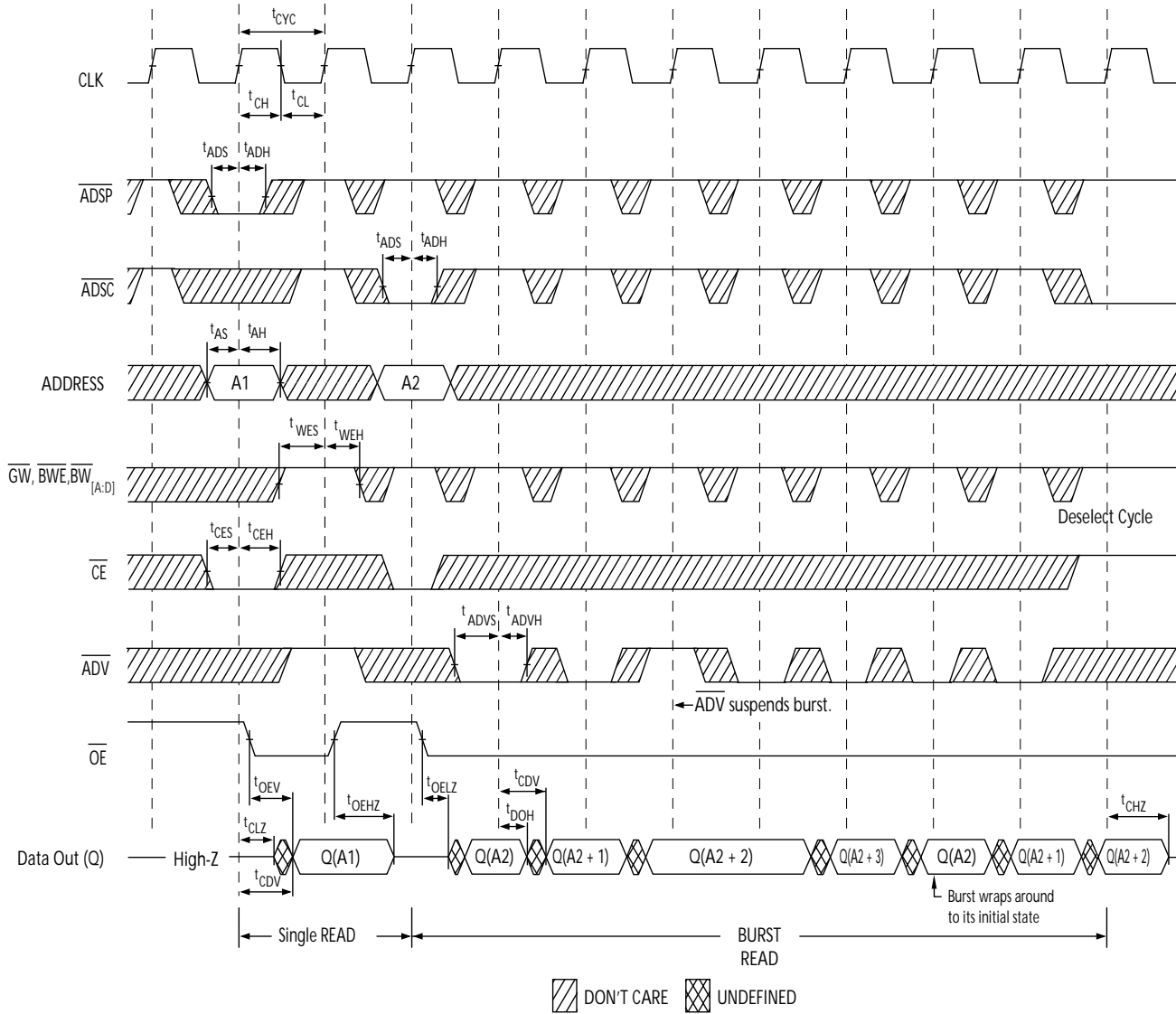
Parameter	Description	-133		-100		Unit
		Min	Max	Min	Max	
t_{POWER}	V_{DD} (Typical) to the first access ^[12]	1	–	1	–	ms
Clock						
t_{CYC}	Clock cycle time	7.5	–	10	–	ns
t_{CH}	Clock HIGH	2.5	–	4.0	–	ns
t_{CL}	Clock LOW	2.5	–	4.0	–	ns
Output Times						
t_{CDV}	Data output valid after CLK rise	–	6.5	–	8.0	ns
t_{DOH}	Data output hold after CLK rise	2.0	–	2.0	–	ns
t_{CLZ}	Clock to low Z ^[13, 14, 15]	0	–	0	–	ns
t_{CHZ}	Clock to high Z ^[13, 14, 15]	–	3.5	–	3.5	ns
$t_{OE\bar{V}}$	\overline{OE} LOW to output valid	–	3.5	–	3.5	ns
t_{OELZ}	\overline{OE} LOW to output low Z ^[13, 14, 15]	0	–	0	–	ns
$t_{OE\bar{H}Z}$	\overline{OE} HIGH to output high Z ^[13, 14, 15]	–	3.5	–	3.5	ns
Setup Times						
t_{AS}	Address set-up before CLK rise	1.5	–	2.0	–	ns
t_{ADS}	\overline{ADSP} , \overline{ADSC} set-up before CLK rise	1.5	–	2.0	–	ns
t_{ADVS}	\overline{ADV} set-up before CLK rise	1.5	–	2.0	–	ns
t_{WES}	\overline{GW} , \overline{BWE} , \overline{BW}_X set-up before CLK rise	1.5	–	2.0	–	ns
t_{DS}	Data input set-up before CLK rise	1.5	–	1.5	–	ns
t_{CES}	Chip enable set-up	1.5	–	2.0	–	ns
Hold Times						
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:

12. 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.
13. t_{CHZ} , t_{CLZ} , t_{OELZ} , and $t_{OE\bar{H}Z}$ are specified with AC test conditions shown in part (b) of AC Test Loads. Transition is measured ± 200 mV from steady-state voltage.
14. At any given voltage and temperature, $t_{OE\bar{H}Z}$ 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.
15. This parameter is sampled and not 100% tested.
16. Timing reference level is 1.5 V when $V_{DDQ} = 3.3$ V and is 1.25 V when $V_{DDQ} = 2.5$ V.
17. Test conditions shown in (a) of AC Test Loads unless otherwise noted.

Timing Diagrams

Read Cycle Timing^[18]

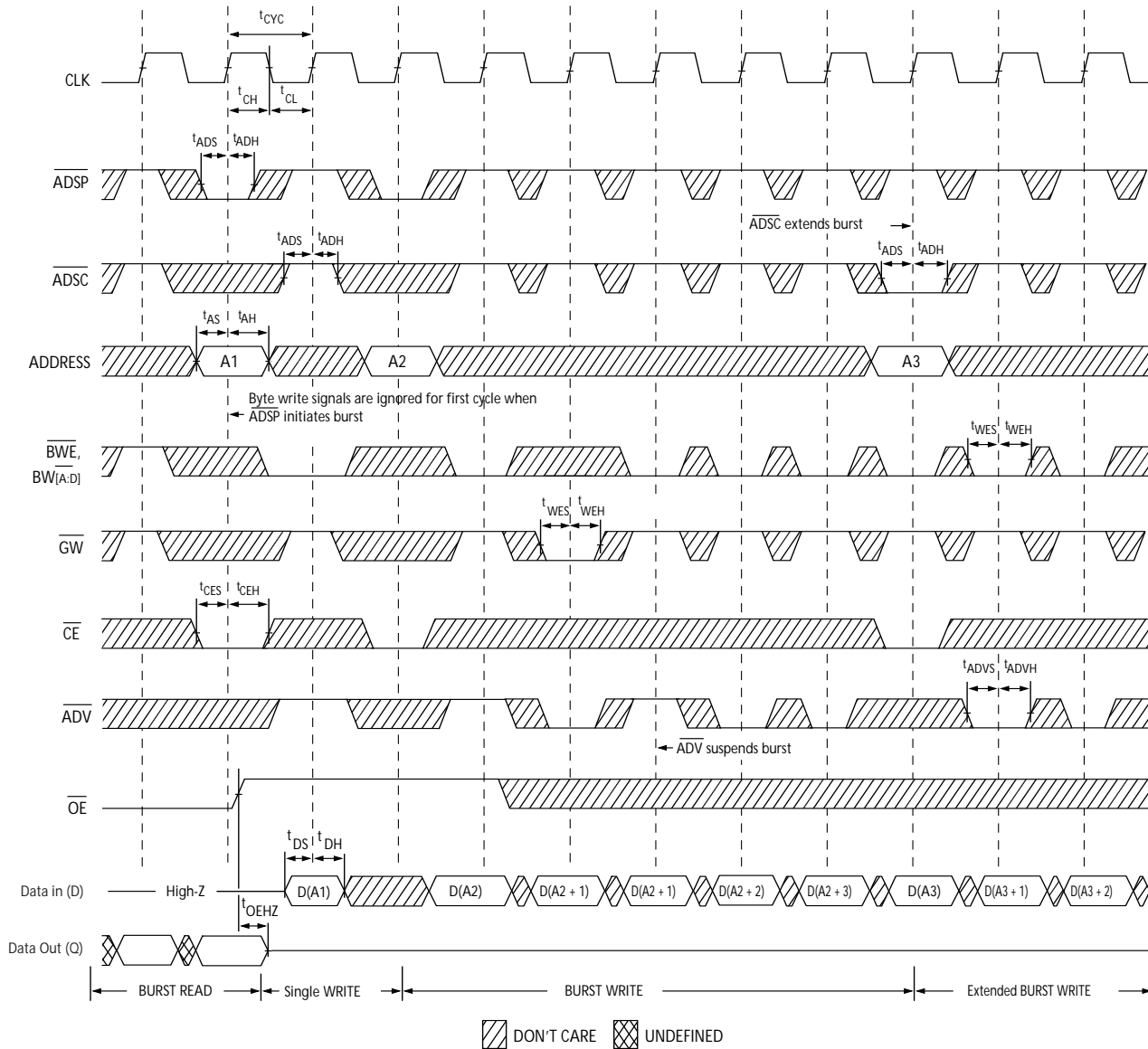


Note

18. 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)

Write Cycle Timing [19, 20]

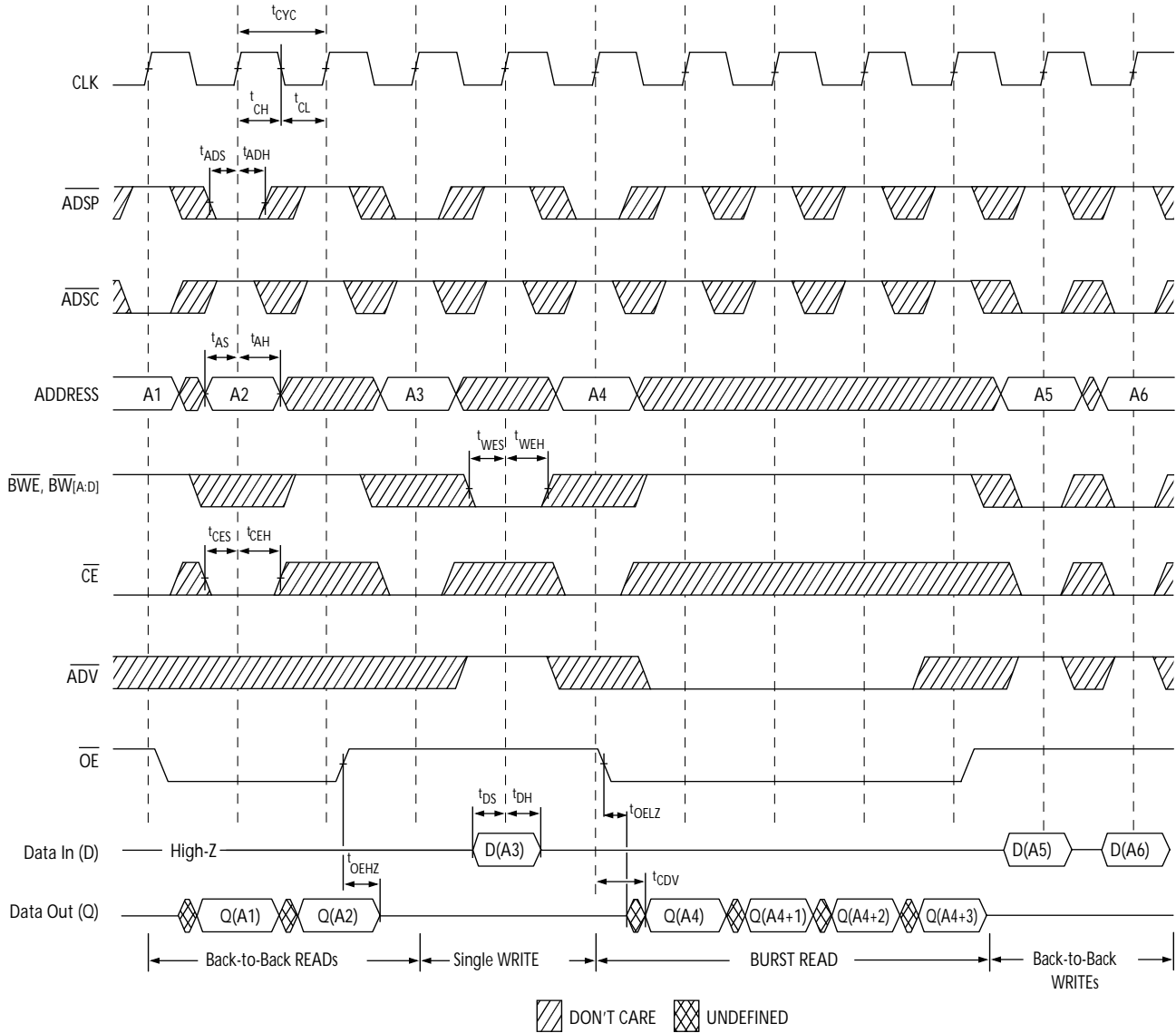


Notes

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 GW LOW; or by GW HIGH, BWE LOW and $BW_{[A:D]}$ LOW.

Timing Diagrams (continued)

Read/Write Timing [21, 22, 23]

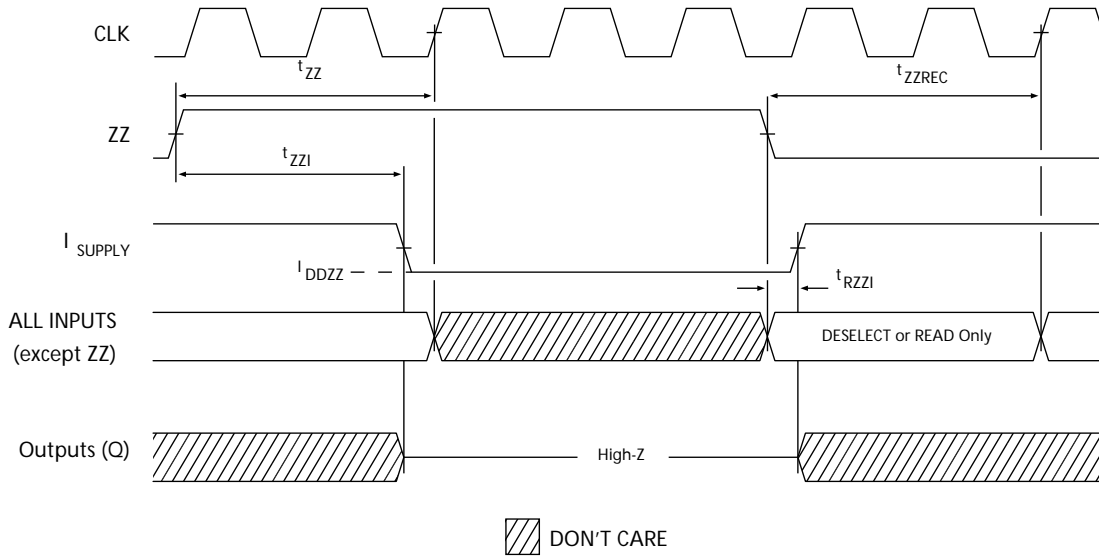


Notes

- 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. \overline{GW} is HIGH.

Timing Diagrams (continued)

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.

Ordering Information

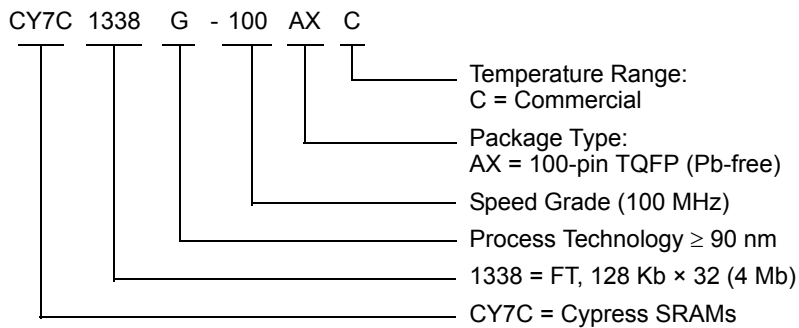
Cypress offers other versions of this type of product in many different configurations and features. The following table contains only the list of parts that are currently available.

For a complete listing of all options, visit the Cypress website at www.cypress.com and refer to the product summary page at <http://www.cypress.com/products> or contact your local sales representative.

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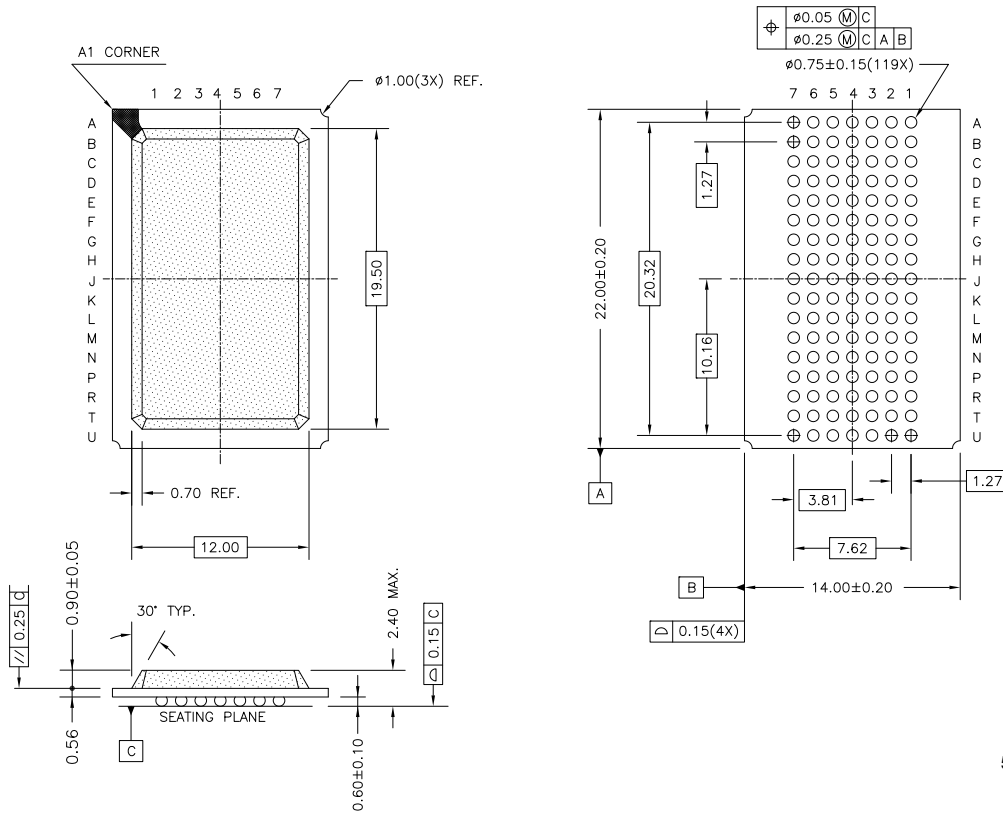
Speed (MHz)	Ordering Code	Package Diagram	Part and Package Type	Operating Range
100	CY7C1338G-100AXC	51-85050	100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-free	Commercial

Ordering Code Definitions



Package Diagrams (continued)

119-ball BGA (14 × 22 × 2.4 mm), 51-85115



51-85115 *C

Acronyms

Acronym	Description
CMOS	complementary metal oxide semiconductor
CE	chip enable
I/O	input/output
OE	output enable
SRAM	static random access memory
TQFP	thin quad flat pack
WE	write enable

Document Conventions

Units of Measure

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

Document History Page

Document Title: CY7C1338G 4-Mbit (128 K × 32) Flow-through Sync SRAM				
Document Number: 38-05521				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	224369	See ECN	RKF	New data sheet
*A	278513	See ECN	VBL	Deleted 66 MHz Changed TQFP to PB-Free TQFP in Ordering Info section Added PB-Free BG package
*B	333626	See ECN	SYT	Removed 117-MHz speed bin Modified Address Expansion balls in the pinouts for 100 TQFP and 119 BGA Packages as per JEDEC standards and updated the Pin Definitions accordingly Modified V_{OL} , V_{OH} test conditions Replaced 'Snooze' with 'Sleep' Replaced TBD's for Θ_{JA} and Θ_{JC} to their respective values on the Thermal Resistance table Removed comment on the availability of BG lead-free package Updated the Ordering Information by shading and unshading MPNs as per availability
*C	418633	See ECN	R XU	Converted from Preliminary to Final Changed address of Cypress Semiconductor Corporation on Page# 1 from "3901 North First Street" to "198 Champion Court" Removed I_{OS} from Electrical Characteristics table on Page #8 Modified test condition from $V_{IH} \leq V_{DD}$ to $V_{IH} < V_{DD}$ Modified test condition from $V_{DDQ} < V_{DD}$ to $V_{DDQ} \leq V_{DD}$ Modified "Input Load" to "Input Leakage Current except ZZ and MODE" in the Electrical Characteristics Table Replaced Package Name column with Package Diagram in the Ordering Information table Replaced Package Diagram of 51-85050 from *A to *B Updated the Ordering Information table
*D	480368	See ECN	VKN	Added the Maximum Rating for Supply Voltage on V_{DDQ} Relative to GND. Updated the Ordering Information table.
*E	2896584	03/20/2010	NJY	Removed obsolete part numbers from Ordering Information table and updated package diagrams.
*F	3036754	09/23/2010	NJY	Added Ordering Code Definitions . Added Acronyms and Units of Measure . Minor edits and updated in new template.

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