

64K x 32 SYNCHRONOUS PIPELINE STATIC RAM

PRELIMINARY INFORMATION
SEPTEMBER 2002

FEATURES

- Internal self-timed write cycle
- Individual Byte Write Control and Global Write
- Clock controlled, registered address, data and control
- Three chip enables for simple depth expansion and address pipelining
- Common data inputs and data outputs
- Power-down control by ZZ input
- JEDEC 100-Pin TQFP package
- Single +3.3V power supply
- IS64S6432: 3.3V V_{DDQ} (I/O Voltage)
- IS64LV6432: 2.5V V_{DDQ} (I/O Voltage)
- Two Clock enables and one Clock disable to eliminate multiple bank bus contention
- Control pins mode upon power-up:
 - MODE in interleave burst mode
 - ZZ in normal operation mode
- Temperature offerings:
 - Option A1: -40°C to +85°C
 - Option A2: -40°C to +105°C
 - Option A3: -40°C to +125°C

DESCRIPTION

The *ISSI* IS64S6432/IS64LV6432 is a high-speed, low-power synchronous static RAM designed to provide a burstable, high-performance memory. It is organized as 65,536 words by 32 bits, fabricated with *ISSI*'s advanced CMOS technology. The device integrates a 2-bit burst counter, high-speed SRAM core, and high-drive capability outputs into a single monolithic circuit. All synchronous inputs pass through registers controlled by a positive-edge-triggered single clock input.

Write cycles are internally self-timed and are initiated by the rising edge of the clock input. Write cycles can be from one to four bytes wide as controlled by the write control inputs.

Separate byte enables allow individual bytes to be written. $\overline{BW1}$ controls DQ1-DQ8, $\overline{BW2}$ controls DQ9-DQ16, $\overline{BW3}$ controls DQ17-DQ24, $\overline{BW4}$ controls DQ25-DQ32, conditioned by \overline{BWE} being LOW. A LOW on \overline{GW} input would cause all bytes to be written.

Bursts can be initiated with either \overline{ADSP} (Address Status Processor) or \overline{ADSC} (Address Status Cache Controller) input pins. Subsequent burst addresses can be generated internally by the IS64S6432/IS64LV6432 and controlled by the \overline{ADV} (burst address advance) input pin.

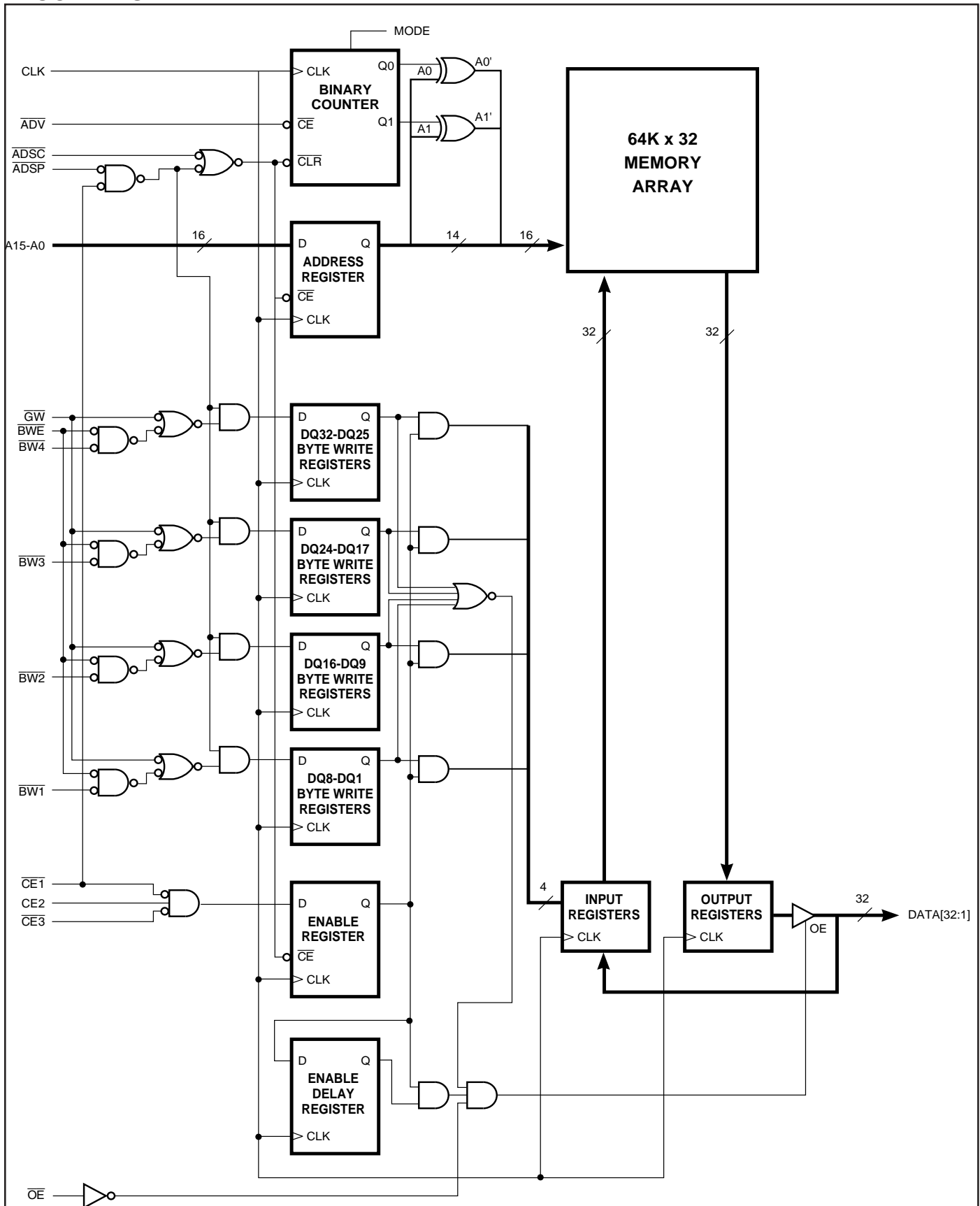
Asynchronous signals include output enable (\overline{OE}), sleep mode input (ZZ), clock (CLK) and burst mode input (MODE). A HIGH input on the ZZ pin puts the SRAM in the power-down state. When ZZ is pulled LOW (or no connect), the SRAM normally operates after three cycles of the wake-up period. A LOW input, i.e., GND_Q, on MODE pin selects LINEAR Burst. A V_{DDQ} (or no connect) on MODE pin selects INTERLEAVED Burst.

FAST ACCESS TIME

Symbol	Parameter	-133	-100	Unit
t _{KQ}	CLK Access Time	5	5	ns
t _{KC}	Cycle Time	7.5	10	ns
—	Frequency	133	100	MHz

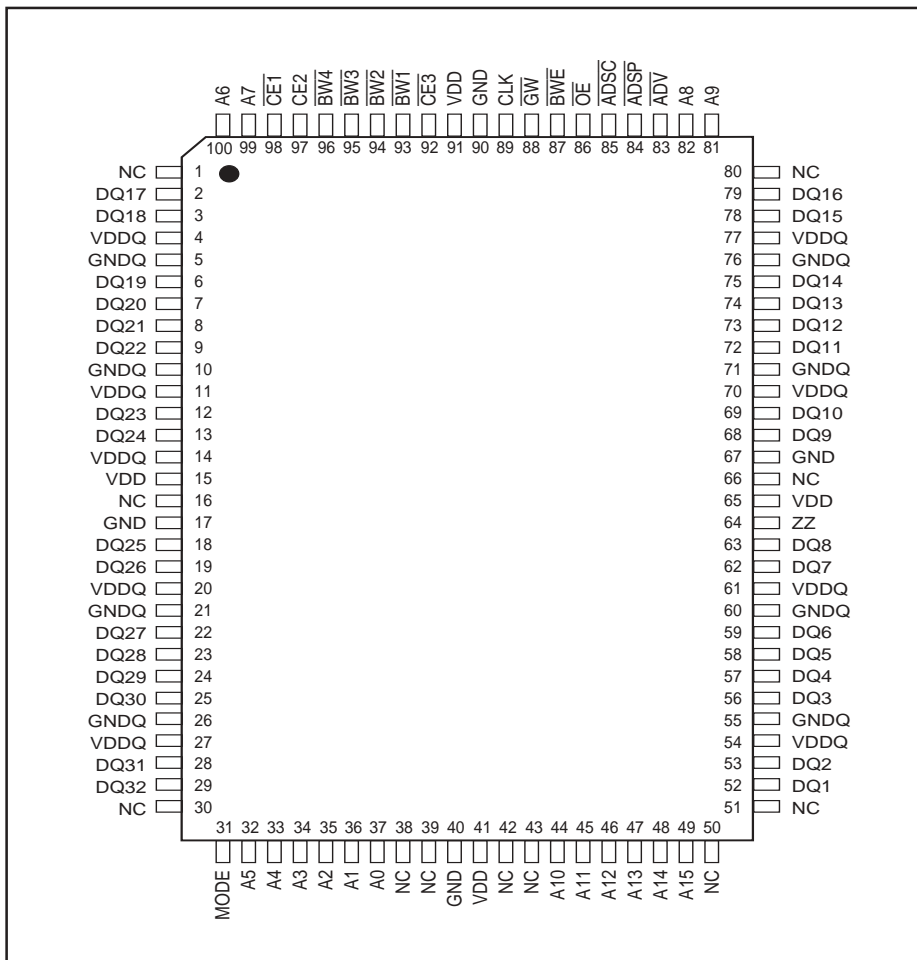
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BLOCK DIAGRAM



PIN CONFIGURATION

100-Pin TQFP (Top View)



PIN DESCRIPTIONS

A0-A15	Address Inputs
CLK	Clock
$\overline{\text{ADSP}}$	Processor Address Status
$\overline{\text{ADSC}}$	Controller Address Status
$\overline{\text{ADV}}$	Burst Address Advance
$\overline{\text{BW1-BW4}}$	Synchronous Byte Write Enable
$\overline{\text{BWE}}$	Byte Write Enable
$\overline{\text{GW}}$	Global Write Enable
$\overline{\text{CE1, CE2, CE3}}$	Synchronous Chip Enable

$\overline{\text{OE}}$	Output Enable
DQ1-DQ32	Data Input/Output
ZZ	Sleep Mode
MODE	Burst Sequence Mode
V _{DD}	+3.3V Power Supply
GND	Ground
V _{DDQ}	Isolated Output Buffer Supply: +3.3V/ 2.5V
GND _Q	Isolated Output Buffer Ground
NC	No Connect

TRUTH TABLE

Operation	Address Used	Address								
		$\overline{CE1}$	CE2	$\overline{CE3}$	\overline{ADSP}	\overline{ADSC}	\overline{ADV}	WRITE	\overline{OE}	DQ
Deselected, Power-down	None	H	X	X	X	L	X	X	X	High-Z
Deselected, Power-down	None	L	L	X	L	X	X	X	X	High-Z
Deselected, Power-down	None	L	X	H	L	X	X	X	X	High-Z
Deselected, Power-down	None	L	L	X	H	L	X	X	X	High-Z
Deselected, Power-down	None	L	X	H	H	L	X	X	X	High-Z
Read Cycle, Begin Burst	External	L	H	L	L	X	X	X	L	Q
Read Cycle, Begin Burst	External	L	H	L	L	X	X	X	H	High-Z
Write Cycle, Begin Burst	External	L	H	L	H	L	X	L	X	D
Read Cycle, Begin Burst	External	L	H	L	H	L	X	H	L	Q
Read Cycle, Begin Burst	External	L	H	L	H	L	X	H	H	High-Z
Read Cycle, Continue Burst	Next	X	X	X	H	H	L	H	L	Q
Read Cycle, Continue Burst	Next	X	X	X	H	H	L	H	H	High-Z
Read Cycle, Continue Burst	Next	H	X	X	X	H	L	H	L	Q
Read Cycle, Continue Burst	Next	H	X	X	X	H	L	H	H	High-Z
Write Cycle, Continue Burst	Next	X	X	X	H	H	L	L	X	D
Write Cycle, Continue Burst	Next	H	X	X	X	H	L	L	X	D
Read Cycle, Suspend Burst	Current	X	X	X	H	H	H	H	L	Q
Read Cycle, Suspend Burst	Current	X	X	X	H	H	H	H	H	High-Z
Read Cycle, Suspend Burst	Current	H	X	X	X	H	H	H	L	Q
Read Cycle, Suspend Burst	Current	H	X	X	X	H	H	H	H	High-Z
Write Cycle, Suspend Burst	Current	X	X	X	H	H	H	L	X	D
Write Cycle, Suspend Burst	Current	H	X	X	X	H	H	L	X	D

Notes:

- All inputs except \overline{OE} must meet setup and hold times for the Low-to-High transition of clock (CLK).
- Wait states are inserted by suspending burst.
- "X" means don't care. WRITE=L means any one or more byte write enable signals ($\overline{BW1}$ - $\overline{BW4}$) and \overline{BWE} are LOW or \overline{GW} is LOW. WRITE=H means all byte write enable signals are HIGH.
- For a Write operation following a Read operation, \overline{OE} must be HIGH before the input data required setup time and held HIGH throughout the input data hold time.
- \overline{ADSP} LOW always initiates an internal READ at the Low-to-High edge of clock. A WRITE is performed by setting one or more byte write enable signals and \overline{BWE} LOW or \overline{GW} LOW for the subsequent L-H edge of clock.

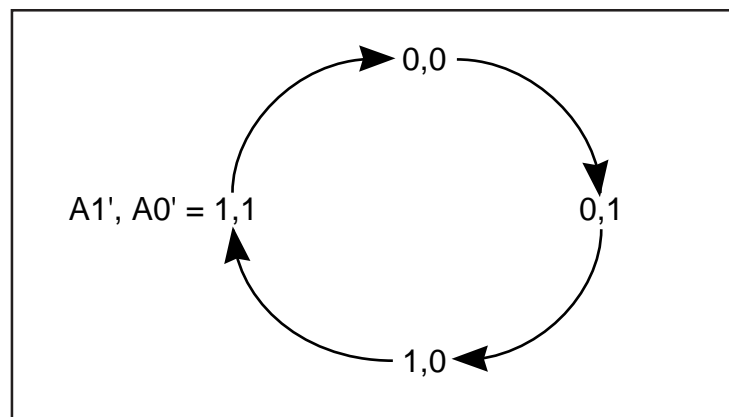
PARTIAL TRUTH TABLE

Function	\overline{GW}	\overline{BWE}	$\overline{BW1}$	$\overline{BW2}$	$\overline{BW3}$	$\overline{BW4}$
READ	H	H	X	X	X	X
READ	H	X	H	H	H	H
WRITE Byte 1	H	L	L	H	H	H
WRITE All Bytes	X	L	L	L	L	L
WRITE All Bytes	L	X	X	X	X	X

INTERLEAVED BURST ADDRESS TABLE (MODE = V_{DDQ} or No Connect)

External Address A1 A0	1st Burst Address A1 A0	2nd Burst Address A1 A0	3rd Burst 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_Q)



ABSOLUTE MAXIMUM RATINGS^(1,2,3)

Symbol	Parameter	Value	Unit
T _{STG}	Storage Temperature	-55 to +150	°C
P _D	Power Dissipation	1.8	W
I _{OUT}	Output Current (per I/O)	100	mA
V _{IN} , V _{OUT}	Voltage Relative to GND for I/O Pins	-0.5 to V _{DDQ} + 0.3	V
V _{IN}	Voltage Relative to GND for for Address and Control Inputs	-0.5 to 4.6V	V

Notes:

1. Stress greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, precautions may be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.
3. This device contains circuitry that will ensure the output devices are in High-Z at power up.

OPERATING RANGE (V_{DD} = 3.3V+10%-5%)

Options	Ambient Temperature	V _{DDQ} (64LV6432)	V _{DDQ} (64S6432)
A1	-40°C to +85°C	2.5V ± 5%	3.3V +10%, -5%
A2	-40°C to +105°C	2.5V ± 5%	3.3V +10%, -5%
A3	-40°C to +125°C	2.5V ± 5%	3.3V +10%, -5%

DC ELECTRICAL CHARACTERISTICS^(1,2) (Over Operating Range) (64S6432)

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	I _{OH} = -5.0 mA	2.4	—	V
V _{OL}	Output LOW Voltage	I _{OL} = 5.0 mA	—	0.4	V
V _{IH}	Input HIGH Voltage		2.0	V _{DDQ} + 0.3	V
V _{IL}	Input LOW Voltage		-0.3	0.8	V
I _{LI}	Input Leakage Current	GND - V _{IN} - V _{DDQ} ⁽²⁾	Com. -5 Ind. -10	5 10	μA
I _{LO}	Output Leakage Current	GND - V _{OUT} - V _{DDQ} , $\overline{OE} = V_{IH}$	Com. -5 Ind. -10	5 10	μA

Notes:

1. MODE pin have an internal pull-up. ZZ pin has an internal pull-down. These pins may be a No Connect, tied to GND, or tied to V_{DDQ}.
2. MODE pin should be tied to V_{dd} or GND. They exhibit ±30 μA maximum leakage current when tied to - GND + 0.2V or V_{dd} - 0.2V.

DC ELECTRICAL CHARACTERISTICS⁽¹⁾ (Over Operating Range) (64LV6432)

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	I _{OH} = -1.0 mA	2.0	—	V
V _{OL}	Output LOW Voltage	I _{OL} = 1.0 mA	—	0.4	V
V _{IH}	Input HIGH Voltage		1.7	V _{DDQ} + 0.3	V
V _{IL}	Input LOW Voltage		-0.3	0.7	V
I _{LI}	Input Leakage Current	GND - V _{IN} - V _{DDQ} ⁽²⁾	Com. -5 Ind. -10	5 10	μA
I _{LO}	Output Leakage Current	GND - V _{OUT} - V _{DDQ} , $\overline{OE} = V_{IH}$	Com. -5 Ind. -10	5 10	μA

POWER SUPPLY CHARACTERISTICS (Operating Range)

Symbol	Parameter	Test Conditions	-133		-100		Unit
			Min.	Max.	Min.	Max.	
I _{CC}	AC Operating Supply Current	Device Selected, All Inputs = V _{IL} or V _{IH} OE = V _{IH} , Cycle Time t _{KC} min.	A1 A2, A3	— 200 215	— 175 195		mA
I _{SB}	Standby Current	Device Deselected, V _{DD} = Max., CLK Cycle Time t _{KC} min.	A1 A2, A3	— 60 70	— 50 60		mA
I _{ZZ}	Power-Down Mode Current	ZZ = V _{DDQ} , CLK Running All Inputs - GND + 0.2V or V _{DD} - 0.2V	A1 A2 A3	— 5 10 15	— 5 10 15		mA

Notes:

1. Advance Information Only.

CAPACITANCE^(1,2)

Symbol	Parameter	Conditions	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	6	pF
C _{OUT}	Input/Output Capacitance	V _{OUT} = 0V	8	pF

Notes:

1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T_A = 25°C, f = 1 MHz, V_{dd} = 3.3V.

AC TEST CONDITIONS (64S6432)

Parameter	Unit
Input Pulse Level	0V to 3.0V
Input Rise and Fall Times	1.5 ns
Input and Output Timing and Reference Level	1.5V
Output Load	See Figures 1 and 2

AC TEST LOADS

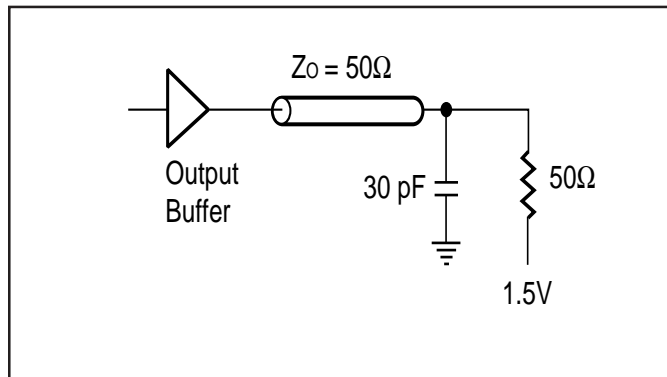


Figure 1

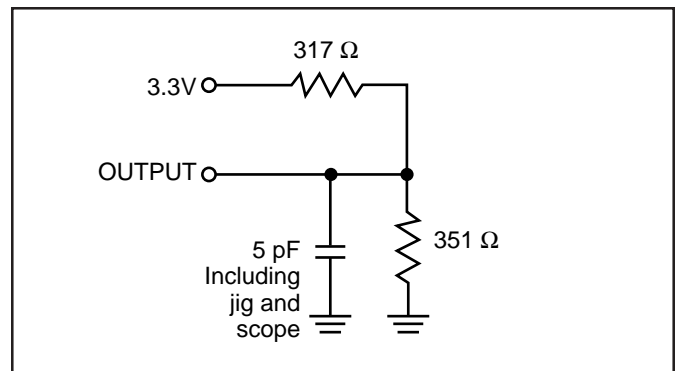


Figure 2

AC TEST CONDITIONS (64LV6432)

Parameter	Unit
Input Pulse Level	0V to 2.5V
Input Rise and Fall Times	1.5 ns
Input and Output Timing and Reference Level	1.25V
Output Load	See Figures 1 and 2

AC TEST LOADS

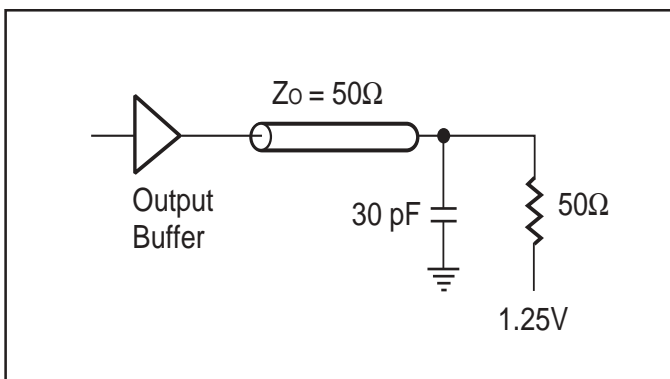


Figure 1

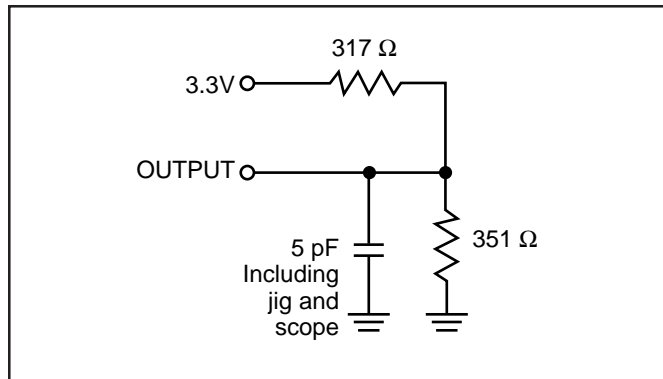


Figure 2

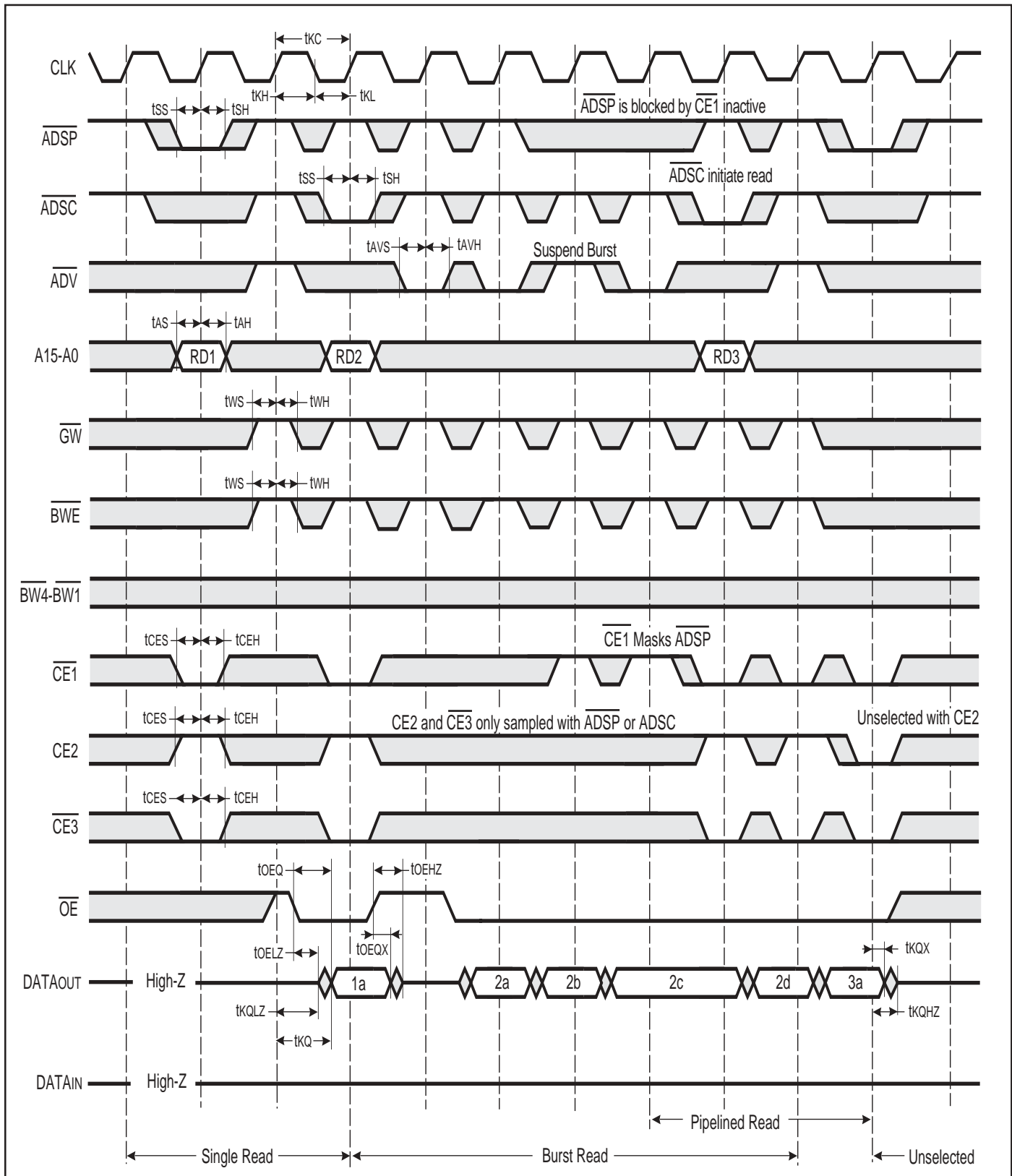
READ CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	-133		-100		Unit
		Min.	Max.	Min.	Max.	
t _κ	Cycle Time	7.5	—	10	—	ns
t _{κH}	Clock High Time	2.8	—	3.5	—	ns
t _{κL}	Clock Low Time	2.8	—	3.5	—	ns
t _{κQ}	Clock Access Time	—	5	—	5	ns
t _{κQX} ⁽¹⁾	Clock High to Output Invalid	1.5	—	1.5	—	ns
t _{κQLZ} ^(1,2)	Clock High to Output Low-Z	0	—	0	—	ns
t _{κQHZ} ^(1,2)	Clock High to Output High-Z	1.5	5	1.5	6	ns
t _{OEQ}	Output Enable to Output Valid	—	4.2	—	4.2	ns
t _{OEQX} ⁽¹⁾	Output Disable to Output Invalid	0	—	0	—	ns
t _{OEZ} ^(1,2)	Output Enable to Output Low-Z	0	—	0	—	ns
t _{OEZ} ^(1,2)	Output Disable to Output High-Z	—	3	—	4	ns
t _{AS}	Address Setup Time	2.5	—	2.5	—	ns
t _{SS}	Address Status Setup Time	2.5	—	2.5	—	ns
t _{WS}	Write Setup Time	2.5	—	2.5	—	ns
t _{CES}	Chip Enable Setup Time	2.5	—	2.5	—	ns
t _{AVS}	Address Advance Setup Time	2.5	—	2.5	—	ns
t _{AH}	Address Hold Time	1.0	—	1.0	—	ns
t _{SH}	Address Status Hold Time	0.5	—	0.5	—	ns
t _{WH}	Write Hold Time	0.5	—	0.5	—	ns
t _{CEH}	Chip Enable Hold Time	0.5	—	0.5	—	ns
t _{AVH}	Address Advance Hold Time	0.5	—	0.5	—	ns
t _{CFG} ⁽³⁾	Configuration Setup	30	—	35	—	ns

Notes:

1. Guaranteed but not 100% tested. This parameter is periodically sampled.
2. Tested with load in Figure 2.
3. Configuration signal MODE is static and must not change during normal operation.

READ CYCLE TIMING: PIPELINE



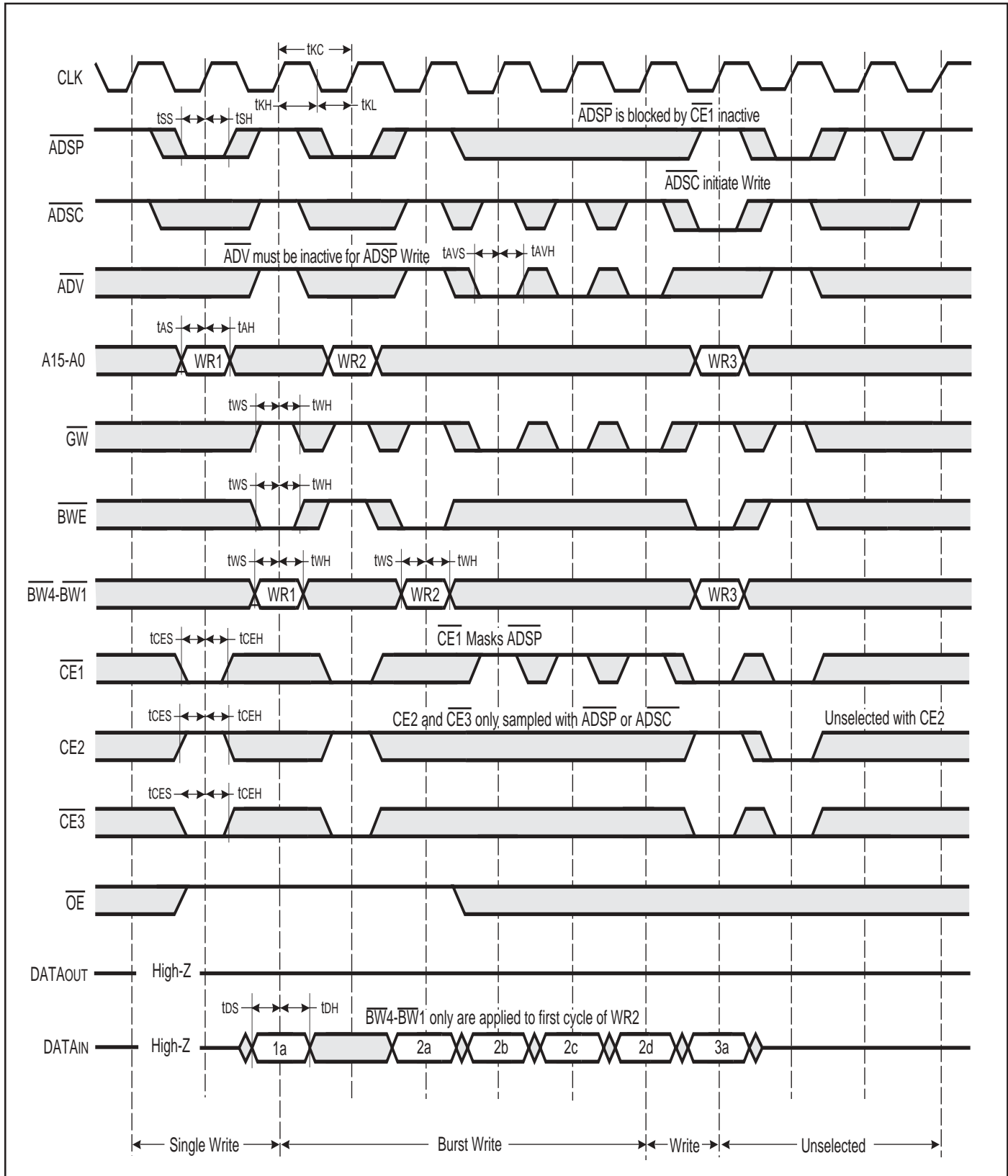
WRITE CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

SYMBOL	PARAMETER	-133		-100		UNIT
		MIN.	MAX.	MIN.	MAX.	
t _{CC}	Cycle Time	7.5	—	10	—	ns
t _{KH}	Clock High Time	2.8	—	3.5	—	ns
t _{KL}	Clock Low Time	2.8	—	3.5	—	ns
t _{AS}	Address Setup Time	2.5	—	2.5	—	ns
t _{SS}	Address Status Setup Time	2.5	—	2.5	—	ns
t _{WS}	Write Setup Time	2.5	—	2.5	—	ns
t _{DS}	Data In Setup Time	2.5	—	2.5	—	ns
t _{CES}	Chip Enable Setup Time	2.5	—	2.5	—	ns
t _{AVS}	Address Advance Setup Time	2.5	—	2.5	—	ns
t _{AH}	Address Hold Time	1.0	—	1.0	—	ns
t _{SH}	Address Status Hold Time	0.5	—	0.5	—	ns
t _{DH}	Data In Hold Time	1.0	—	1.0	—	ns
t _{WH}	Write Hold Time	0.5	—	0.5	—	ns
t _{CEH}	Chip Enable Hold Time	0.5	—	0.5	—	ns
t _{AVH}	Address Advance Hold Time	0.5	—	0.5	—	ns
t _{CFG} ⁽¹⁾	Configuration Setup	30	—	35	—	ns

Note:

1. Configuration signal MODE is static and must not change during normal operation.

WRITE CYCLE TIMING



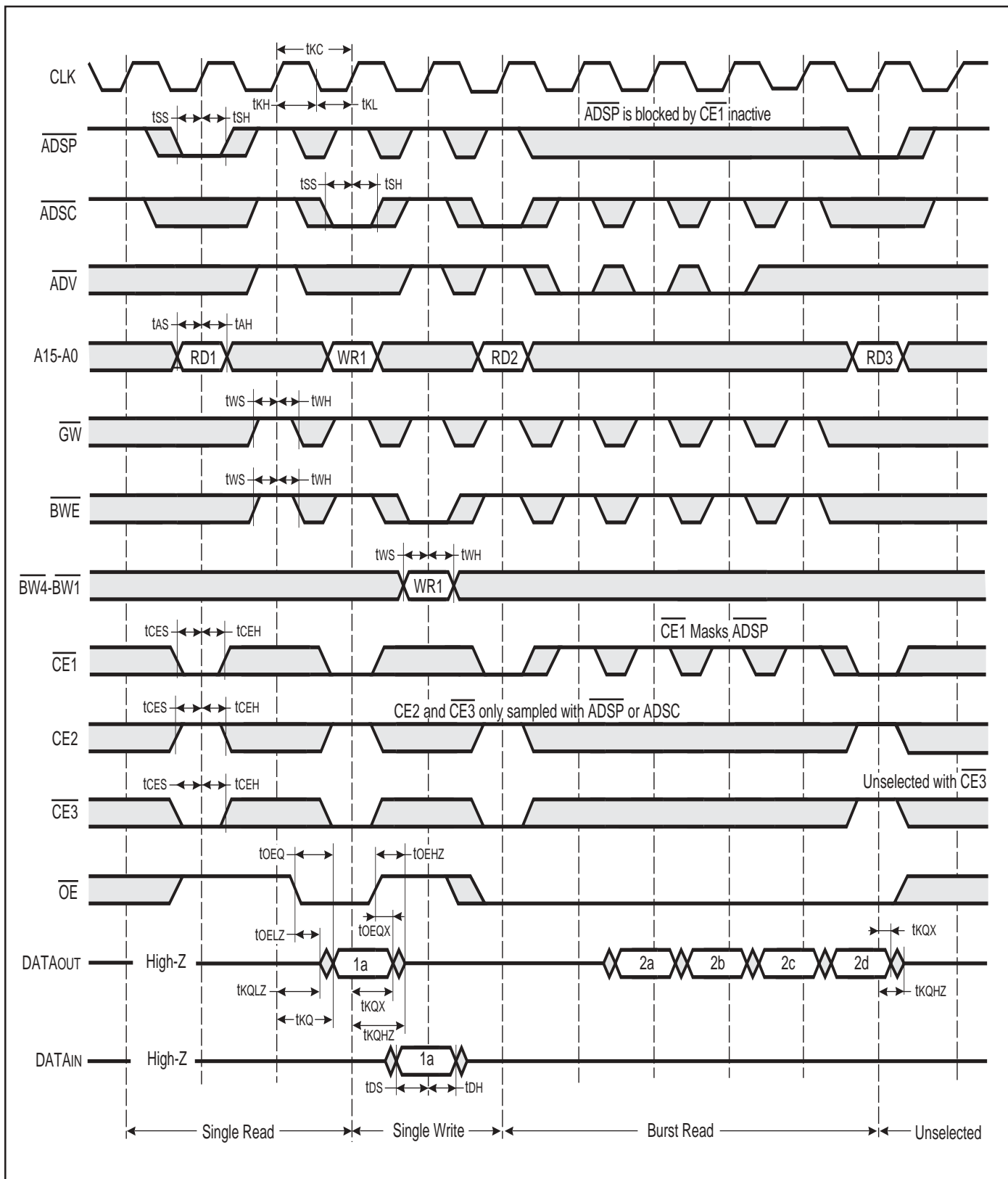
READ/WRITE CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	-133		-100		Unit
		Min.	Max.	Min.	Max.	
t _{KC}	Cycle Time	7.5	—	10	—	ns
t _{KH}	Clock High Time	2.8	—	3.5	—	ns
t _{KL}	Clock Low Time	2.8	—	3.5	—	ns
t _{KQ}	Clock Access Time	—	5	—	5	ns
t _{KQX} ⁽¹⁾	Clock High to Output Invalid	1.5	—	1.5	—	ns
t _{KQLZ} ^(1,2)	Clock High to Output Low-Z	0	—	0	—	ns
t _{KQHZ} ^(1,2)	Clock High to Output High-Z	1.5	5	1.5	6	ns
t _{OEQ}	Output Enable to Output Valid	—	4.2	—	4.2	ns
t _{OEQX} ⁽¹⁾	Output Disable to Output Invalid	0	—	0	—	ns
t _{OELZ} ^(1,2)	Output Enable to Output Low-Z	0	—	0	—	ns
t _{OEHZ} ^(1,2)	Output Disable to Output High-Z	—	3	—	4	ns
t _{AS}	Address Setup Time	2.5	—	2.5	—	ns
t _{SS}	Address Status Setup Time	2.5	—	2.5	—	ns
t _{WS}	Write Setup Time	2.5	—	2.5	—	ns
t _{CES}	Chip Enable Setup Time	2.5	—	2.5	—	ns
t _{AH}	Address Hold Time	1.0	—	1.0	—	ns
t _{SH}	Address Status Hold Time	0.5	—	0.5	—	ns
t _{WH}	Write Hold Time	0.5	—	0.5	—	ns
t _{CEH}	Chip Enable Hold Time	0.5	—	0.5	—	ns
t _{CFG} ⁽³⁾	Configuration Setup	30	—	35	—	ns

Notes:

1. Guaranteed but not 100% tested. This parameter is periodically sampled.
2. Tested with load in Figure 2.
3. Configuration signal MODE is static and must not change during normal operation.

READ/WRITE CYCLE TIMING: PIPELINE



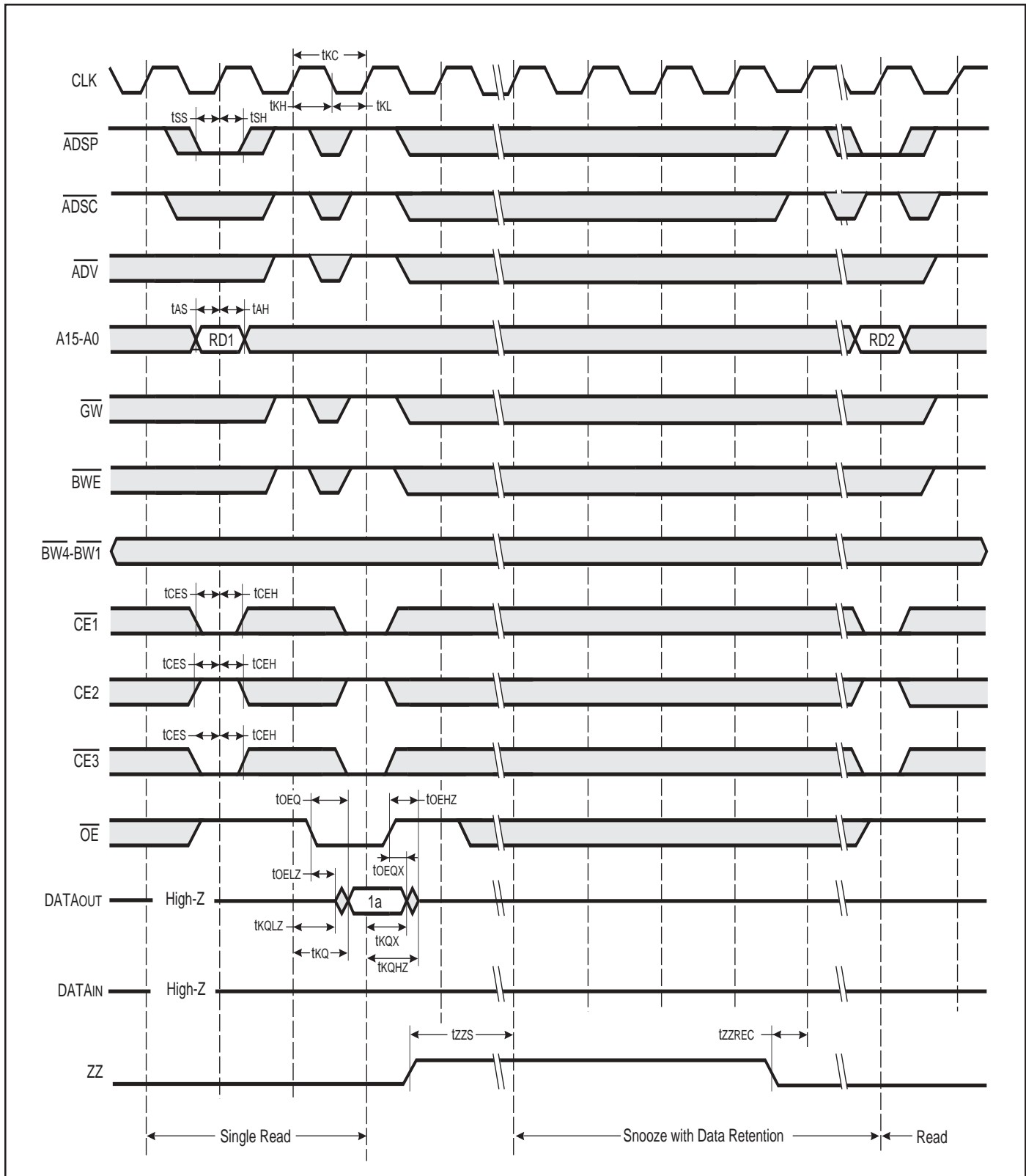
SNOOZE AND RECOVERY CYCLE SWITCHING CHARACTERISTICS⁽¹⁾ (Over Operating Range)

Symbol	Parameter	-133		-100		Unit
		Min.	Max.	Min.	Max.	
t _{KC}	Cycle Time	7.5	—	10	—	ns
t _{KH}	Clock High Time	2.8	—	3.5	—	ns
t _{KL}	Clock Low Time	2.8	—	3.5	—	ns
t _{KQ}	Clock Access Time	—	5	—	5	ns
t _{KQX} ⁽²⁾	Clock High to Output Invalid	1.5	—	1.5	—	ns
t _{KQLZ} ^(2,3)	Clock High to Output Low-Z	0	—	0	—	ns
t _{KQHZ} ^(2,3)	Clock High to Output High-Z	1.5	5	1.5	6	ns
t _{OEQ}	Output Enable to Output Valid	—	4.2	—	4.2	ns
t _{OEQX} ⁽²⁾	Output Disable to Output Invalid	0	—	0	—	ns
t _{OELZ} ^(2,3)	Output Enable to Output Low-Z	0	—	0	—	ns
t _{OEHZ} ^(2,3)	Output Disable to Output High-Z	—	3	—	4	ns
t _{AS}	Address Setup Time	2.5	—	2.5	—	ns
t _{SS}	Address Status Setup Time	2.5	—	2.5	—	ns
t _{CES}	Chip Enable Setup Time	2.5	—	2.5	—	ns
t _{AH}	Address Hold Time	2.5	—	2.5	—	ns
t _{SH}	Address Status Hold Time	2.5	—	2.5	—	ns
t _{CEH}	Chip Enable Hold Time	2.5	—	2.5	—	ns
t _{ZZS} ⁽⁴⁾	ZZ Standby	2	—	2	—	cyc
t _{ZZREC} ⁽⁵⁾	ZZ Recovery	2	—	2	—	cyc

Notes:

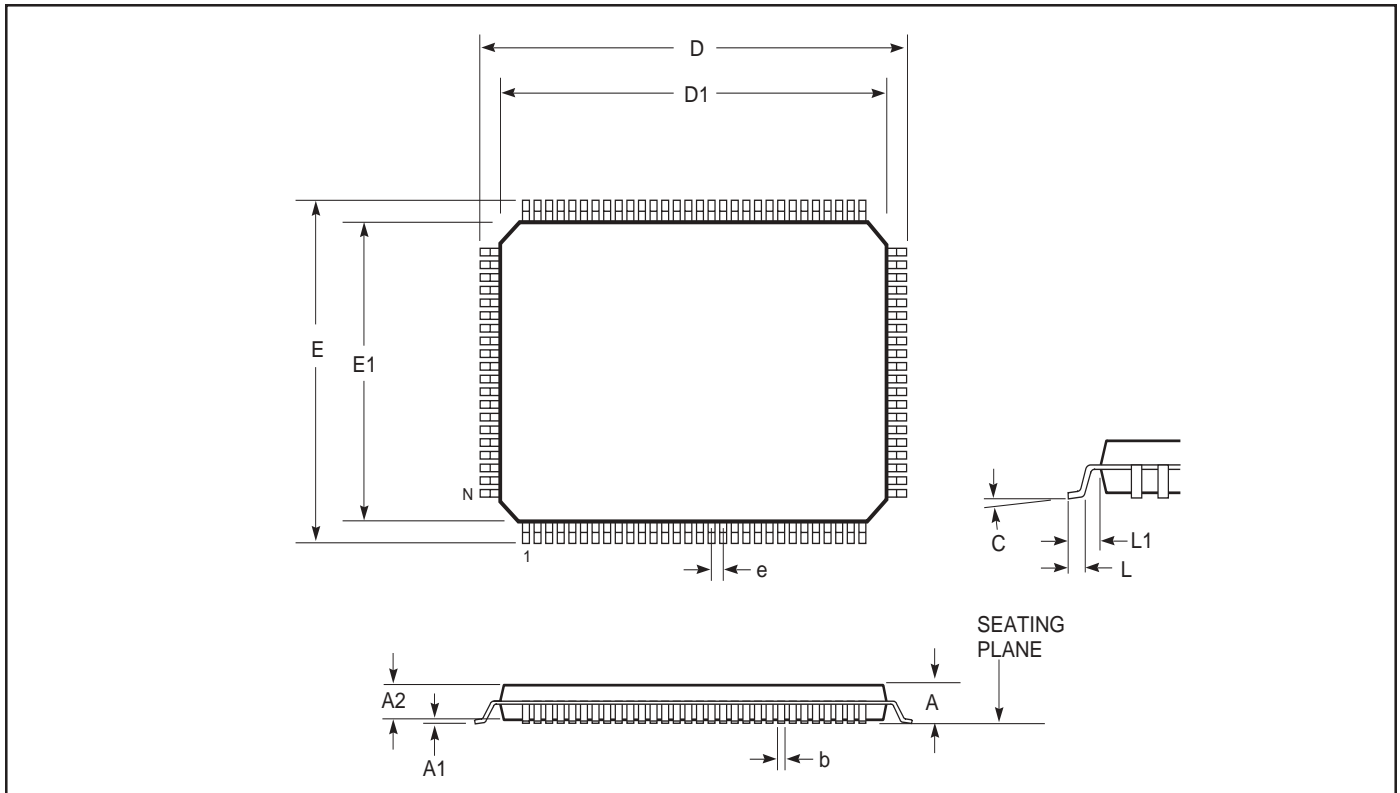
1. Configuration signal MODE is static and must not change during normal operation.
2. Guaranteed but not 100% tested. This parameter is periodically sampled.
3. Tested with load in Figure 2.
4. The assertion of ZZ allows the SRAM to enter a lower power state than when deselected within the time specified. Data retention is guaranteed when ZZ is asserted and clock remains active.
5. ADSC and ADSP must not be asserted for at least two cycles after leaving ZZ state.

SNOOZE AND RECOVERY CYCLE TIMING



TQFP (Thin Quad Flat Pack Package) (1.4 mm Thickness)

Package Code: TQ



Notes:

1. All dimensioning and tolerancing conforms to ANSI Y 14.5M-1982.
2. Dimensions D1 and E1 do not include mold protrusions. Allowable protrusion is 0.25mm per side. D1 and E1 do include mold mismatch and are determined at datum plane -H-.
3. Controlling dimension: millimeters.

Thin Quad Flat Pack (1.4 mm Thickness) TQ

Symbol	Millimeters		Inches	
	Min	Max	Min	Max
Ref. Std.				
No. Leads(N)	100			
A	—	1.60	—	0.063
A1	0.05	0.15	0.002	0.006
A2	1.35	1.45	0.053	0.057
b	0.22	0.38	0.009	0.0015
C	0.09	0.20	0.004	0.008
E	15.90	16.10	0.626	0.634
E1	13.90	14.10	0.547	0.555

Symbol	Millimeters		Inches	
	Min	Max	Min	Max
D	21.90	22.10	0.862	0.870
D1	19.90	20.10	0.783	0.791
e	0.65 BSC		0.026 BSC	
L	0.45	0.75	0.018	0.030
L1	1.00 Nom.		0.039 Nom.	

ORDERING INFORMATION

IS64S6432 (3.3V I/O)

Temperature Range (A1): -40°C to +85°C

Speed (ns)	Order Part No.	Package
133	IS64S6432-133TQA1	TQFP
100	IS64S6432-100TQA1	TQFP

Temperature Range (A2): -40°C to +105°C

Speed (ns)	Order Part No.	Package
133	IS64S6432-133TQA2	TQFP
100	IS64S6432-100TQA2	TQFP

Temperature Range (A3): -40°C to +125C

Speed (ns)	Order Part No.	Package
133	IS64S6432-133TQA3	TQFP
100	IS64S6432-100TQA3	TQFP

ORDERING INFORMATION

IS64LV6432 (2.5V I/O)

Temperature Range (A1): -40°C to +85°C

Speed (ns)	Order Part No.	Package
133	IS64LV6432-133TQA1	TQFP
100	IS64LV6432-100TQA1	TQFP

Temperature Range (A2): -40°C to +105°C

Speed (ns)	Order Part No.	Package
133	IS64LV6432-133TQA2	TQFP
100	IS64LV6432-100TQA2	TQFP

Temperature Range (A3): -40°C to +125C

Speed (ns)	Order Part No.	Package
133	IS64LV6432-133TQA3	TQFP
100	IS64LV6432-100TQA3	TQFP