

64K x 32, 64Kx36
SYNCHRONOUS FLOW-THROUGH
STATIC RAM

FEBRUARY 2004

FEATURES

- Internal self-timed write cycle
- Individual Byte Write Control and Global Write
- Clock controlled, registered address, data and control
- Interleaved or linear burst sequence control using MODE input
- 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
- Power Supply:
 - +3.3V V_{DD}
 - +3.3V or 2.5V V_{DDQ}
- Control pins mode upon power-up:
 - MODE in interleave burst mode
 - ZZ in normal operation mode
- Industrial Temperature Available: (-40°C to +85°C)
- Automotive Temperature offerings:
 - Option A2: -40°C to +105°C
 - Option A3: -40°C to +125°C

DESCRIPTION

The *ISSI* IS64LF6432, IS64LF6436, IS61LF6432A, and IS61LF6436A are high-speed, low-power synchronous static RAM designed to provide a burstable, high-performance, memory. IS64LF6432 and IS61LF6432A are organized as 65,536 words by 32 bits. IS64LF6436 and IS61LF6436A are organized as 65,536 words by 36 bits. They are 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. BW1 controls DQ1-DQ8, BW2 controls DQ9-DQ16, BW3 controls DQ17-DQ24, 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 ADSC (Address Status Cache Controller) input pins. Subsequent burst addresses can be generated internally by the IS61LF6432A/36A and IS64LF6432/36, and controlled by the \overline{ADV} (burst address advance) input pin.

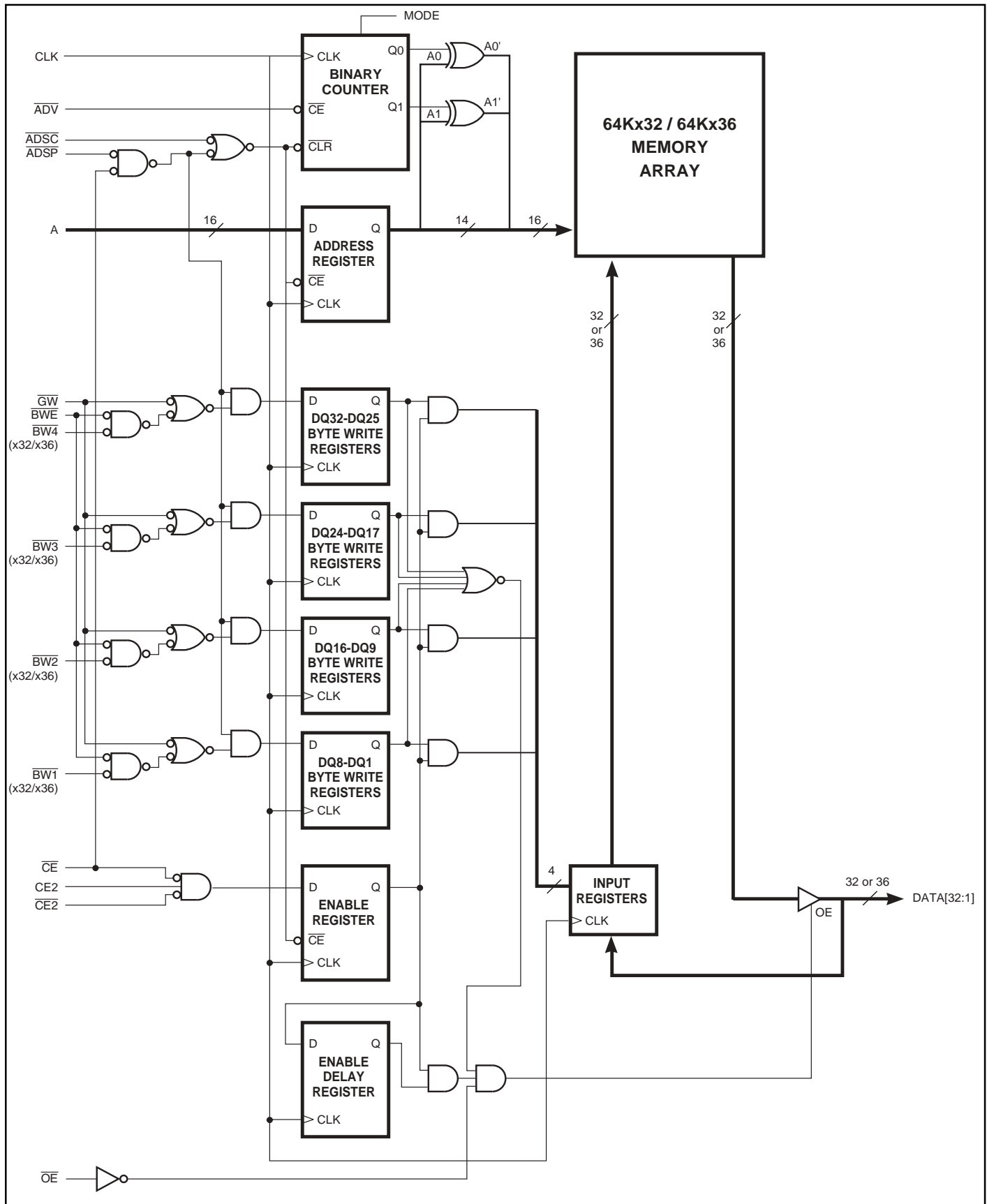
The mode pin is used to select the burst sequence order. Linear burst is achieved when this pin is tied LOW. Interleave burst is achieved when this pin is tied HIGH or left floating.

FAST ACCESS TIME

| Symbol | Parameter | 8.5 | 10 | Unit |
|-----------------|-------------------|-----|----|------|
| t _{KQ} | Clock Access Time | 8.5 | 10 | ns |
| t _{KC} | Cycle Time | 11 | 15 | ns |
| | Frequency | 90 | 66 | MHz |

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BLOCK DIAGRAM



TRUTH TABLE

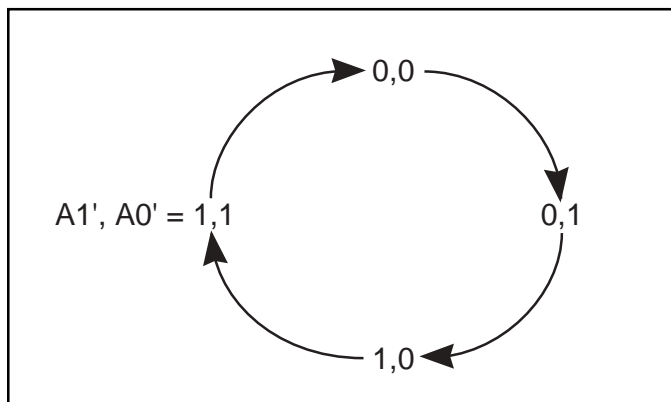
| Operation | Address Used | Address | | | | | | | | |
|-----------------------------|--------------|-----------------|-----|------------------|-------------------|-------------------|------------------|--------------------|-----------------|--------|
| | | \overline{CE} | CE2 | $\overline{CE2}$ | \overline{ADSP}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

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 | L | H | H | H | H |
| Write Byte 1 | H | L | L | H | H | H |
| Write All Bytes | H | L | L | L | L | L |
| Write All Bytes | L | X | X | X | X | X |

INTERLEAVED BURST ADDRESS TABLE (MODE = V_{DD} 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 |



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| Symbol | Parameter | Value | Unit |
|------------------------------------|---|--------------------------------|------|
| T _{STG} | Storage Temperature | -55 to +150 | °C |
| P _D | Power Dissipation | 1.6 | 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 V _{DD} + 0.5 | V |
| V _{DD} | Voltage on V _{DD} Supply Relative to GND | -0.5 to 4.6 | 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 (IS61LF6432A, IS61LF6436A)

| Range | Ambient Temperature | V _{DD} | 3.3V (I/O) V _{DDQ} | 2.5V (I/O) V _{DDQ} |
|------------|---------------------|-----------------|--------------------------------|--------------------------------|
| Industrial | -40°C to +85°C | 3.3V, +10%, -5% | 3.3V, +10%, -5% | 2.5V ± 5% |

OPERATING RANGE (IS64LF6432, IS64LF6436)

| Option | Ambient Temperature | V _{DD} | 3.3V (I/O) V _{DDQ} | 2.5V (I/O) V _{DDQ} |
|--------|---------------------|-----------------|--------------------------------|--------------------------------|
| A2 | -40°C to +105°C | 3.3V, +10%, -5% | 3.3V, +10%, -5% | 2.5V ± 5% |
| A3 | -40°C to +125°C | 3.3V, +10%, -5% | 3.3V, +10%, -5% | 2.5V ± 5% |

DC ELECTRICAL CHARACTERISTICS⁽¹⁾ (Over Operating Range)

| Symbol | Parameter | Test Conditions | 2.5V (I/O) | | 3.3V (I/O) | | Unit |
|-----------------|------------------------|---|------------|-----------------------|------------|-----------------------|------|
| | | | Min. | Max. | Min. | Max. | |
| V _{OH} | Output HIGH Voltage | I _{OH} = -4.0 mA (3.3V) I _{OH} = 1.0 mA (2.5V) | 2.0 | — | 2.4 | — | V |
| V _{OL} | Output LOW Voltage | I _{OL} = 8.0 mA (3.3V) I _{OL} = 1.0 mA (2.5V) | — | 0.4 | — | 0.4 | V |
| V _{IH} | Input HIGH Voltage | | 1.7 | V _{DD} + 0.3 | 2.0 | V _{DD} + 0.3 | V |
| V _{IL} | Input LOW Voltage | | -0.3 | 0.7 | -0.3 | 0.8 | V |
| I _{LI} | Input Leakage Current | GND ≤ V _{IN} ≤ V _{DD} | -5 | 5 | -5 | 5 | μA |
| I _{LO} | Output Leakage Current | GND ≤ V _{OUT} ≤ V _{DDQ} , OE = V _I | -5 | 5 | -5 | 5 | μA |

POWER SUPPLY CHARACTERISTICS (Over Operating Range)

| Symbol | Parameter | Test Conditions | | 8.5 | 10 | Unit |
|-----------------|-----------------------------|---|------|------|------|------|
| | | | | Max. | Max. | |
| I _{CC} | AC Operating Supply Current | Device Selected, All Inputs = V _{IL} or V _{IH} OE = V _{IH} , V _{DD} = Max. Cycle Time ≥ t _{kc} min. | IND. | 180 | — | mA |
| | | | A2 | 190 | — | mA |
| | | | A3 | — | 190 | mA |
| I _{SB} | Standby Current | Device Deselected, V _{DD} = Max., All Inputs = V _{IH} or V _{IL} CLK Cycle Time ≥ t _{kc} min. | IND. | 70 | — | mA |
| | | | A2 | 80 | — | mA |
| | | | A3 | — | 90 | mA |
| I _{ZZ} | Power-down Mode Current | ZZ = V _{DD} Clock Running All Inputs ≤ GND + 0.2V or ≥ V _{DD} - 0.2V | IND. | 15 | — | mA |
| | | | A2 | 20 | — | mA |
| | | | A3 | — | 30 | mA |

Notes:

- The MODE pin has an internal pullup. This pin may be a No Connect, tied to GND, or tied to V_{DD}.
- The MODE pin should be tied to V_{DD} or GND. It exhibits ±10 μA maximum leakage current when tied to ≤ GND + 0.2V or ≥ V_{DD} - 0.2V.

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.

3.3V I/O AC TEST CONDITIONS

| 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 |

3.3V I/O OUTPUT LOAD EQUIVALENT

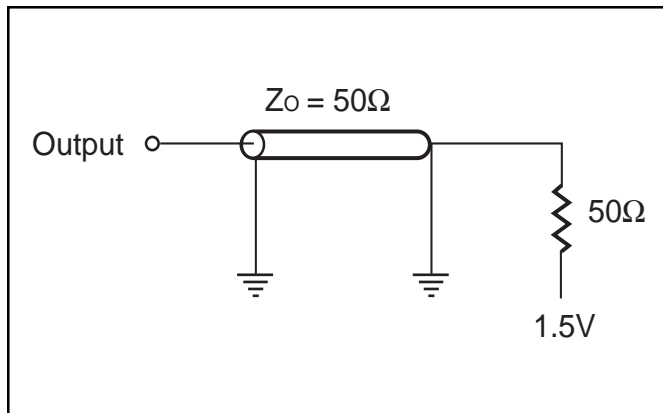


Figure 1

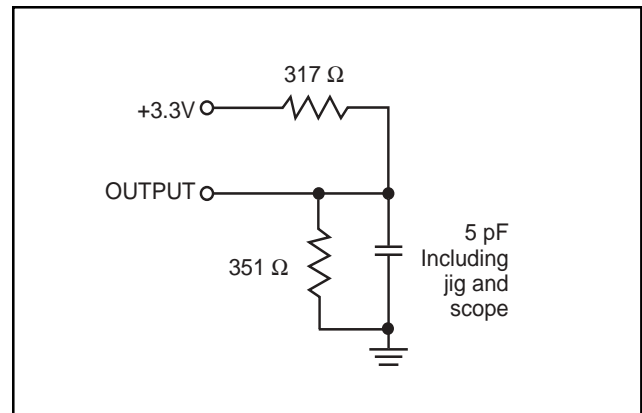


Figure 2

2.5V I/O AC TEST CONDITIONS

| Parameter | Unit |
|---|---------------------|
| Input Pulse Level | 0V to 2.5V |
| Input Rise and Fall Times | 1ns |
| Input and Output Timing and Reference Level | 1.25V |
| Output Load | See Figures 3 and 4 |

2.5V I/O OUTPUT LOAD EQUIVALENT

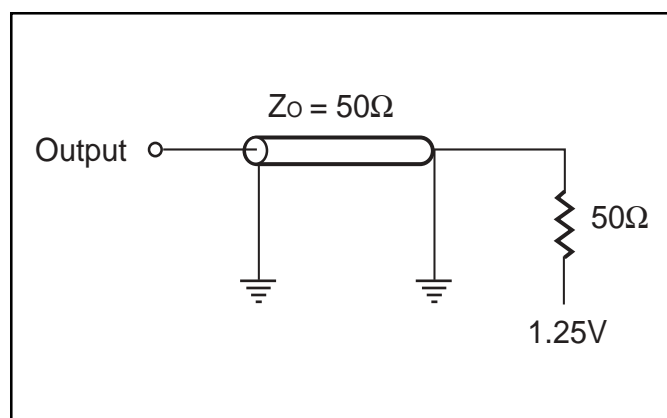


Figure 3

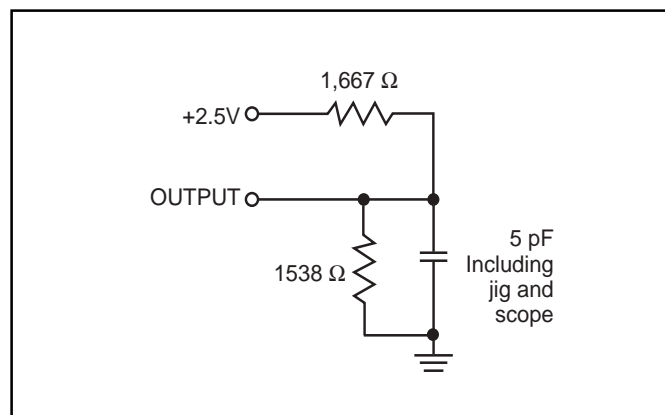


Figure 4

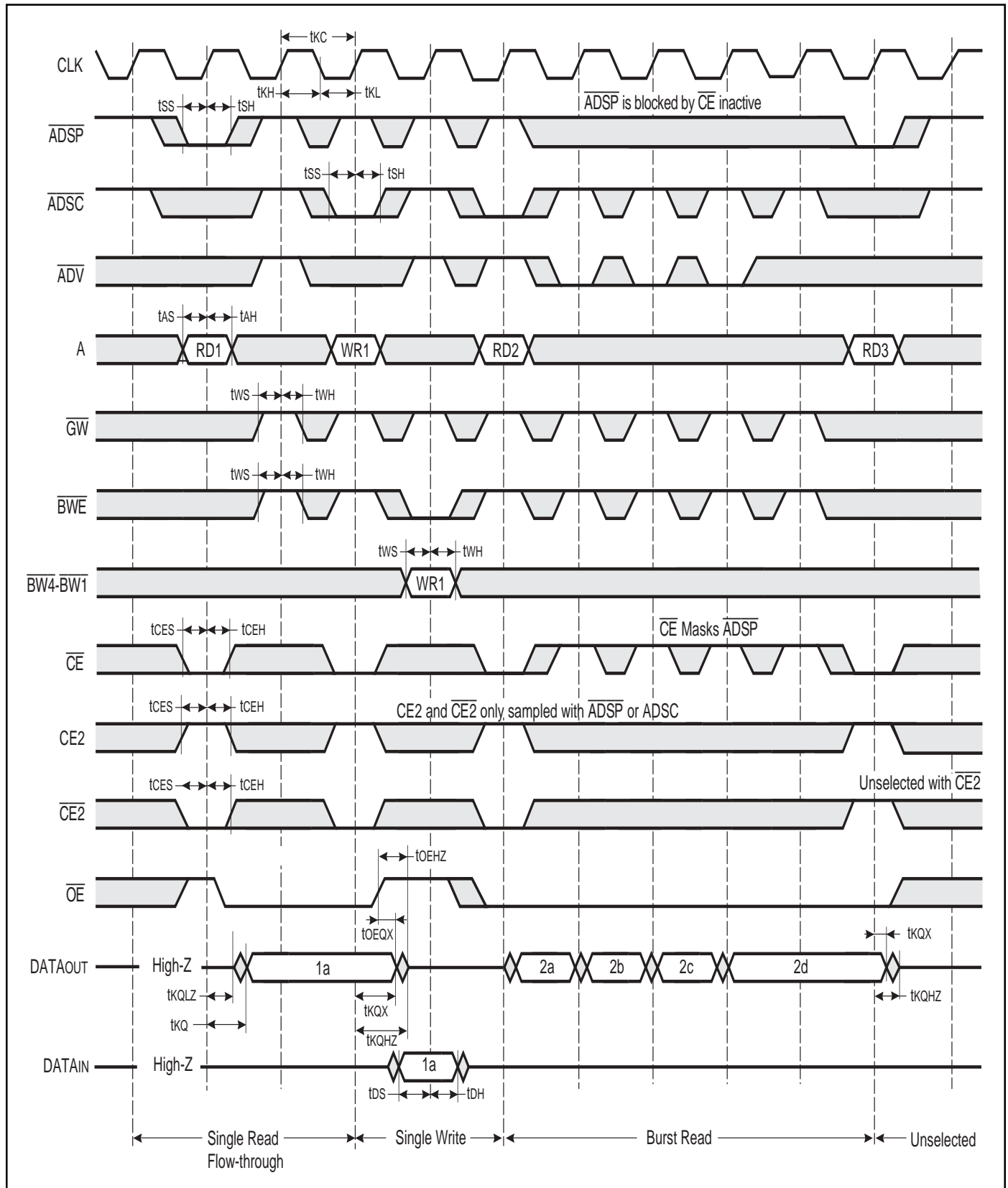
READ/WRITE CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

| Symbol | Parameter | 8.5 | | 10 | | Unit |
|------------------------------------|---------------------------------|------|------|------|------|------|
| | | Min. | Max. | Min. | Max. | |
| f _{MAX} ⁽³⁾ | Clock Frequency | — | 90 | — | 66 | MHz |
| t _{CC} ⁽³⁾ | Cycle Time | 11 | — | 15 | — | ns |
| t _{KH} | Clock High Time | 4.5 | — | 4.5 | — | ns |
| t _{KL} ⁽³⁾ | Clock Low Time | 4.5 | — | 4.5 | — | ns |
| t _{KQ} ⁽³⁾ | Clock Access Time | — | 8.5 | — | 10 | ns |
| t _{KQX} ⁽¹⁾ | Clock High to Output Invalid | 2 | — | 2 | — | ns |
| t _{KQLZ} ^(1,2) | Clock High to Output Low-Z | 0 | — | 0 | — | ns |
| t _{KQHZ} ^(1,2) | Clock High to Output High-Z | 2 | 3.5 | 2 | 3.5 | ns |
| t _{OEQ} ⁽³⁾ | Output Enable to Output Valid | — | 4.0 | — | 4.0 | ns |
| t _{OEZ} ^(1,2) | Output Enable to Output Low-Z | 0 | — | 0 | — | ns |
| t _{OEZH} ^(1,2) | Output Disable to Output High-Z | — | 5.0 | — | 5.0 | ns |
| t _{AS} ⁽³⁾ | Address Setup Time | 2 | — | 2 | — | ns |
| t _{SS} ⁽³⁾ | Address Status Setup Time | 2 | — | 2 | — | ns |
| t _{WS} ⁽³⁾ | Write Setup Time | 2 | — | 2 | — | ns |
| t _{CES} ⁽³⁾ | Chip Enable Setup Time | 2 | — | 2 | — | ns |
| t _{AVS} ⁽³⁾ | Address Advance Setup Time | 2 | — | 2 | — | ns |
| t _{AH} ⁽³⁾ | Address Hold Time | 1 | — | 1 | — | ns |
| t _{SH} ⁽³⁾ | Address Status Hold Time | 0.5 | — | 0.5 | — | ns |
| t _{WH} ⁽³⁾ | Write Hold Time | 0.5 | — | 0.5 | — | ns |
| t _{CEH} ⁽³⁾ | Chip Enable Hold Time | 0.5 | — | 0.5 | — | ns |
| t _{AVH} ⁽³⁾ | Address Advance Hold Time | 0.5 | — | 0.5 | — | ns |

Notes:

1. Guaranteed but not 100% tested. This parameter is periodically sampled.
2. Tested with load in Figure 2.
3. Tested with load in Figure 1.

READ/WRITE CYCLE TIMING



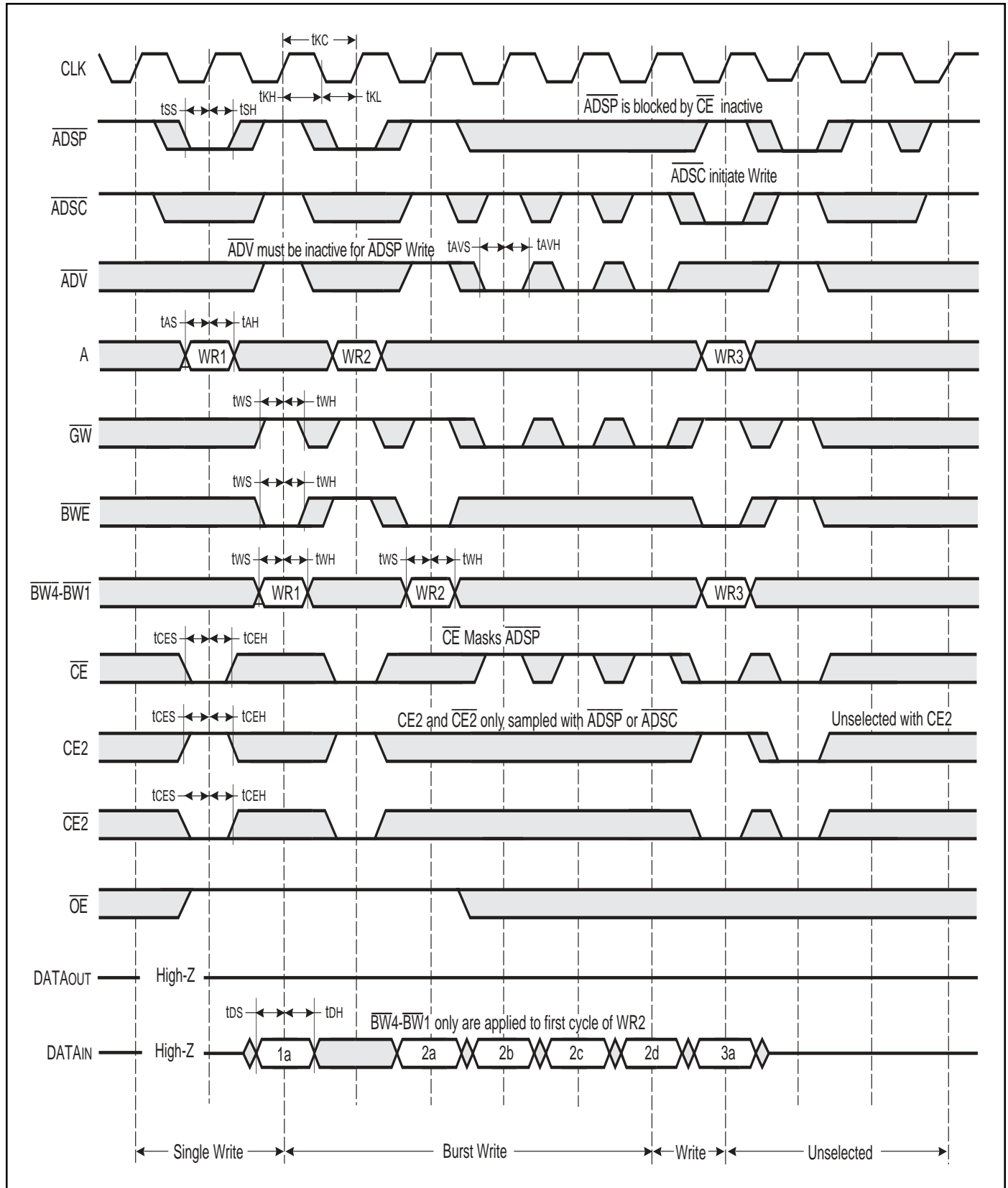
WRITE CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

| Symbol | Parameter | 8.5 | | 10 | | Unit |
|---------------------------------|----------------------------|------|------|------|------|------|
| | | Min. | Max. | Min. | Max. | |
| t _{CC} ⁽¹⁾ | Cycle Time | 11 | — | 15 | — | ns |
| t _{CH} ⁽¹⁾ | Clock High Time | 4.5 | — | 4.5 | — | ns |
| t _{CL} ⁽¹⁾ | Clock Low Time | 4.5 | — | 4.5 | — | ns |
| t _{AS} ⁽¹⁾ | Address Setup Time | 2 | — | 2 | — | ns |
| t _{SS} ⁽¹⁾ | Address Status Setup Time | 2 | — | 2 | — | ns |
| t _{WS} ⁽¹⁾ | Write Setup Time | 2 | — | 2 | — | ns |
| t _{DS} ⁽¹⁾ | Data In Setup Time | 3 | — | 3 | — | ns |
| t _{CEs} ⁽¹⁾ | Chip Enable Setup Time | 2 | — | 2 | — | ns |
| t _{AVS} ⁽¹⁾ | Address Advance Setup Time | 2 | — | 2 | — | ns |
| t _{AH} ⁽¹⁾ | Address Hold Time | 1 | — | 1 | — | ns |
| t _{SH} ⁽¹⁾ | Address Status Hold Time | 0.5 | — | 0.5 | — | ns |
| t _{DH} ⁽¹⁾ | Data In Hold Time | 1 | — | 1 | — | ns |
| t _{WH} ⁽¹⁾ | Write Hold Time | 0.5 | — | 0.5 | — | ns |
| t _{CEH} ⁽¹⁾ | Chip Enable Hold Time | 0.5 | — | 0.5 | — | ns |
| t _{AVH} ⁽¹⁾ | Address Advance Hold Time | 0.5 | — | 0.5 | — | ns |

Notes:

1. Tested with load in Figure 1.

WRITE CYCLE TIMING



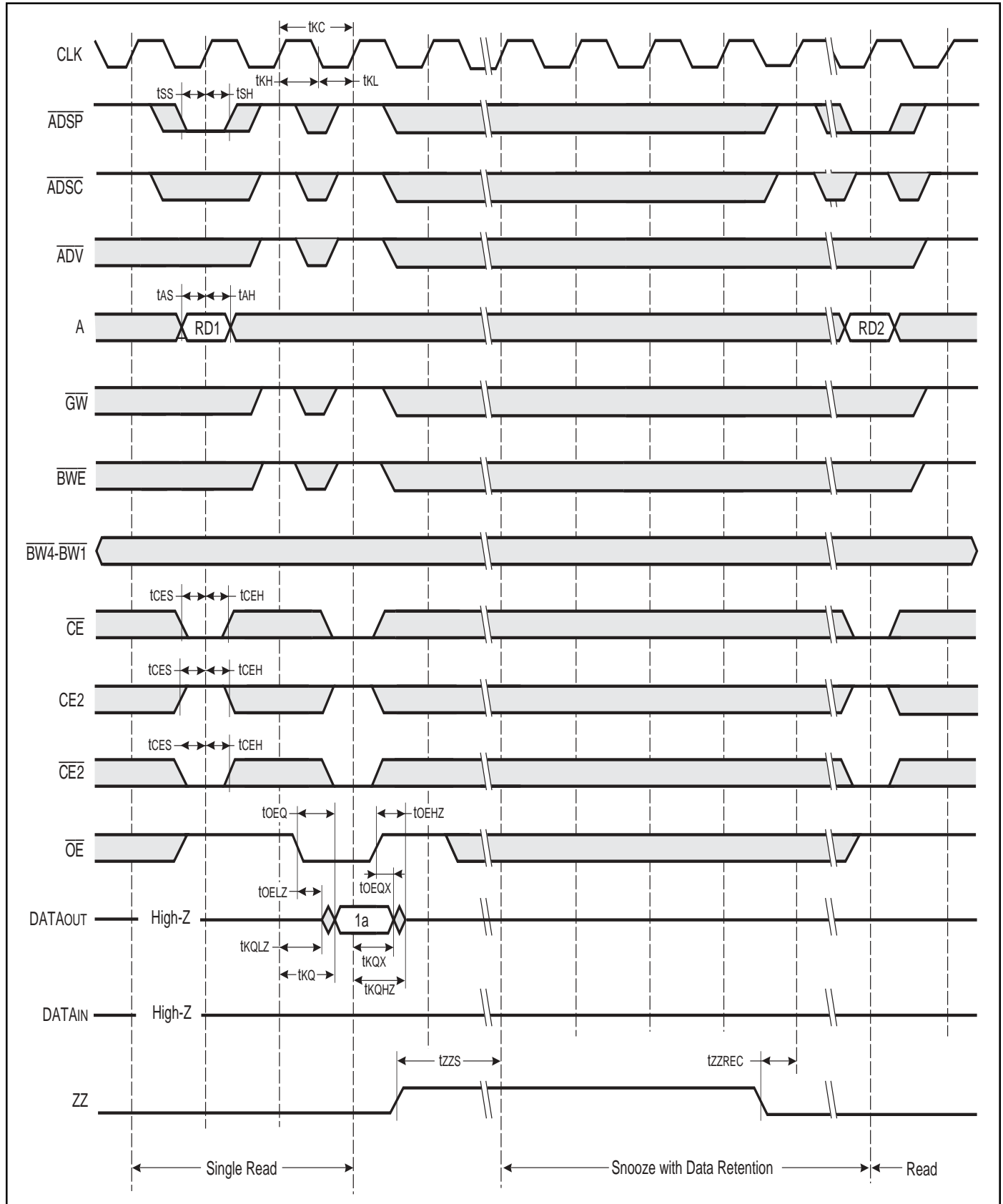
SNOOZE AND RECOVERY CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

| Symbol | Parameter | 8.5 | | 10 | | Unit |
|------------------------|---------------------------------|------|------|------|------|------|
| | | Min. | Max. | Min. | Max. | |
| tkC ⁽³⁾ | Cycle Time | 11 | — | 15 | — | ns |
| tkH ⁽³⁾ | Clock High Time | 4.5 | — | 4.5 | — | ns |
| tkL ⁽³⁾ | Clock Low Time | 4.5 | — | 4.5 | — | ns |
| tkQ ⁽³⁾ | Clock Access Time | — | 8.5 | — | 10 | ns |
| tkQX ⁽¹⁾ | Clock High to Output Invalid | 2 | — | 2 | — | ns |
| tkQLZ ^(1,2) | Clock High to Output Low-Z | 0 | — | 0 | — | ns |
| tkQHZ ^(1,2) | Clock High to Output High-Z | 2 | 3.5 | 2 | 3.5 | ns |
| toEQ ⁽³⁾ | Output Enable to Output Valid | — | 4.0 | — | 4.0 | ns |
| toELZ ^(1,2) | Output Enable to Output Low-Z | 0 | — | 0 | — | ns |
| toEHZ ^(1,2) | Output Disable to Output High-Z | — | 5.0 | — | 5.0 | ns |
| tAS ⁽³⁾ | Address Setup Time | 2 | — | 2 | — | ns |
| tSS ⁽³⁾ | Address Status Setup Time | 2 | — | 2 | — | ns |
| tCES ⁽³⁾ | Chip Enable Setup Time | 2 | — | 2 | — | ns |
| tAH ⁽³⁾ | Address Hold Time | 1.0 | — | 1.0 | — | ns |
| tSH ⁽³⁾ | Address Status Hold Time | 0.5 | — | 0.5 | — | ns |
| tCEH ⁽³⁾ | Chip Enable Hold Time | 0.5 | — | 0.5 | — | ns |
| tZZS | ZZ Standby | 2 | — | 2 | — | cyc |
| tZZREC | ZZ Recovery | 2 | — | 2 | — | cyc |

Notes:

1. Guaranteed but not 100% tested. This parameter is periodically sampled.
2. Tested with load in Figure 2.
3. Tested with load in Figure 1.

SNOOZE AND RECOVERY CYCLE TIMING



ORDERING INFORMATION (IS61LF6432A, IS61LF6436A)

3.3V I/O OR 2.5V I/O

Industrial Range: -40°C TO +85°C

| Speed (ns) | Order Part No. | Package |
|------------|--------------------|---------|
| 8.5 | IS61LF6432A-8.5TQI | TQFP |
| 8.5 | IS61LF6436A-8.5TQI | TQFP |

ORDERING INFORMATION (IS64LF6432, IS64LF6436)

3.3V I/O OR 2.5V I/O

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

| Speed (ns) | Order Part No. | Package |
|------------|--------------------|---------|
| 8.5 | IS64LF6432-8.5TQA2 | TQFP |
| 8.5 | IS64LF6436-8.5TQA2 | TQFP |

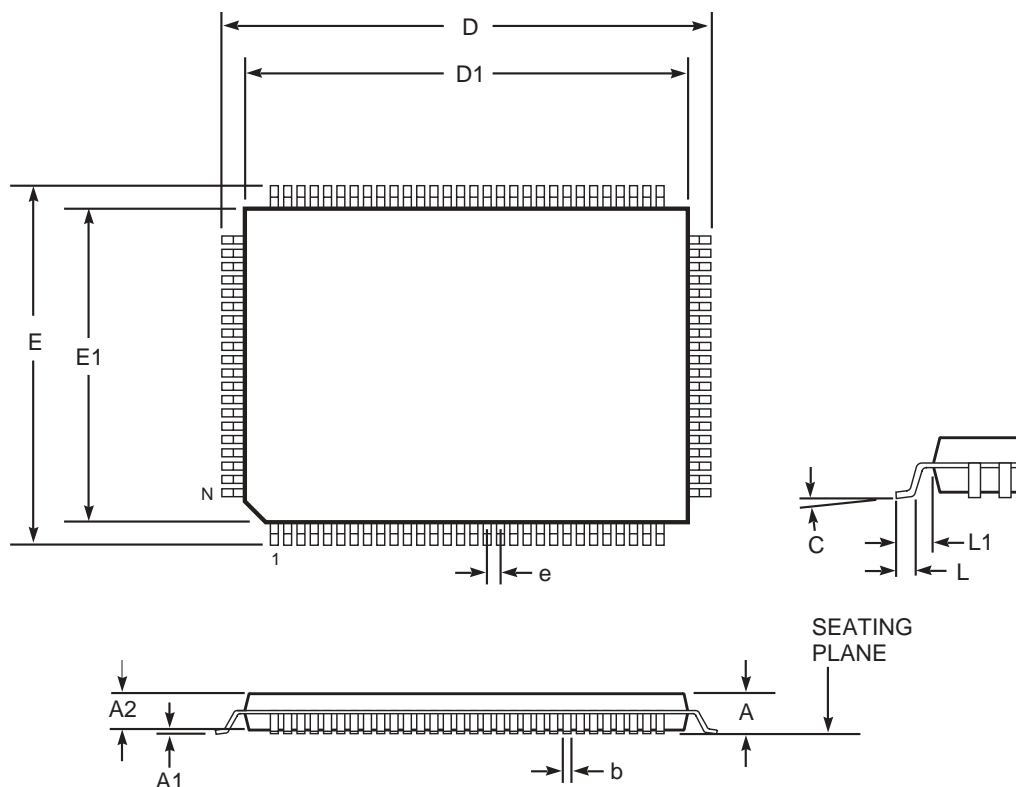
Temperature Range (A3): -40°C to +125°C

| Speed (ns) | Order Part No. | Package |
|------------|-------------------|---------|
| 10 | IS64LF6432-10TQA3 | TQFP |
| 10 | IS64LF6436-10TQA3 | TQFP |

PACKAGING INFORMATION

TQFP (Thin Quad Flat Pack Package)

Package Code: TQ



| Thin Quad Flat Pack (TQ) | | | | | | | | | |
|--------------------------|-------------|-------|------------|-------|-----------|-------------|------------|--------|-----|
| Symbol | Millimeters | | Inches | | Symbol | Millimeters | | Inches | |
| | Min | Max | Min | Max | | Min | Max | Min | Max |
| Ref. Std. | | | | | | | | | |
| No. Leads (N) | 100 | | | | 128 | | | | |
| A | — | 1.60 | — | 0.063 | — | 1.60 | — | 0.063 | |
| A1 | 0.05 | 0.15 | 0.002 | 0.006 | 0.05 | 0.15 | 0.002 | 0.006 | |
| A2 | 1.35 | 1.45 | 0.053 | 0.057 | 1.35 | 1.45 | 0.053 | 0.057 | |
| b | 0.22 | 0.38 | 0.009 | 0.015 | 0.17 | 0.27 | 0.007 | 0.011 | |
| D | 21.90 | 22.10 | 0.862 | 0.870 | 21.80 | 22.20 | 0.858 | 0.874 | |
| D1 | 19.90 | 20.10 | 0.783 | 0.791 | 19.90 | 20.10 | 0.783 | 0.791 | |
| E | 15.90 | 16.10 | 0.626 | 0.634 | 15.80 | 16.20 | 0.622 | 0.638 | |
| E1 | 13.90 | 14.10 | 0.547 | 0.555 | 13.90 | 14.10 | 0.547 | 0.555 | |
| e | 0.65 BSC | | 0.026 BSC | | 0.50 BSC | | 0.020 BSC | | |
| L | 0.45 | 0.75 | 0.018 | 0.030 | 0.45 | 0.75 | 0.018 | 0.030 | |
| L1 | 1.00 REF. | | 0.039 REF. | | 1.00 REF. | | 0.039 REF. | | |
| C | 0° | 7° | 0° | 7° | 0° | 7° | 0° | 7° | |

Notes:

1. All dimensioning and tolerancing conforms to ANSI Y14.5M-1982.
2. Dimensions D1 and E1 do not include mold protrusions. Allowable protrusion is 0.25 mm per side. D1 and E1 do include mold mismatch and are determined at datum plane -H-.
3. Controlling dimension: millimeters.