

# 1M x 36, 2M x 18 36Mb SYNCHRONOUS FLOW-THROUGH STATIC RAM

APRIL 2008

## FEATURES

- Internal self-timed write cycle
- Individual Byte Write Control and Global Write
- Clock controlled, registered address, data and control
- Burst sequence control using MODE input
- Three chip enable option for simple depth expansion and address pipelining
- Common data inputs and data outputs
- Auto Power-down during deselect
- Single cycle deselect
- Snooze MODE for reduced-power standby
- Power Supply  
LF:  $V_{DD} \ 3.3V \pm 5\%$ ,  $V_{DDQ} \ 3.3V/2.5V \pm 5\%$   
VF:  $V_{DD} \ 2.5V \pm 5\%$ ,  $V_{DDQ} \ 2.5V \pm 5\%$
- JEDEC 100-Pin TQFP and 165-pin PBGA packages.
- Lead-free available

## DESCRIPTION

The *ISSI* IS61LF/VF102436A and IS61LF/VF204818A are high-speed, low-power synchronous static RAMs designed to provide burstable, high-performance memory for communication and networking applications. The IS61LF/VF102436A is organized as 1,048,476 words by 36 bits. The IS61LF/VF204818A is organized as 2M-words by 18 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 one to four bytes wide as controlled by the write control inputs.

Separate byte enables allow individual bytes to be written. Byte write operation is performed by using byte write enable ( $\overline{BWE}$ ) input combined with one or more individual byte write signals ( $\overline{BWx}$ ). In addition, Global Write ( $\overline{GW}$ ) is available for writing all bytes at one time, regardless of the byte write controls.

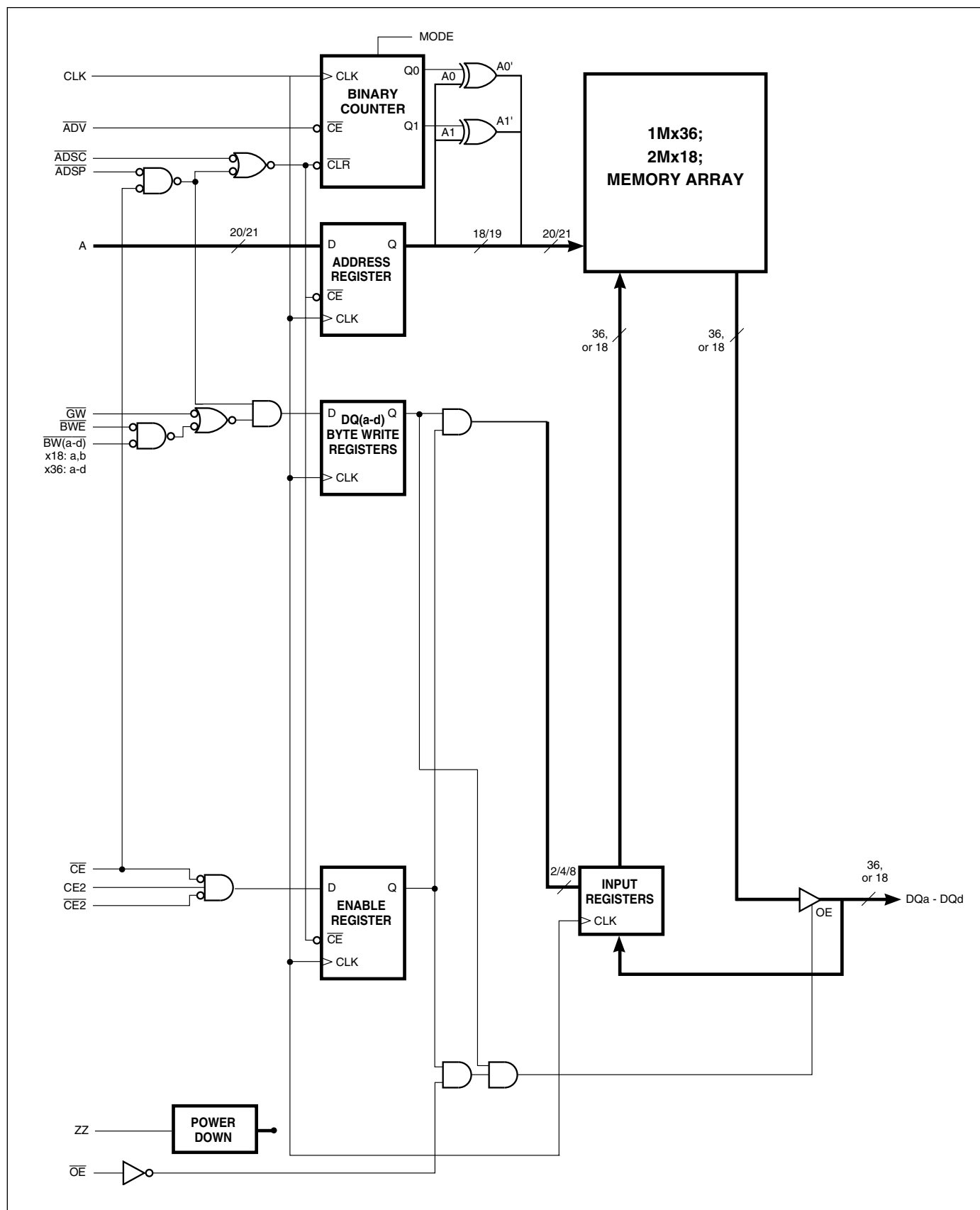
Bursts can be initiated with either  $\overline{ADSP}$  (Address Status Processor) or  $\overline{ADSC}$  (Address Status Cache Controller) input pins. Subsequent burst addresses can be generated internally and controlled by the  $\overline{ADV}$  (burst address advance) input pin.

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

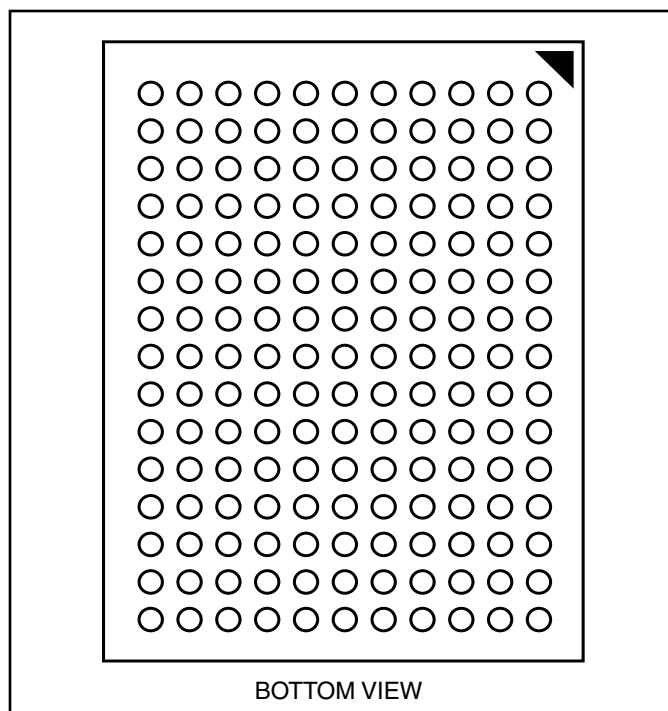
| Symbol          | Parameter         | -6.5 | -7.5 | Units |
|-----------------|-------------------|------|------|-------|
| t <sub>KQ</sub> | Clock Access Time | 6.5  | 7.5  | ns    |
| t <sub>KC</sub> | Cycle Time        | 7.5  | 8.5  | ns    |
|                 | Frequency         | 133  | 117  | MHz   |

## BLOCK DIAGRAM



**165-PIN BGA**

165-Ball, 13x15 mm BGA



## 165 PBGA PACKAGE PIN CONFIGURATION

1M x 36 (TOP VIEW)

|          | 1    | 2   | 3                | 4                | 5                | 6                | 7                | 8                 | 9                 | 10  | 11   |
|----------|------|-----|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-----|------|
| <b>A</b> | NC   | A   | $\overline{CE}$  | $\overline{BWc}$ | $\overline{BWb}$ | $\overline{CE2}$ | $\overline{BWE}$ | $\overline{ADSC}$ | $\overline{ADV}$  | A   | NC   |
| <b>B</b> | NC   | A   | CE2              | $\overline{BWd}$ | $\overline{BWa}$ | CLK              | $\overline{GW}$  | $\overline{OE}$   | $\overline{ADSP}$ | A   | NC   |
| <b>C</b> | DQPc | NC  | V <sub>DDQ</sub> | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>   | V <sub>DDQ</sub>  | NC  | DQPb |
| <b>D</b> | DQc  | DQc | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQb | DQb  |
| <b>E</b> | DQc  | DQc | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQb | DQb  |
| <b>F</b> | DQc  | DQc | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQb | DQb  |
| <b>G</b> | DQc  | DQc | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQb | DQb  |
| <b>H</b> | NC   | NC  | NC               | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | NC                | NC  | ZZ   |
| <b>J</b> | DQd  | DQd | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQa | DQa  |
| <b>K</b> | DQd  | DQd | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQa | DQa  |
| <b>L</b> | DQd  | DQd | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQa | DQa  |
| <b>M</b> | DQd  | DQd | V <sub>DDQ</sub> | V <sub>DD</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>SS</sub>  | V <sub>DD</sub>   | V <sub>DDQ</sub>  | DQa | DQa  |
| <b>N</b> | DQPd | NC  | V <sub>DDQ</sub> | V <sub>SS</sub>  | NC               | A                | NC               | V <sub>SS</sub>   | V <sub>DDQ</sub>  | NC  | DQPa |
| <b>P</b> | NC   | NC  | A                | A                | NC               | A1*              | NC               | A                 | A                 | A   | A    |
| <b>R</b> | MODE | A   | A                | A                | NC               | A0*              | NC               | A                 | A                 | A   | A    |

**Note:** \* A<sub>0</sub> and A<sub>1</sub> are the two least significant bits (LSB) of the address field and set the internal burst counter if burst is desired.  
(Under Evaluation)

## PIN DESCRIPTIONS

| Symbol                                   | Pin Name                           |
|------------------------------------------|------------------------------------|
| A                                        | Address Inputs                     |
| A0, A1                                   | Synchronous Burst Address Inputs   |
| $\overline{ADV}$                         | Synchronous Burst Address Advance. |
| $\overline{ADSP}$                        | Address Status Processor           |
| $\overline{ADSC}$                        | Address Status Controller          |
| $\overline{GW}$                          | Global Write Enable                |
| CLK                                      | Synchronous Clock                  |
| $\overline{CE}$ , $\overline{CE2}$ , CE2 | Synchronous Chip Select            |
| $\overline{BWx}$ (x=a,b,c,d)             | Synchronous Byte Write Controls    |

| Symbol           | Pin Name                 |
|------------------|--------------------------|
| $\overline{BWE}$ | Byte Write Enable        |
| $\overline{OE}$  | Output Enable            |
| ZZ               | Power Sleep Mode         |
| MODE             | Burst Sequence Selection |
| NC               | No Connect               |
| DQa-DQd          | Data Inputs/Outputs      |
| DQPa-Pd          | Data Inputs/Outputs      |
| V <sub>DD</sub>  | Power Supply             |
| V <sub>DDQ</sub> | Output Power Supply      |
| V <sub>SS</sub>  | Ground                   |

**165 PBGA PACKAGE PIN CONFIGURATION**  
2M x 18 (TOP VIEW)

|          | 1    | 2   | 3               | 4   | 5                | 6   | 7                | 8                 | 9                 | 10  | 11   |
|----------|------|-----|-----------------|-----|------------------|-----|------------------|-------------------|-------------------|-----|------|
| <b>A</b> | NC   | A   | $\overline{CE}$ | BWb | NC               | CE2 | $\overline{BWE}$ | $\overline{ADSC}$ | $\overline{ADV}$  | A   | A    |
| <b>B</b> | NC   | A   | CE2             | NC  | $\overline{BWA}$ | CLK | $\overline{GW}$  | $\overline{OE}$   | $\overline{ADSP}$ | A   | NC   |
| <b>C</b> | NC   | NC  | VDDQ            | VSS | VSS              | VSS | VSS              | VSS               | VDDQ              | NC  | DQPa |
| <b>D</b> | NC   | DQb | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | NC  | DQa  |
| <b>E</b> | NC   | DQb | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | NC  | DQa  |
| <b>F</b> | NC   | DQb | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | NC  | DQa  |
| <b>G</b> | NC   | DQb | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | NC  | DQa  |
| <b>H</b> | NC   | NC  | NC              | VDD | VSS              | VSS | VSS              | VDD               | NC                | NC  | ZZ   |
| <b>J</b> | DQb  | NC  | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | DQa | NC   |
| <b>K</b> | DQb  | NC  | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | DQa | NC   |
| <b>L</b> | DQb  | NC  | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | DQa | NC   |
| <b>M</b> | DQb  | NC  | VDDQ            | VDD | VSS              | VSS | VSS              | VDD               | VDDQ              | DQa | NC   |
| <b>N</b> | DQPa | NC  | VDDQ            | VSS | NC               | A   | NC               | VSS               | VDDQ              | NC  | NC   |
| <b>P</b> | NC   | NC  | A               | A   | NC               | A1* | NC               | A                 | A                 | A   | A    |
| <b>R</b> | MODE | A   | A               | A   | NC               | A0* | NC               | A                 | A                 | A   | A    |

**Note:** \* A0 and A1 are the two least significant bits (LSB) of the address field and set the internal burst counter if burst is desired.  
(Under Evaluation)

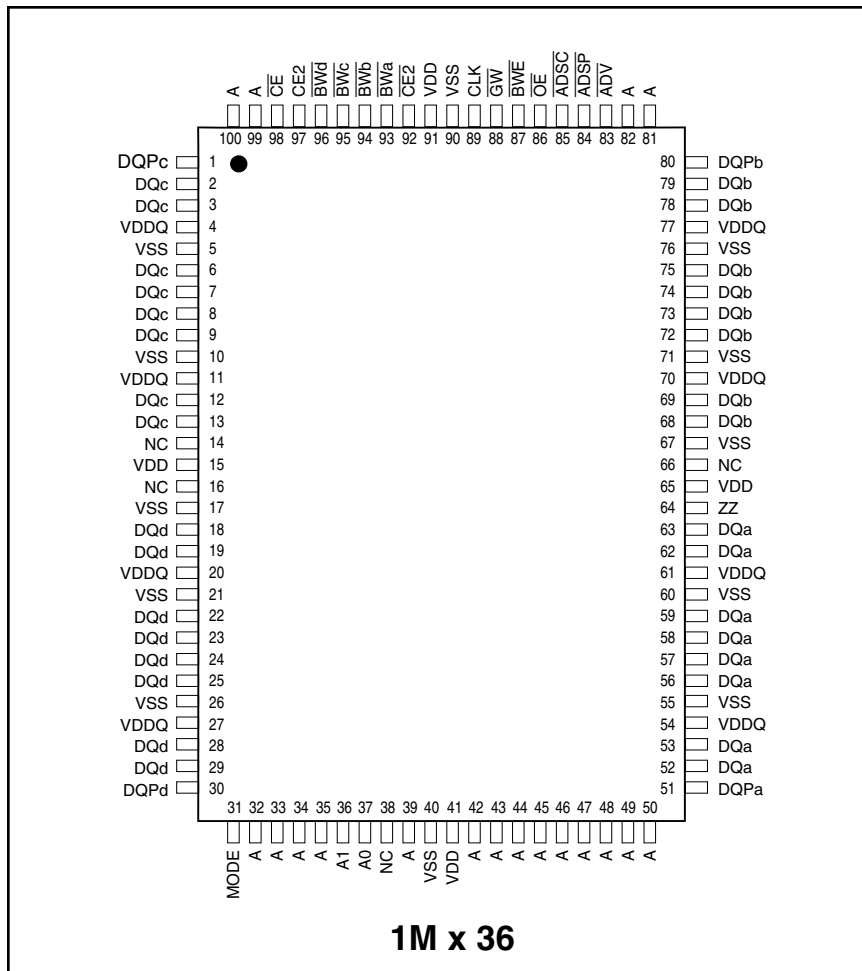
**PIN DESCRIPTIONS**

| Symbol                                   | Pin Name                           |
|------------------------------------------|------------------------------------|
| A                                        | Address Inputs                     |
| A0, A1                                   | Synchronous Burst Address Inputs   |
| $\overline{ADV}$                         | Synchronous Burst Address Advance. |
| $\overline{ADSP}$                        | Address Status Processor           |
| $\overline{ADSC}$                        | Address Status Controller          |
| $\overline{GW}$                          | Global Write Enable                |
| CLK                                      | Synchronous Clock                  |
| $\overline{CE}$ , $\overline{CE2}$ , CE2 | Synchronous Chip Select            |
| BWx (x=a,b)                              | Synchronous Byte Write Controls    |

| Symbol           | Pin Name                 |
|------------------|--------------------------|
| $\overline{BWE}$ | Byte Write Enable        |
| $\overline{OE}$  | Output Enable            |
| ZZ               | Power Sleep Mode         |
| MODE             | Burst Sequence Selection |
| NC               | No Connect               |
| DQa-DQd          | Data Inputs/Outputs      |
| DQPa-Pd          | Data Inputs/Outputs      |
| VDD              | Power Supply             |
| VDDQ             | Output Power Supply      |
| VSS              | Ground                   |

## PIN CONFIGURATION

### 100-Pin TQFP



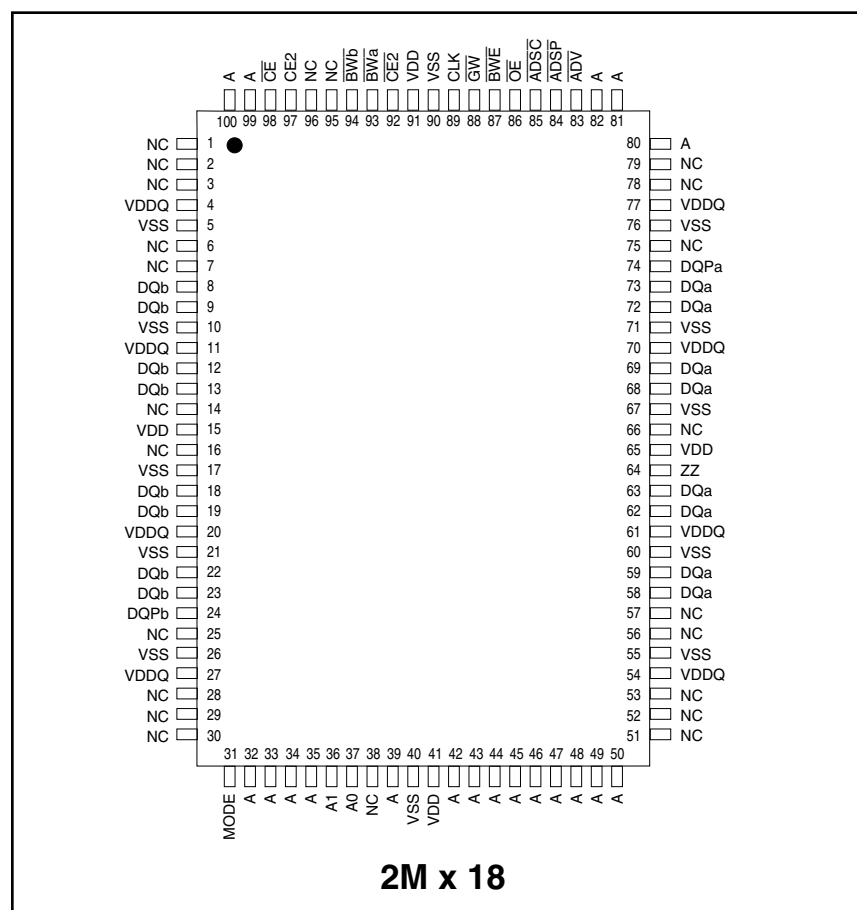
## PIN DESCRIPTIONS

|                                  |                                                                                      |
|----------------------------------|--------------------------------------------------------------------------------------|
| A0, A1                           | Synchronous Address Inputs. These pins must tied to the two LSBs of the address bus. |
| A                                | Synchronous Address Inputs                                                           |
| ADSC                             | Synchronous Controller Address Status                                                |
| ADSP                             | Synchronous Processor Address Status                                                 |
| ADV                              | Synchronous Burst Address Advance                                                    |
| BW <sub>a</sub> -BW <sub>d</sub> | Synchronous Byte Write Enable                                                        |
| BWE                              | Synchronous Byte Write Enable                                                        |
| CE, CE2, CE2                     | Synchronous Chip Enable                                                              |
| CLK                              | Synchronous Clock                                                                    |
| DQa-DQd                          | Synchronous Data Input/Output                                                        |

|           |                                             |
|-----------|---------------------------------------------|
| DQPa-DQPd | Parity Data Input/Output                    |
| Vss       | Ground                                      |
| GW        | Synchronous Global Write Enable             |
| MODE      | Burst Sequence Mode Selection               |
| OE        | Output Enable                               |
| VDD       | 3.3V/2.5V Power Supply                      |
| VDDQ      | Isolated Output Buffer Supply:<br>3.3V/2.5V |
| ZZ        | Snooze Enable                               |

## PIN CONFIGURATION

## 100-Pin TQFP



## PIN DESCRIPTIONS

|                                                           |                                                                                      |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------|
| A0, A1                                                    | Synchronous Address Inputs. These pins must tied to the two LSBs of the address bus. |
| A                                                         | Synchronous Address Inputs                                                           |
| $\overline{\text{ADSC}}$                                  | Synchronous Controller Address Status                                                |
| $\overline{\text{ADSP}}$                                  | Synchronous Processor Address Status                                                 |
| $\overline{\text{ADV}}$                                   | Synchronous Burst Address Advance                                                    |
| $\overline{\text{BWA-BWb}}$                               | Synchronous Byte Write Enable                                                        |
| $\overline{\text{BWE}}$                                   | Synchronous Byte Write Enable                                                        |
| $\overline{\text{CE}}, \text{CE2}, \overline{\text{CE2}}$ | Synchronous Chip Enable                                                              |
| CLK                                                       | Synchronous Clock                                                                    |
| DQa-DQb                                                   | Synchronous Data Input/Output                                                        |

|                        |                                                                       |
|------------------------|-----------------------------------------------------------------------|
| DQPa-DQPb              | Parity Data I/O; DQPa is parity for DQa1-8; DQPb is parity for DQb1-8 |
| V <sub>SS</sub>        | Ground                                                                |
| $\overline{\text{GW}}$ | Synchronous Global Write Enable                                       |
| MODE                   | Burst Sequence Mode Selection                                         |
| $\overline{\text{OE}}$ | Output Enable                                                         |
| V <sub>DD</sub>        | 3.3V/2.5V Power Supply                                                |
| V <sub>DDQ</sub>       | Isolated Output Buffer Supply:<br>3.3V/2.5V                           |
| ZZ                     | Snooze Enable                                                         |

**TRUTH TABLE<sup>(1-8)</sup> (3CE option)**

| OPERATION                   | ADDRESS  | $\overline{CE}$ | $\overline{CE2}$ | CE2 | 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 | High-Z |
| Deselect Cycle, Power-Down  | None     | L               | X                | L   | L  | L                 | X                 | X                | X                  | X               | L-H | High-Z |
| Deselect Cycle, Power-Down  | None     | L               | H                | X   | L  | L                 | X                 | X                | X                  | X               | L-H | High-Z |
| Deselect Cycle, Power-Down  | None     | L               | X                | L   | L  | H                 | L                 | X                | X                  | X               | L-H | High-Z |
| Deselect Cycle, Power-Down  | None     | L               | H                | X   | L  | H                 | L                 | X                | X                  | X               | L-H | High-Z |
| Snooze Mode, Power-Down     | None     | X               | X                | X   | H  | X                 | X                 | X                | X                  | X               | X   | High-Z |
| Read Cycle, Begin Burst     | External | L               | L                | H   | L  | L                 | X                 | X                | X                  | L               | L-H | Q      |
| Read Cycle, Begin Burst     | External | L               | L                | H   | L  | L                 | X                 | X                | X                  | H               | L-H | High-Z |
| Write Cycle, Begin Burst    | External | L               | L                | H   | L  | H                 | L                 | X                | L                  | X               | L-H | D      |
| Read Cycle, Begin Burst     | External | L               | L                | H   | L  | H                 | L                 | X                | H                  | L               | L-H | Q      |
| Read Cycle, Begin Burst     | External | L               | L                | H   | L  | H                 | L                 | X                | H                  | H               | L-H | High-Z |
| 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 | High-Z |
| 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 | High-Z |
| 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 | High-Z |
| 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 | High-Z |
| 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      |

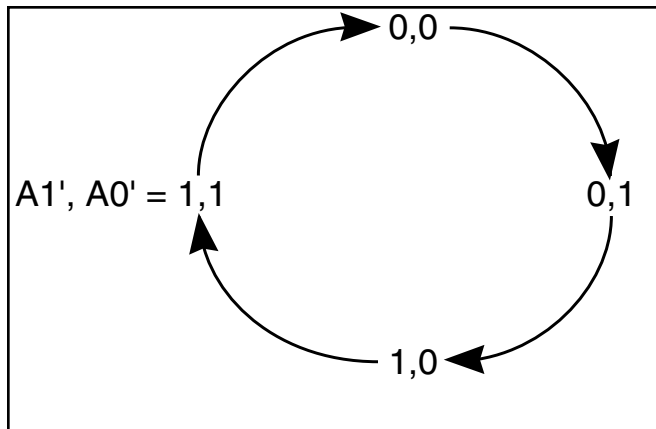
**NOTE:**

1. X means "Don't Care." H means logic HIGH. L means logic LOW.
2. For  $\overline{WRITE}$ , L means one or more byte write enable signals ( $\overline{BWA-h}$ ) and  $\overline{BWE}$  are LOW or  $\overline{GW}$  is LOW.  $\overline{WRITE} = H$  for all  $\overline{BWx}$ ,  $\overline{BWE}$ ,  $\overline{GW}$  HIGH.
3.  $\overline{BWA}$  enables WRITES to DQa's and DQPa.  $\overline{BWb}$  enables WRITES to DQb's and DQPb.  $\overline{BWc}$  enables WRITES to DQc's and DQPC.  $\overline{BWD}$  enables WRITES to DQd's and DQPD.  $\overline{BWE}$  enables WRITES to DQe's and DQPe.  $\overline{BWf}$  enables WRITES to DQf's and DQPF.  $\overline{BWg}$  enables WRITES to DQg's and DQPG.  $\overline{BWh}$  enables WRITES to DQh's and DQPh. DQPa-DQPh are available on the x72 version. DQPa and DQPb are available on the x18 version. DQPa-DQPD are available on the x36 version.
4. All inputs except  $\overline{OE}$  and ZZ must meet setup and hold times around the rising edge (LOW to HIGH) of CLK.
5. Wait states are inserted by suspending burst.
6. For a  $\overline{WRITE}$  operation following a  $\overline{READ}$  operation,  $\overline{OE}$  must be HIGH before the input data setup time and held HIGH during the input data hold time.
7. This device contains circuitry that will ensure the outputs will be in High-Z during power-up.
8.  $\overline{ADSP}$  LOW always initiates an internal  $\overline{READ}$  at the L-H edge of CLK. A  $\overline{WRITE}$  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 CLK. See  $\overline{WRITE}$  timing diagram for clarification.

### INTERLEAVED BURST ADDRESS TABLE (MODE = V<sub>DD</sub> or No Connect)

| External Address<br>A1 A0 | 1st Burst Address<br>A1 A0 | 2nd Burst Address<br>A1 A0 | 3rd Burst Address<br>A1 A0 |
|---------------------------|----------------------------|----------------------------|----------------------------|
| 00                        | 01                         | 10                         | 11                         |
| 01                        | 00                         | 11                         | 10                         |
| 10                        | 11                         | 00                         | 01                         |
| 11                        | 10                         | 01                         | 00                         |

### LINEAR BURST ADDRESS TABLE (MODE = V<sub>SS</sub>)



### ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                             | Parameter                                                                 | Value                          | Unit |
|------------------------------------|---------------------------------------------------------------------------|--------------------------------|------|
| T <sub>STG</sub>                   | Storage Temperature                                                       | −55 to +150                    | °C   |
| P <sub>D</sub>                     | Power Dissipation                                                         | 1.6                            | W    |
| I <sub>OUT</sub>                   | Output Current (per I/O)                                                  | 100                            | mA   |
| V <sub>IN</sub> , V <sub>OUT</sub> | Voltage Relative to V <sub>SS</sub> for I/O Pins                          | −0.5 to V <sub>DDQ</sub> + 0.5 | V    |
| V <sub>IN</sub>                    | Voltage Relative to V <sub>SS</sub> for<br>for Address and Control Inputs | −0.5 to V <sub>DD</sub> + 0.5  | V    |
| V <sub>DD</sub>                    | Voltage on V <sub>DD</sub> Supply Relative to V <sub>SS</sub>             | −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 (IS61LFxxxxx)**

| Range      | Ambient Temperature | V <sub>DD</sub> | V <sub>DDQ</sub> |
|------------|---------------------|-----------------|------------------|
| Commercial | 0°C to +70°C        | 3.3V ± 5%       | 3.3V/2.5V ± 5%   |
| Industrial | -40°C to +85°C      | 3.3V ± 5%       | 3.3V/2.5V ± 5%   |

**OPERATING RANGE (IS61VFxxxxx)**

| Range      | Ambient Temperature | V <sub>DD</sub> | V <sub>DDQ</sub> |
|------------|---------------------|-----------------|------------------|
| Commercial | 0°C to +70°C        | 2.5V ± 5%       | 2.5V ± 5%        |
| Industrial | -40°C to +85°C      | 2.5V ± 5%       | 2.5V ± 5%        |

**DC ELECTRICAL CHARACTERISTICS** (Over Operating Range)

| Symbol          | Parameter              | Test Conditions                                                              | 3.3V |                       | 2.5V |                       | Unit |
|-----------------|------------------------|------------------------------------------------------------------------------|------|-----------------------|------|-----------------------|------|
|                 |                        |                                                                              | Min. | Max.                  | Min. | Max.                  |      |
| V <sub>OH</sub> | Output HIGH Voltage    | I <sub>OH</sub> = -4.0 mA (3.3V)<br>I <sub>OH</sub> = -1.0 mA (2.5V)         | 2.4  | —                     | 2.0  | —                     | V    |
| V <sub>OL</sub> | Output LOW Voltage     | I <sub>OL</sub> = 8.0 mA (3.3V)<br>I <sub>OL</sub> = 1.0 mA (2.5V)           | —    | 0.4                   | —    | 0.4                   | V    |
| V <sub>IH</sub> | Input HIGH Voltage     |                                                                              | 2.0  | V <sub>DD</sub> + 0.3 | 1.7  | V <sub>DD</sub> + 0.3 | V    |
| V <sub>IL</sub> | Input LOW Voltage      |                                                                              | -0.3 | 0.8                   | -0.3 | 0.7                   | V    |
| I <sub>LI</sub> | Input Leakage Current  | V <sub>SS</sub> ≤ V <sub>IN</sub> ≤ V <sub>DD</sub> <sup>(1)</sup>           | -5   | 5                     | -5   | 5                     | μA   |
| I <sub>LO</sub> | Output Leakage Current | V <sub>SS</sub> ≤ V <sub>OUT</sub> ≤ V <sub>DDQ</sub> , OE = V <sub>IH</sub> | -5   | 5                     | -5   | 5                     | μA   |

**Note:**

1. V<sub>IL</sub> (min.) = -2.0V AC (pulse width 2.0 ns). Not 100% tested.  
V<sub>IH</sub> (max.) = V<sub>DD</sub> + 2.0V AC (pulse width 2.0 ns). Not 100% tested.

**POWER SUPPLY CHARACTERISTICS<sup>(1)</sup>** (Over Operating Range)

| Symbol           | Parameter                   | Test Conditions                                                                                                                                                              | Temp. range                         | 6.5<br>MAX        |            | 7.5<br>MAX        |            | Unit |
|------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------|------------|-------------------|------------|------|
|                  |                             |                                                                                                                                                                              |                                     | x18               | x36        | x18               | x36        |      |
| I <sub>CC</sub>  | AC Operating Supply Current | Device Selected,<br>OE = V <sub>IH</sub> , ZZ ≤ V <sub>IL</sub> ,<br>All Inputs ≤ 0.2V or ≥ V <sub>DD</sub> - 0.2V, typ. <sup>(2)</sup><br>Cycle Time ≥ t <sub>kc</sub> min. | Com.<br>Ind.                        | 360<br>375<br>295 | 360<br>375 | 340<br>350<br>295 | 340<br>350 | mA   |
| I <sub>SB</sub>  | Standby Current TTL Input   | Device Deselected,<br>V <sub>DD</sub> = Max.,<br>All Inputs ≤ V <sub>IL</sub> or ≥ V <sub>IH</sub> ,<br>ZZ ≤ V <sub>IL</sub> , f = Max.                                      | Com.<br>Ind.                        | 155<br>160        | 155<br>160 | 155<br>160        | 155<br>160 | mA   |
| I <sub>SBI</sub> | Standby Current CMOS Input  | Device Deselected,<br>V <sub>DD</sub> = Max.,<br>V <sub>IN</sub> ≤ V <sub>SS</sub> + 0.2V or ≥ V <sub>DD</sub> - 0.2V<br>f = 0                                               | Com.<br>Ind.<br>typ. <sup>(2)</sup> | 140<br>145<br>80  | 140<br>145 | 140<br>145<br>80  | 140<br>145 | mA   |

**Note:**

1. MODE pin has an internal pullup and should be tied to V<sub>DD</sub> or V<sub>SS</sub>. It exhibits ±100 μA maximum leakage current when tied to ≤ V<sub>SS</sub> + 0.2V or ≥ V<sub>DD</sub> - 0.2V.  
2. Typical values are measured at V<sub>CC</sub> = 3.3V, T<sub>A</sub> = 25°C and not 100% tested.

## CAPACITANCE<sup>(1,2)</sup>

| Symbol           | Parameter                | Conditions            | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 6    | pF   |
| C <sub>OUT</sub> | Input/Output Capacitance | V <sub>OUT</sub> = 0V | 8    | pF   |

### Notes:

1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T<sub>A</sub> = 25°C, f = 1 MHz, V<sub>DD</sub> = 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 |

## AC TEST LOADS

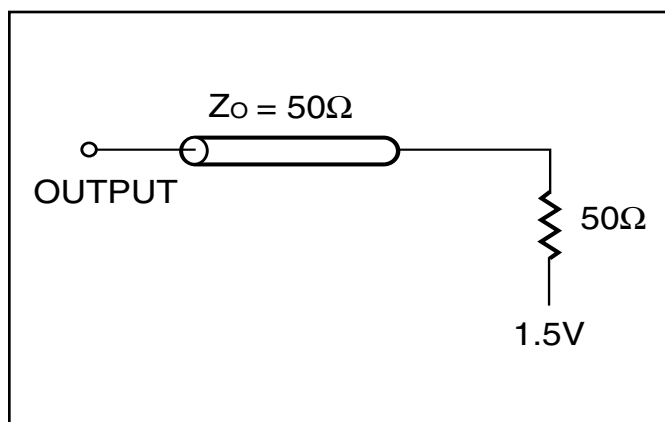


Figure 1

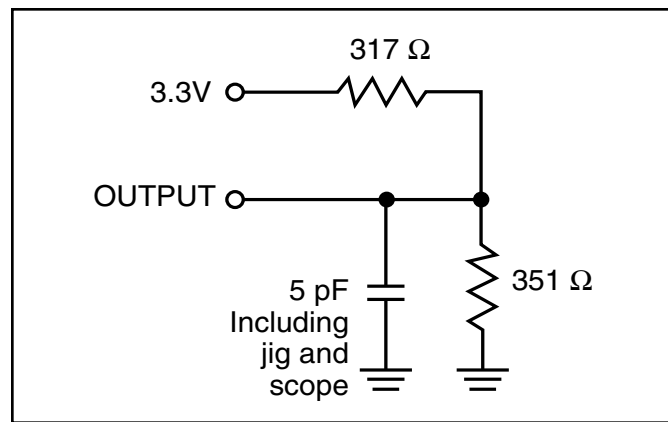


Figure 2

## 2.5V I/O AC TEST CONDITIONS

| Parameter                                   | Unit                |
|---------------------------------------------|---------------------|
| Input Pulse Level                           | 0V to 2.5V          |
| Input Rise and Fall Times                   | 1.5 ns              |
| Input and Output Timing and Reference Level | 1.25V               |
| Output Load                                 | See Figures 3 and 4 |

## 2.5V I/O OUTPUT LOAD EQUIVALENT

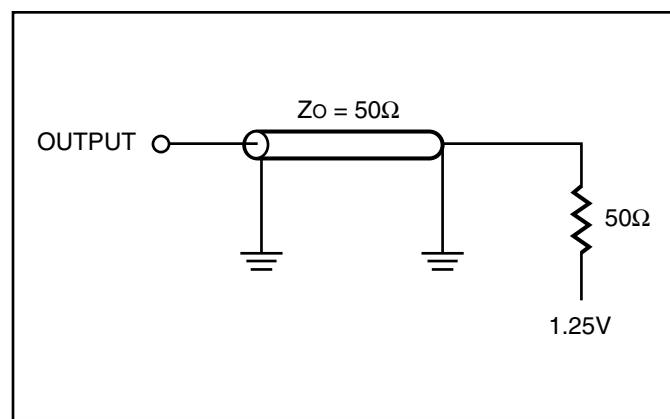


Figure 3

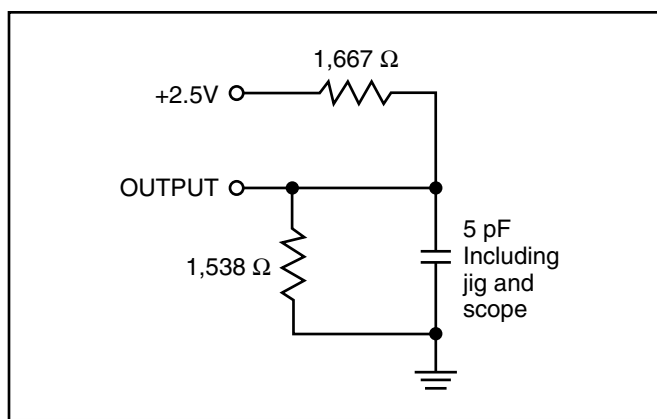


Figure 4

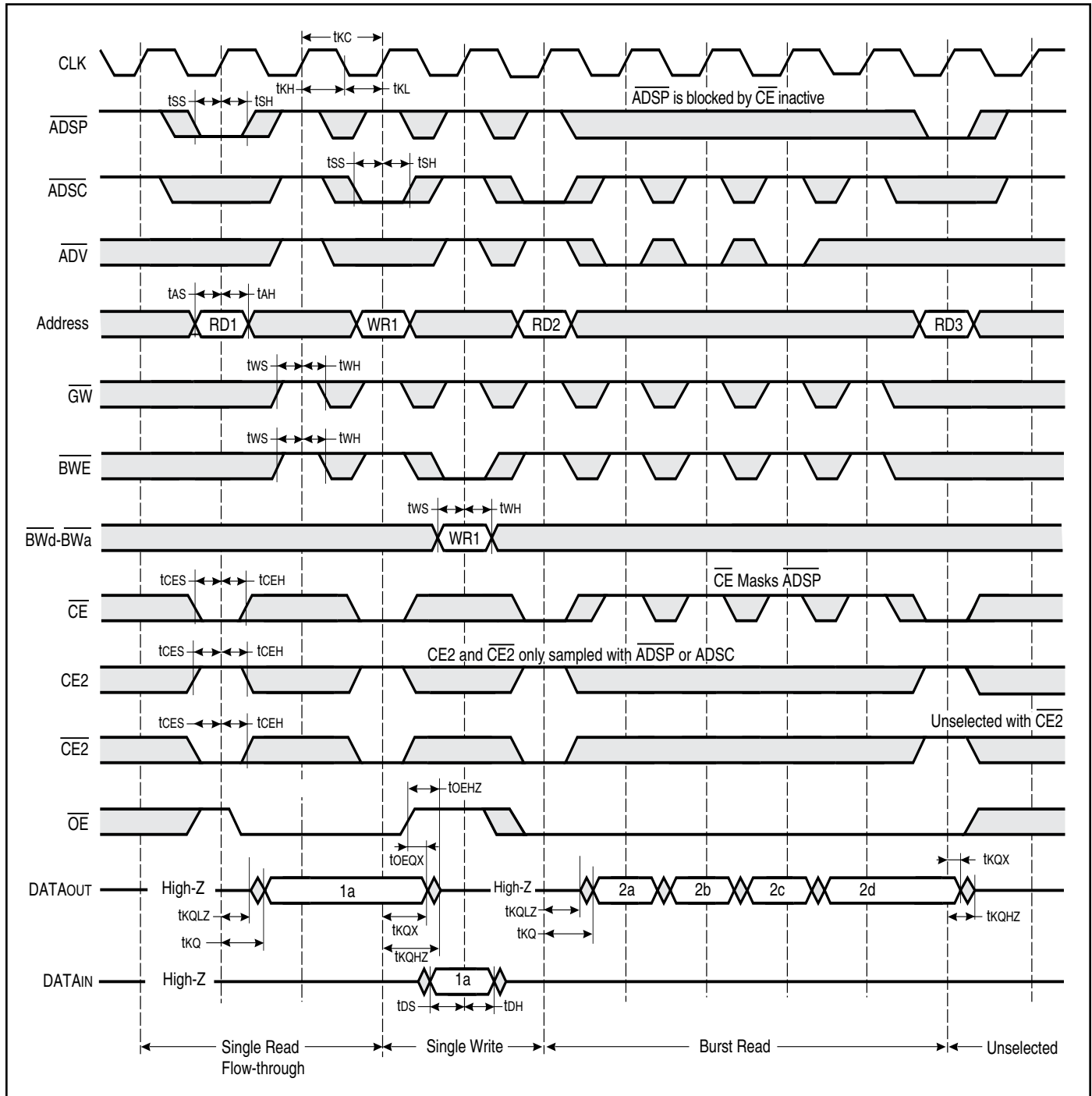
**READ/WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup>** (Over Operating Range)

| Symbol                             | Parameter                       | 6.5  |      | 7.5  |      | Unit |
|------------------------------------|---------------------------------|------|------|------|------|------|
|                                    |                                 | Min. | Max. | Min. | Max. |      |
| fmax                               | Clock Frequency                 | —    | 133  | —    | 117  | MHz  |
| t <sub>KC</sub>                    | Cycle Time                      | 7.5  | —    | 8.5  | —    | ns   |
| t <sub>KH</sub>                    | Clock High Time                 | 2.2  | —    | 2.5  | —    | ns   |
| t <sub>KL</sub>                    | Clock Low Time                  | 2.2  | —    | 2.5  | —    | ns   |
| t <sub>KQ</sub>                    | Clock Access Time               | —    | 6.5  | —    | 7.5  | ns   |
| t <sub>KQX</sub> <sup>(2)</sup>    | Clock High to Output Invalid    | 2.5  | —    | 2.5  | —    | ns   |
| t <sub>KQLZ</sub> <sup>(2,3)</sup> | Clock High to Output Low-Z      | 2.5  | —    | 2.5  | —    | ns   |
| t <sub>KQHZ</sub> <sup>(2,3)</sup> | Clock High to Output High-Z     | —    | 3.8  | —    | 4.0  | ns   |
| t <sub>OEQ</sub>                   | Output Enable to Output Valid   | —    | 3.2  | —    | 3.4  | ns   |
| t <sub>OELZ</sub> <sup>(2,3)</sup> | Output Enable to Output Low-Z   | 0    | —    | 0    | —    | ns   |
| t <sub>OEHZ</sub> <sup>(2,3)</sup> | Output Disable to Output High-Z | —    | 3.5  | —    | 3.5  | ns   |
| t <sub>AS</sub>                    | Address Setup Time              | 1.5  | —    | 1.5  | —    | ns   |
| t <sub>WS</sub>                    | Read/Write Setup Time           | 1.5  | —    | 1.5  | —    | ns   |
| t <sub>CES</sub>                   | Chip Enable Setup Time          | 1.5  | —    | 1.5  | —    | ns   |
| t <sub>AVS</sub>                   | Address Advance Setup Time      | 1.5  | —    | 1.5  | —    | ns   |
| t <sub>DS</sub>                    | Data Setup Time                 | 1.5  | —    | 1.5  | —    | ns   |
| t <sub>AH</sub>                    | Address Hold Time               | 0.5  | —    | 0.5  | —    | ns   |
| t <sub>WH</sub>                    | Write Hold Time                 | 0.5  | —    | 0.5  | —    | ns   |
| t <sub>CEH</sub>                   | Chip Enable Hold Time           | 0.5  | —    | 0.5  | —    | ns   |
| t <sub>AVH</sub>                   | Address Advance Hold Time       | 0.5  | —    | 0.5  | —    | ns   |
| t <sub>DH</sub>                    | Data Hold Time                  | 0.5  | —    | 0.5  | —    | ns   |
| t <sub>PDS</sub>                   | ZZ High to Power Down           | —    | 2    | —    | 2    | cyc  |
| t <sub>PUS</sub>                   | ZZ Low to Power Down            | —    | 2    | —    | 2    | cyc  |

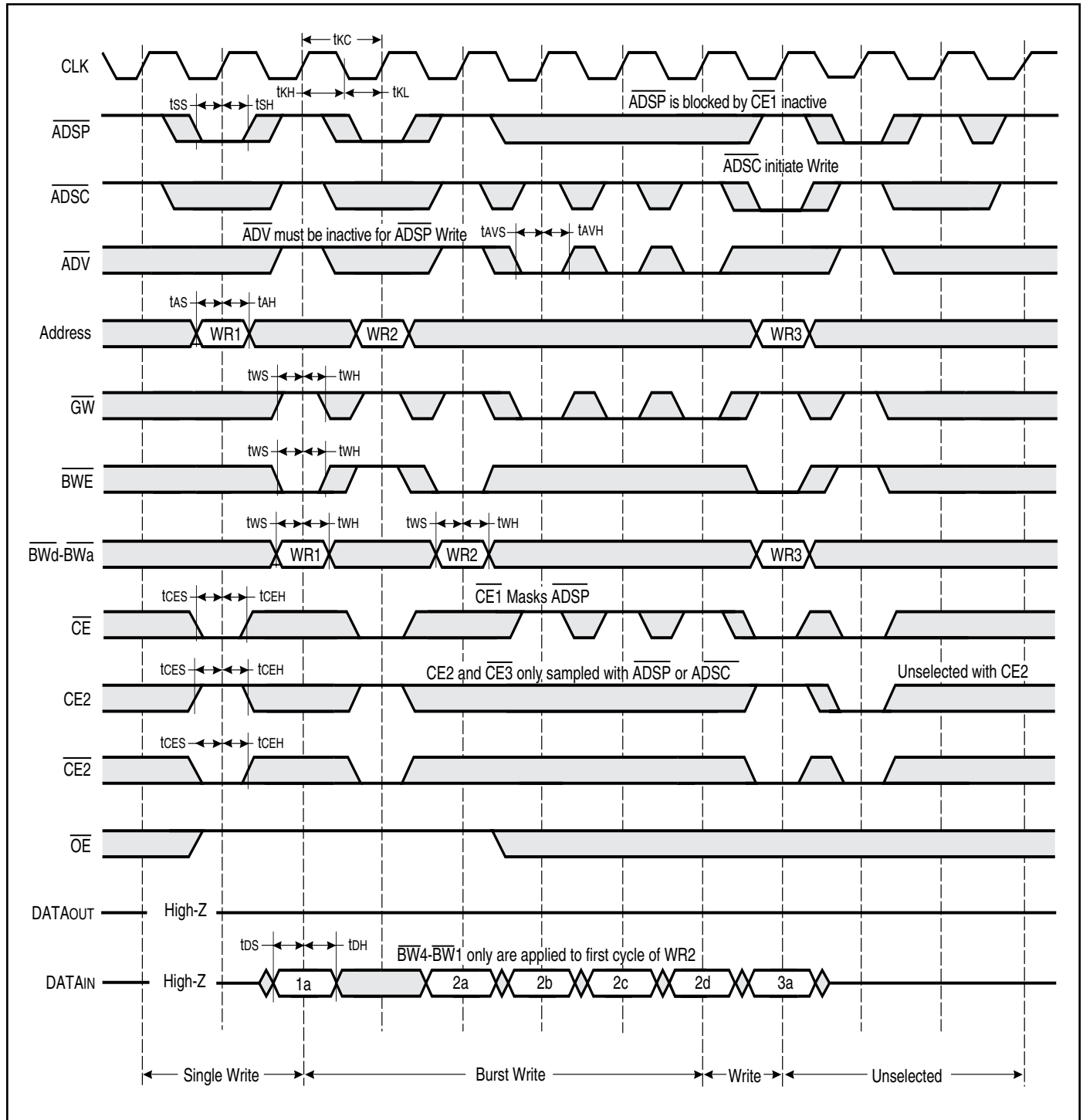
**Notes:**

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.

## READ/WRITE CYCLE TIMING



## WRITE CYCLE TIMING

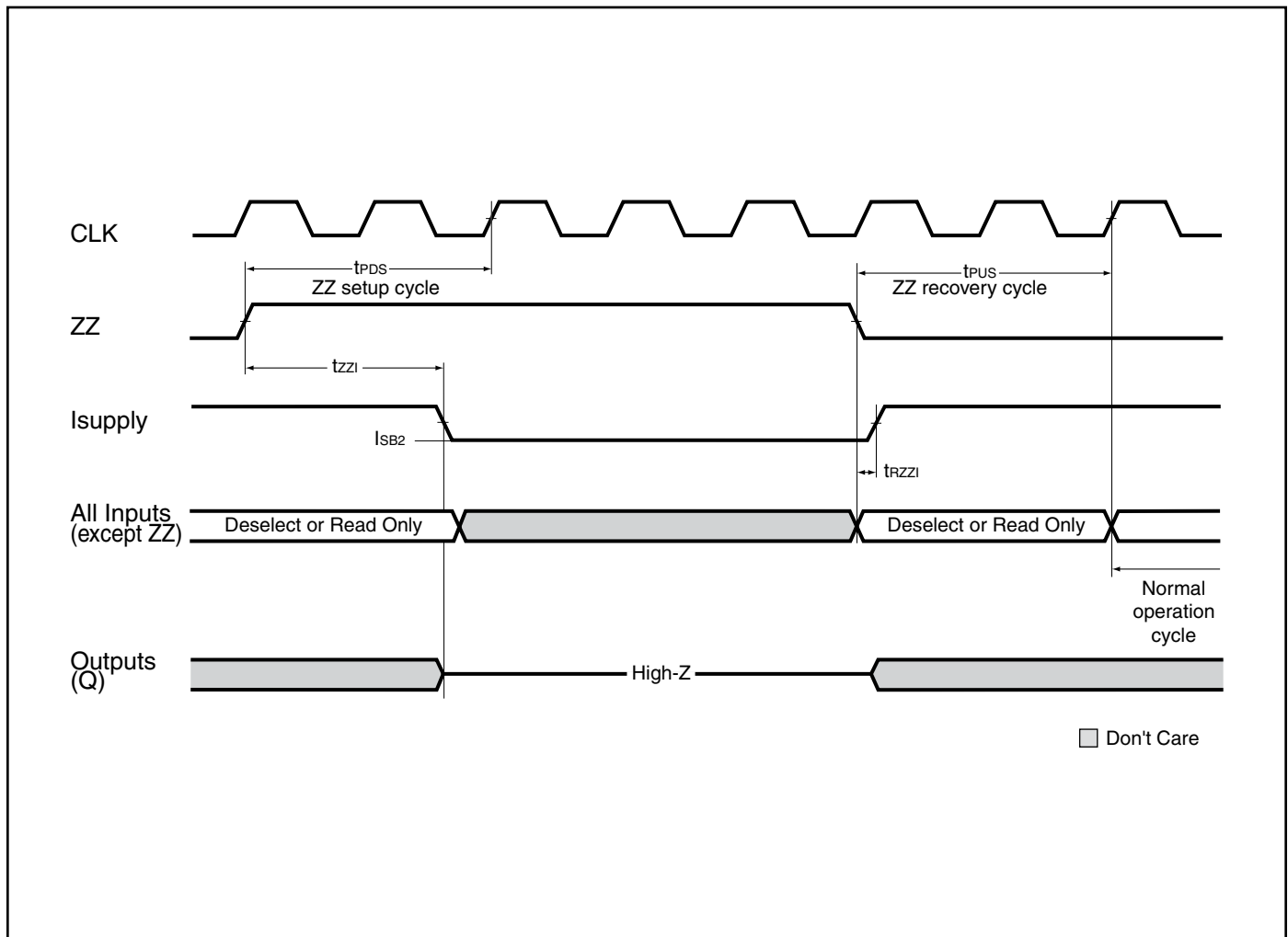


## SNOOZE MODE ELECTRICAL CHARACTERISTICS

| Symbol            | Parameter                          | Conditions           | Min. | typ. <sup>(1)</sup> | Max. | Unit  |
|-------------------|------------------------------------|----------------------|------|---------------------|------|-------|
| I <sub>SB2</sub>  | Current during SNOOZE MODE         | ZZ ≥ V <sub>ih</sub> | —    | 27                  | 90   | mA    |
| t <sub>PDS</sub>  | ZZ active to input ignored         |                      | —    |                     | 2    | cycle |
| t <sub>PUS</sub>  | ZZ inactive to input sampled       |                      | 2    |                     | —    | cycle |
| t <sub>ZZI</sub>  | ZZ active to SNOOZE current        |                      | —    |                     | 2    | cycle |
| t <sub>RZZI</sub> | ZZ inactive to exit SNOOZE current |                      | 0    |                     | —    | ns    |

1. Typical values are measured at V<sub>cc</sub> = 3.3V, T<sub>A</sub> = 25°C and not 100% tested.

## SNOOZE MODE TIMING



**ORDERING INFORMATION ( $V_{DD} = 3.3V/V_{DDQ} = 2.5V/3.3V$ )**

**Commercial Range: 0°C to +70°C**

| Configuration | Access Time | Order Part Number    | Package             |
|---------------|-------------|----------------------|---------------------|
| <b>1Mx36</b>  | 6.5         | IS61LF102436A-6.5TQL | 100 TQFP, Lead-free |
|               |             | IS61LF102436A-6.5B3  | 165 PBGA            |
| <b>2Mx18</b>  | 6.5         | IS61LF204818A-6.5TQ  | 100 TQFP            |
|               |             | IS61LF204818A-6.5TQL | 100 TQFP, Lead-free |
|               |             | IS61LF204818A-6.5B3  | 165 PBGA            |

**Industrial Range: -40°C to +85°C**

| Configuration | Access Time | Order Part Number     | Package             |
|---------------|-------------|-----------------------|---------------------|
| <b>1Mx36</b>  | 6.5         | IS61LF102436A-6.5TQLI | 100 TQFP, Lead-free |
|               |             | IS61LF102436A-6.5B3I  | 165 PBGA            |
| <b>1Mx36</b>  | 7.5         | IS61LF102436A-7.5TQI  | 100 TQFP            |
|               |             | IS61LF102436A-7.5TQLI | 100 TQFP, Lead-free |
|               |             | IS61LF102436A-7.5B3I  | 165 PBGA            |
|               |             | IS61LF102436A-7.5B3LI | 165 PBGA, Lead-free |
| <b>2Mx18</b>  | 6.5         | IS61LF204818A-6.5TQI  | 100 TQFP            |
|               |             | IS61LF204818A-6.5B3I  | 165 PBGA            |
| <b>2Mx18</b>  | 7.5         | IS61LF204818A-7.5TQI  | 100 TQFP            |
|               |             | IS61LF204818A-7.5TQLI | 100 TQFP, Lead-free |
|               |             | IS61LF204818A-7.5B3I  | 165 PBGA            |

**ORDERING INFORMATION ( $V_{DD} = 2.5V$  /  $V_{DDQ} = 2.5V$ )**

**Commercial Range: 0°C to +70°C**

| Configuration | Access Time | Order Part Number   | Package  |
|---------------|-------------|---------------------|----------|
| 1Mx36         | 6.5         | IS61VF102436A-6.5TQ | 100 TQFP |
|               |             | IS61VF102436A-6.5B3 | 165 PBGA |
| 1Mx36         | 7.5         | IS61VF102436A-7.5TQ | 100 TQFP |
|               |             | IS61VF102436A-7.5B3 | 165 PBGA |
| 2Mx18         | 6.5         | IS61VF204818A-6.5TQ | 100 TQFP |
|               |             | IS61VF204818A-6.5B3 | 165 PBGA |
| 2Mx18         | 7.5         | IS61VF204818A-7.5TQ | 100 TQFP |
|               |             | IS61VF204818A-7.5B3 | 165 PBGA |

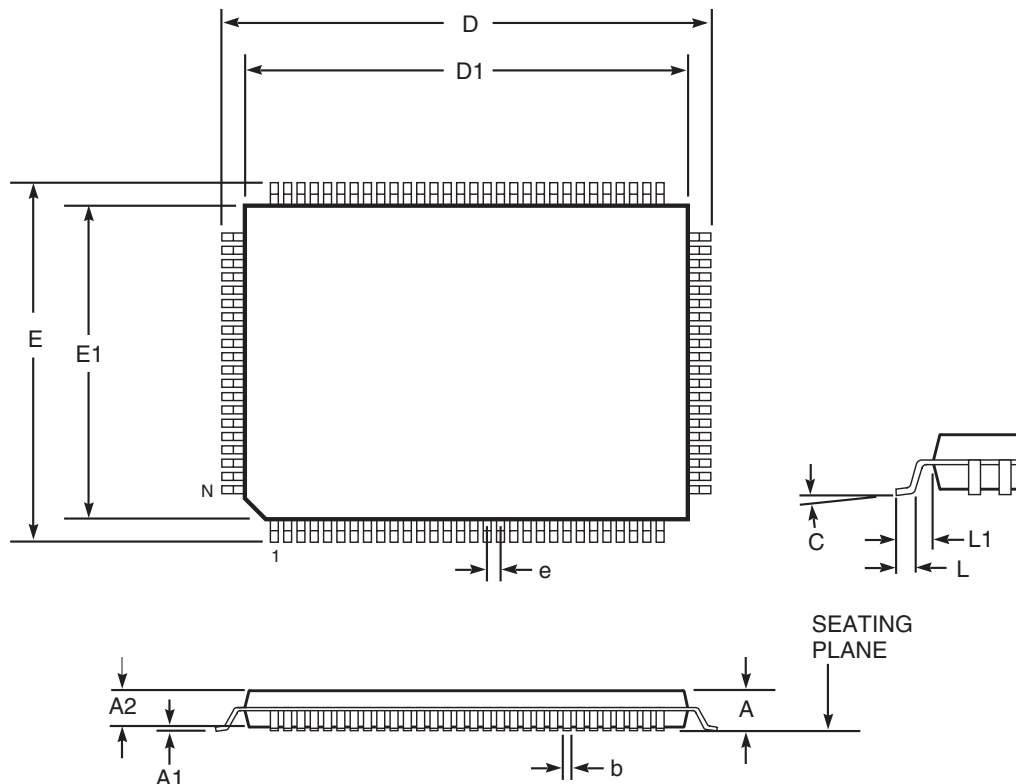
**Industrial Range: -40°C to +85°C**

| Configuration | Access Time | Order Part Number     | Package             |
|---------------|-------------|-----------------------|---------------------|
| 1Mx36         | 6.5         | IS61VF102436A-6.5TQI  | 100 TQFP            |
|               |             | IS61VF102436A-6.5B3I  | 165 PBGA            |
| 1Mx36         | 7.5         | IS61VF102436A-7.5TQI  | 100 TQFP            |
|               |             | IS61VF102436A-7.5TQLI | 100 TQFP, Lead-free |
|               |             | IS61VF102436A-7.5B3I  | 165 PBGA            |
| 2Mx18         | 6.5         | IS61VF204818A-6.5TQI  | 100 TQFP            |
|               |             | IS61VF204818A-6.5B3I  | 165 PBGA            |
| 2Mx18         | 7.5         | IS61VF204818A-7.5TQI  | 100 TQFP            |
|               |             | IS61VF204818A-7.5B3I  | 165 PBGA            |

# PACKAGING INFORMATION

TQFP (Thin Quad Flat Pack Package)

Package Code: TQ



| Thin Quad Flat Pack (TQ) |             |       |            |       |           |       |            |       |
|--------------------------|-------------|-------|------------|-------|-----------|-------|------------|-------|
| Symbol                   | Millimeters |       | Inches     |       |           |       | Inches     |       |
|                          | 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°    |

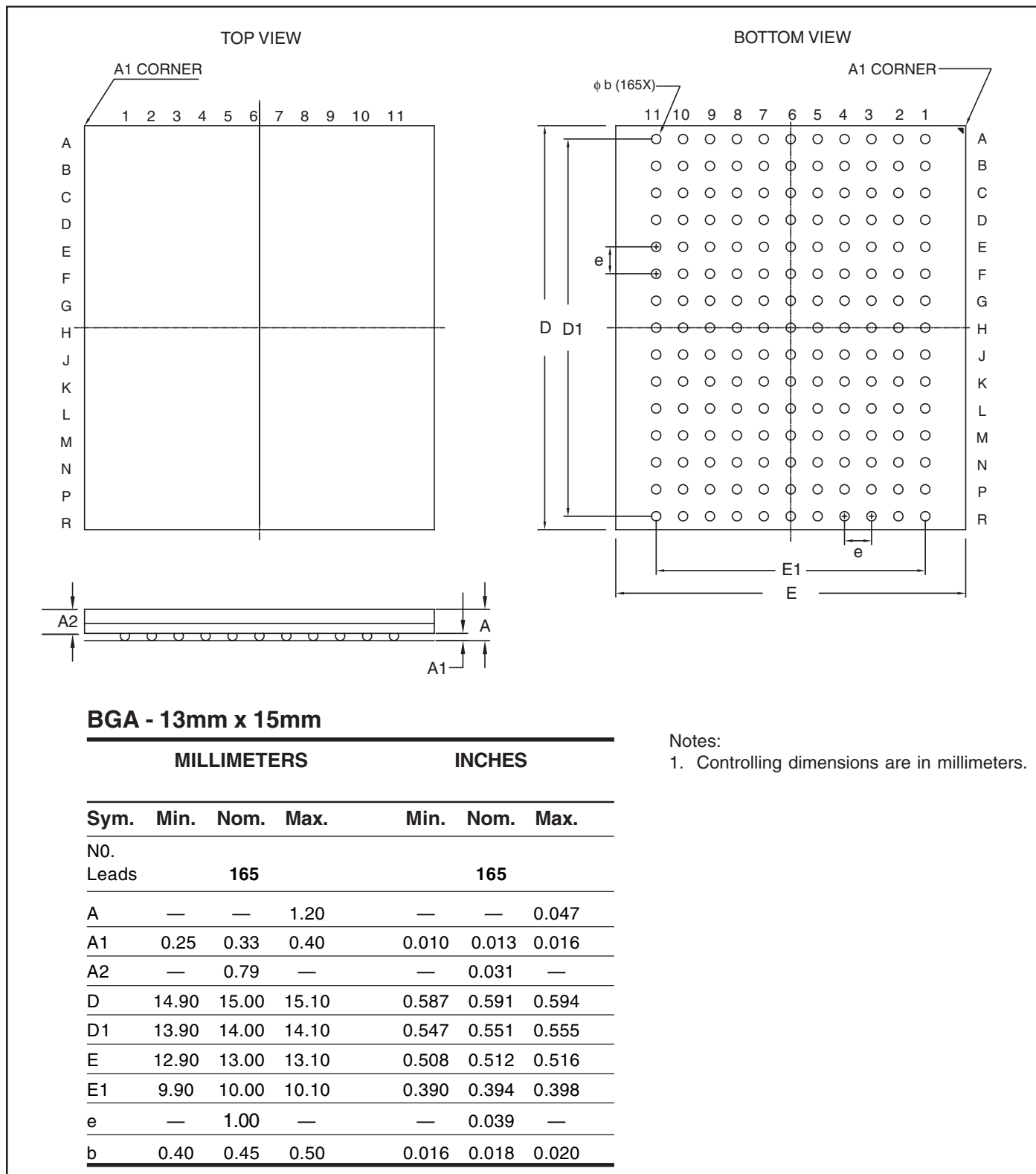
## Notes:

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.

# PACKAGING INFORMATION

## Ball Grid Array

Package Code: B (165-pin)



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