

## **1M x 16 HIGH-SPEED ASYNCHRONOUS CMOS STATIC RAM WITH 3.3V SUPPLY**

MAY 2012

### **FEATURES**

- High-speed access times:  
8, 10, 20 ns
- High-performance, low-power CMOS process
- Multiple center power and ground pins for greater noise immunity
- Easy memory expansion with  $\overline{\text{CE}}$  and  $\overline{\text{OE}}$  options
- $\overline{\text{CE}}$  power-down
- Fully static operation: no clock or refresh required
- TTL compatible inputs and outputs
- Single power supply  
 $V_{\text{DD}}$  1.65V to 2.2V (IS61WV102416ALL)  
speed = 20ns for  $V_{\text{DD}}$  1.65V to 2.2V  
 $V_{\text{DD}}$  2.4V to 3.6V (IS61/64WV102416BLL)  
speed = 10ns for  $V_{\text{DD}}$  2.4V to 3.6V  
speed = 8ns for  $V_{\text{DD}}$  3.3V  $\pm$  5%
- Packages available:
  - 48-ball miniBGA (9mm x 11mm)
  - 48-pin TSOP (Type I)
- Industrial and Automotive Temperature Support
- Lead-free available
- Data control for upper and lower bytes

### **DESCRIPTION**

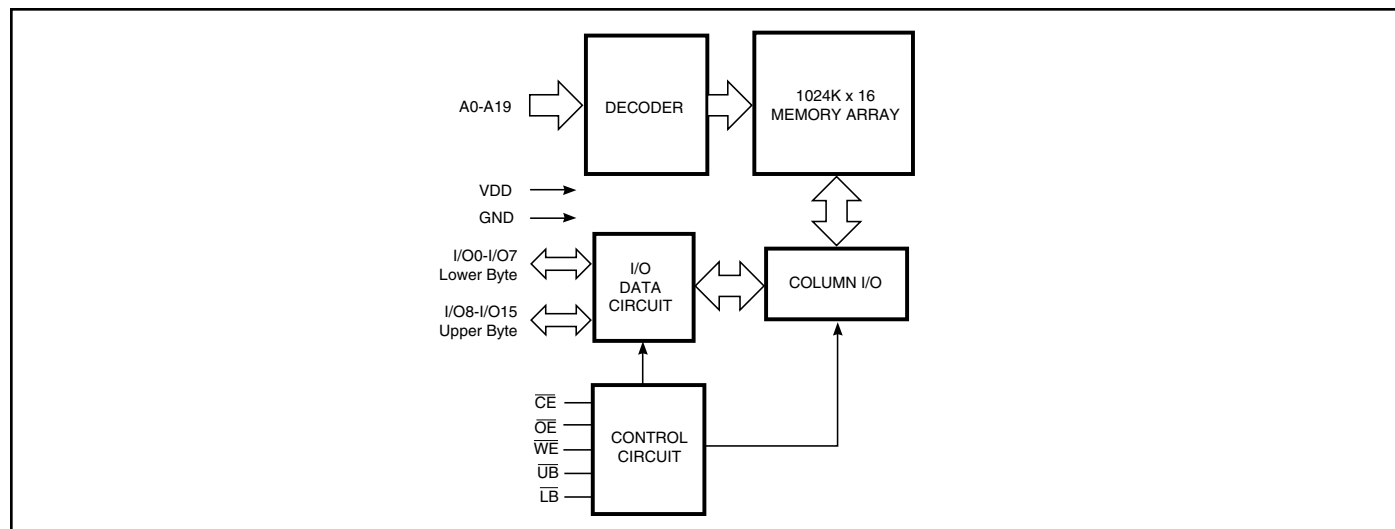
The *ISSI* IS61WV102416ALL/BLL and IS64WV102416BLL are high-speed, 16M-bit static RAMs organized as 1024K words by 16 bits. It is fabricated using *ISSI*'s high-performance CMOS technology. This highly reliable process coupled with innovative circuit design techniques, yields high-performance and low power consumption devices.

When  $\overline{\text{CE}}$  is HIGH (deselected), the device assumes a standby mode at which the power dissipation can be reduced down with CMOS input levels.

Easy memory expansion is provided by using Chip Enable and Output Enable inputs,  $\overline{\text{CE}}$  and  $\overline{\text{OE}}$ . The active LOW Write Enable ( $\overline{\text{WE}}$ ) controls both writing and reading of the memory. A data byte allows Upper Byte ( $\overline{\text{UB}}$ ) and Lower Byte ( $\overline{\text{LB}}$ ) access.

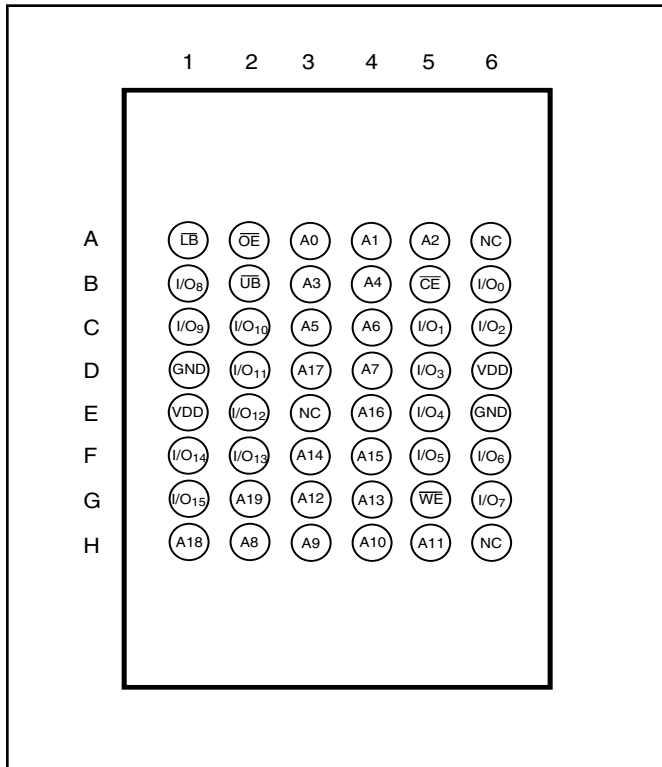
The device is packaged in the JEDEC standard 48-pin TSOP Type I and 48-pin Mini BGA (9mm x 11mm).

### **FUNCTIONAL BLOCK DIAGRAM**



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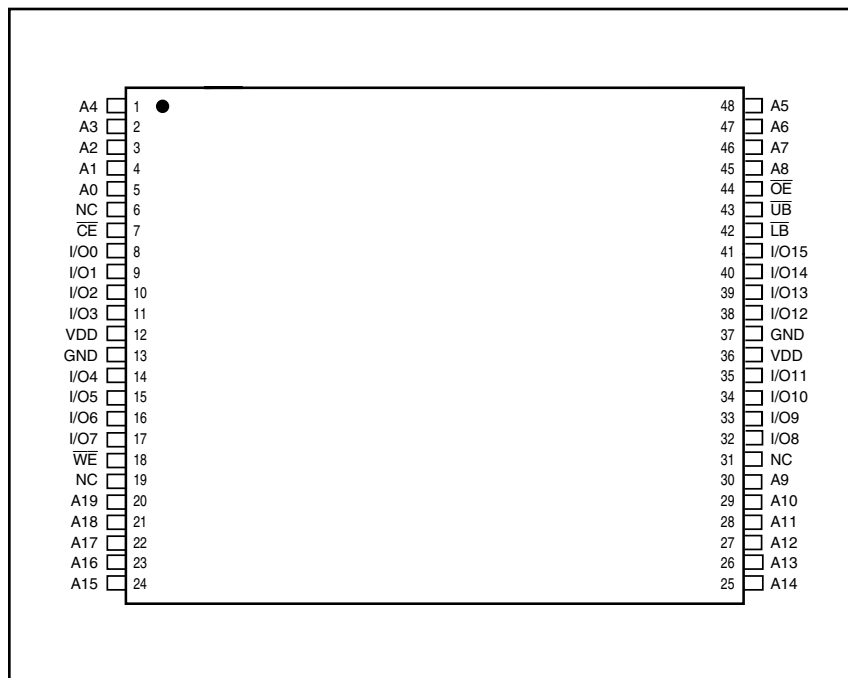
48-pin mini BGA (9mmx11mm)



**PIN DESCRIPTIONS**

|                 |                                 |
|-----------------|---------------------------------|
| A0-A19          | Address Inputs                  |
| I/O0-I/O15      | Data Inputs/Outputs             |
| $\overline{CE}$ | Chip Enable Input               |
| $\overline{OE}$ | Output Enable Input             |
| $\overline{WE}$ | Write Enable Input              |
| $\overline{LB}$ | Lower-byte Control (I/O0-I/O7)  |
| $\overline{UB}$ | Upper-byte Control (I/O8-I/O15) |
| NC              | No Connection                   |
| V <sub>DD</sub> | Power                           |
| GND             | Ground                          |

## 48-pin TSOP-I (12mm x 20mm)



## PIN DESCRIPTIONS

|                 |                                 |
|-----------------|---------------------------------|
| A0-A19          | Address Inputs                  |
| I/O0-I/O15      | Data Inputs/Outputs             |
| $\overline{CE}$ | Chip Enable Input               |
| $\overline{OE}$ | Output Enable Input             |
| $\overline{WE}$ | Write Enable Input              |
| $\overline{LB}$ | Lower-byte Control (I/O0-I/O7)  |
| $\overline{UB}$ | Upper-byte Control (I/O8-I/O15) |
| NC              | No Connection                   |
| VDD             | Power                           |
| GND             | Ground                          |

## TRUTH TABLE

| Mode            | $\overline{WE}$ | $\overline{CE}$ | $\overline{OE}$ | $\overline{LB}$ | $\overline{UB}$ | I/O PIN          |                  | V <sub>DD</sub> Current             |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-------------------------------------|
|                 |                 |                 |                 |                 |                 | I/O0-I/O7        | I/O8-I/O15       |                                     |
| Not Selected    | X               | H               | X               | X               | X               | High-Z           | High-Z           | I <sub>SB1</sub> , I <sub>SB2</sub> |
| Output Disabled | H               | L               | H               | X               | X               | High-Z           | High-Z           | I <sub>CC</sub>                     |
|                 | X               | L               | X               | H               | H               | High-Z           | High-Z           |                                     |
| Read            | H               | L               | L               | L               | H               | D <sub>OUT</sub> | High-Z           | I <sub>CC</sub>                     |
|                 | H               | L               | L               | H               | L               | High-Z           | D <sub>OUT</sub> |                                     |
|                 | H               | L               | L               | L               | L               | D <sub>OUT</sub> | D <sub>OUT</sub> |                                     |
| Write           | L               | L               | X               | L               | H               | D <sub>IN</sub>  | High-Z           | I <sub>CC</sub>                     |
|                 | L               | L               | X               | H               | L               | High-Z           | D <sub>IN</sub>  |                                     |
|                 | L               | L               | X               | L               | L               | D <sub>IN</sub>  | D <sub>IN</sub>  |                                     |

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

| Symbol            | Parameter                            | Value                         | Unit |
|-------------------|--------------------------------------|-------------------------------|------|
| V <sub>TERM</sub> | Terminal Voltage with Respect to GND | −0.5 to V <sub>DD</sub> + 0.5 | V    |
| V <sub>DD</sub>   | V <sub>DD</sub> Relates to GND       | −0.3 to 4.0                   | V    |
| T <sub>STG</sub>  | Storage Temperature                  | −65 to +150                   | °C   |
| P <sub>T</sub>    | Power Dissipation                    | 1.0                           | W    |

### 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.

## 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>I/O</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.

**OPERATING RANGE (V<sub>DD</sub>) (IS61WV102416ALL)**

| Range      | Ambient Temperature | V <sub>DD</sub> (20 ns) |
|------------|---------------------|-------------------------|
| Commercial | 0°C to +70°C        | 1.65V-2.2V              |
| Industrial | −40°C to +85°C      | 1.65V-2.2V              |
| Automotive | −40°C to +125°C     | 1.65V-2.2V              |

**OPERATING RANGE (V<sub>DD</sub>) (IS61WV102416BLL)<sup>(1)</sup>**

| Range      | Ambient Temperature | V <sub>DD</sub> (8 ns) | V <sub>DD</sub> (10 ns) |
|------------|---------------------|------------------------|-------------------------|
| Commercial | 0°C to +70°C        | 3.3V ± 5%              | 2.4V-3.6V               |
| Industrial | −40°C to +85°C      | 3.3V ± 5%              | 2.4V-3.6V               |

**Note:**

1. When operated in the range of 2.4V-3.6V, the device meets 10ns. When operated in the range of 3.3V ± 5%, the device meets 8ns.

**OPERATING RANGE (V<sub>DD</sub>) (IS64WV102416BLL)**

| Range      | Ambient Temperature | V <sub>DD</sub> (10 ns) |
|------------|---------------------|-------------------------|
| Automotive | −40°C to +125°C     | 2.4V-3.6V               |

## DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

**V<sub>DD</sub> = 3.3V ± 5%**

| Symbol          | Parameter                        | Test Conditions                                             | Min. | Max.                  | Unit |
|-----------------|----------------------------------|-------------------------------------------------------------|------|-----------------------|------|
| V <sub>OH</sub> | Output HIGH Voltage              | V <sub>DD</sub> = Min., I <sub>OH</sub> = -4.0 mA           | 2.4  | —                     | V    |
| V <sub>OL</sub> | Output LOW Voltage               | V <sub>DD</sub> = Min., I <sub>OL</sub> = 8.0 mA            | —    | 0.4                   | V    |
| V <sub>IH</sub> | Input HIGH Voltage               |                                                             | 2    | V <sub>DD</sub> + 0.3 | V    |
| V <sub>IL</sub> | Input LOW Voltage <sup>(1)</sup> |                                                             | -0.3 | 0.8                   | V    |
| I <sub>LI</sub> | Input Leakage                    | GND ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>                     | -1   | 1                     | μA   |
| I <sub>LO</sub> | Output Leakage                   | GND ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> , Outputs Disabled | -1   | 1                     | μA   |

### Note:

1. V<sub>IL</sub> (min.) = -0.3V DC; 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> + 0.3V DC; V<sub>IH</sub> (max.) = V<sub>DD</sub> + 2.0V AC (pulse width 2.0 ns). Not 100% tested.

## DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

**V<sub>DD</sub> = 2.4V-3.6V**

| Symbol          | Parameter                        | Test Conditions                                             | Min. | Max.                  | Unit |
|-----------------|----------------------------------|-------------------------------------------------------------|------|-----------------------|------|
| V <sub>OH</sub> | Output HIGH Voltage              | V <sub>DD</sub> = Min., I <sub>OH</sub> = -1.0 mA           | 1.8  | —                     | V    |
| V <sub>OL</sub> | Output LOW Voltage               | V <sub>DD</sub> = Min., I <sub>OL</sub> = 1.0 mA            | —    | 0.4                   | V    |
| V <sub>IH</sub> | Input HIGH Voltage               |                                                             | 2.0  | V <sub>DD</sub> + 0.3 | V    |
| V <sub>IL</sub> | Input LOW Voltage <sup>(1)</sup> |                                                             | -0.3 | 0.8                   | V    |
| I <sub>LI</sub> | Input Leakage                    | GND ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>                     | -1   | 1                     | μA   |
| I <sub>LO</sub> | Output Leakage                   | GND ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> , Outputs Disabled | -1   | 1                     | μA   |

### Note:

1. V<sub>IL</sub> (min.) = -0.3V DC; 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> + 0.3V DC; V<sub>IH</sub> (max.) = V<sub>DD</sub> + 2.0V AC (pulse width 2.0 ns). Not 100% tested.

## DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

**V<sub>DD</sub> = 1.65V-2.2V**

| Symbol                         | Parameter           | Test Conditions                                             | V <sub>DD</sub> | Min. | Max.                  | Unit |
|--------------------------------|---------------------|-------------------------------------------------------------|-----------------|------|-----------------------|------|
| V <sub>OH</sub>                | Output HIGH Voltage | I <sub>OH</sub> = -0.1 mA                                   | 1.65-2.2V       | 1.4  | —                     | V    |
| V <sub>OL</sub>                | Output LOW Voltage  | I <sub>OL</sub> = 0.1 mA                                    | 1.65-2.2V       | —    | 0.2                   | V    |
| V <sub>IH</sub>                | Input HIGH Voltage  |                                                             | 1.65-2.2V       | 1.4  | V <sub>DD</sub> + 0.2 | V    |
| V <sub>IL</sub> <sup>(1)</sup> | Input LOW Voltage   |                                                             | 1.65-2.2V       | -0.2 | 0.4                   | V    |
| I <sub>LI</sub>                | Input Leakage       | GND ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>                     |                 | -1   | 1                     | μA   |
| I <sub>LO</sub>                | Output Leakage      | GND ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> , Outputs Disabled |                 | -1   | 1                     | μA   |

### Notes:

1. V<sub>IL</sub> (min.) = -0.3V DC; V<sub>IL</sub> (min.) = -2.0V AC (pulse width -2.0ns). Not 100% tested.  
V<sub>IH</sub> (max.) = V<sub>DD</sub> + 0.3V DC; V<sub>IH</sub> (max.) = V<sub>DD</sub> + 2.0V AC (pulse width -2.0ns). Not 100% tested.

## AC TEST CONDITIONS (HIGH SPEED)

| Parameter                                                    | Unit<br>(2.4V-3.6V)   | Unit<br>(3.3V $\pm$ 5%) | Unit<br>(1.65V-2.2V)  |
|--------------------------------------------------------------|-----------------------|-------------------------|-----------------------|
| Input Pulse Level                                            | 0.4V to $V_{DD}-0.3V$ | 0.4V to $V_{DD}-0.3V$   | 0.4V to $V_{DD}-0.2V$ |
| Input Rise and Fall Times                                    | 1.5ns                 | 1.5ns                   | 1.5ns                 |
| Input and Output Timing<br>and Reference Level ( $V_{Ref}$ ) | $V_{DD}/2$            | $V_{DD}/2 + 0.05$       | $V_{DD}/2$            |
| Output Load                                                  | See Figures 1 and 2   | See Figures 1 and 2     | See Figures 1 and 2   |

## AC TEST LOADS

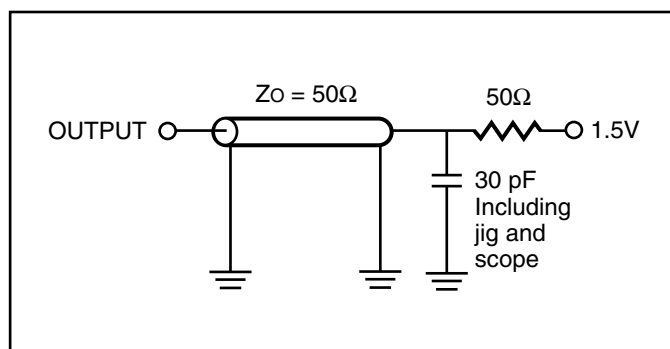


Figure 1.

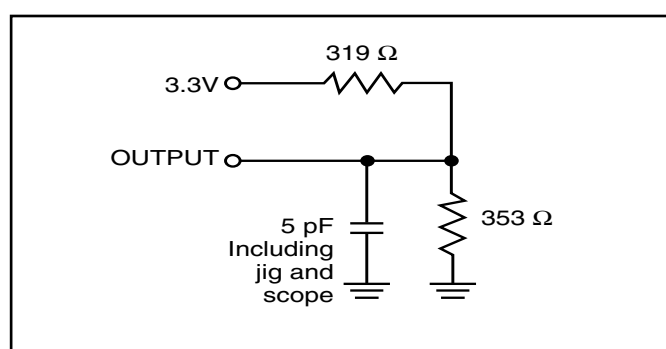


Figure 2.

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

| Symbol           | Parameter                                        | Test Conditions                                      |                     | -8   |      | -10  |      | -20  |      | Unit |
|------------------|--------------------------------------------------|------------------------------------------------------|---------------------|------|------|------|------|------|------|------|
|                  |                                                  |                                                      |                     | Min. | Max. | Min. | Max. | Min. | Max. |      |
| I <sub>CC</sub>  | V <sub>DD</sub> Dynamic Operating Supply Current | V <sub>DD</sub> = Max.,                              | Com.                | —    | 110  | —    | 90   | —    | 50   | mA   |
|                  |                                                  | I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub>        | Ind.                | —    | 115  | —    | 95   | —    | 60   |      |
|                  |                                                  | V <sub>IN</sub> = 0.4V or V <sub>DD</sub> - 0.3V     | Auto.               | —    | —    | —    | 140  | —    | 100  |      |
|                  |                                                  |                                                      | typ. <sup>(2)</sup> |      |      |      | 60   |      |      |      |
| I <sub>CC1</sub> | Operating Supply Current                         | V <sub>DD</sub> = Max.,                              | Com.                | —    | 85   | —    | 85   | —    | 45   | mA   |
|                  |                                                  | I <sub>OUT</sub> = 0 mA, f = 0                       | Ind.                | —    | 90   | —    | 90   | —    | 55   |      |
|                  |                                                  | V <sub>IN</sub> = 0.4V or V <sub>DD</sub> - 0.3V     | Auto.               | —    | —    | —    | 110  | —    | 90   |      |
|                  |                                                  |                                                      |                     |      |      |      |      |      |      |      |
| I <sub>SB1</sub> | TTL Standby Current (TTL Inputs)                 | V <sub>DD</sub> = Max.,                              | Com.                | —    | 30   | —    | 30   | —    | 30   | mA   |
|                  |                                                  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | Ind.                | —    | 35   | —    | 35   | —    | 35   |      |
|                  |                                                  | $\overline{CE} \geq V_{IH}$ , f = 0                  | Auto.               | —    | —    | —    | 70   | —    | 70   |      |
|                  |                                                  |                                                      |                     |      |      |      |      |      |      |      |
| I <sub>SB2</sub> | CMOS Standby Current (CMOS Inputs)               | V <sub>DD</sub> = Max.,                              | Com.                | —    | 20   | —    | 20   | —    | 20   | mA   |
|                  |                                                  | $\overline{CE} \geq V_{DD} - 0.2V$ ,                 | Ind.                | —    | 25   | —    | 25   | —    | 25   |      |
|                  |                                                  | V <sub>IN</sub> $\geq V_{DD} - 0.2V$ , or            | Auto.               | —    | —    | —    | 60   | —    | 60   |      |
|                  |                                                  | V <sub>IN</sub> $\leq 0.2V$ , f = 0                  | typ. <sup>(2)</sup> |      |      |      | 4    |      |      |      |

### Note:

1. At f = f<sub>MAX</sub>, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.
2. Typical values are measured at V<sub>DD</sub> = 3.0V, T<sub>A</sub> = 25°C and not 100% tested.

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

| Symbol                          | Parameter                                                     | -8   |      | -10  |      | Unit |
|---------------------------------|---------------------------------------------------------------|------|------|------|------|------|
|                                 |                                                               | Min. | Max. | Min. | Max. |      |
| t <sub>RC</sub>                 | Read Cycle Time                                               | 8    | —    | 10   | —    | ns   |
| t <sub>AA</sub>                 | Address Access Time                                           | —    | 8    | —    | 10   | ns   |
| t <sub>OHA</sub>                | Output Hold Time                                              | 2.5  | —    | 2.5  | —    | ns   |
| t <sub>ACE</sub>                | $\overline{\text{CE}}$ Access Time                            | —    | 8    | —    | 10   | ns   |
| t <sub>DOE</sub>                | $\overline{\text{OE}}$ Access Time                            | —    | 5.5  | —    | 6.5  | ns   |
| t <sub>HZOE<sup>(2)</sup></sub> | $\overline{\text{OE}}$ to High-Z Output                       | —    | 3    | —    | 4    | ns   |
| t <sub>LZOE<sup>(2)</sup></sub> | $\overline{\text{OE}}$ to Low-Z Output                        | 0    | —    | 0    | —    | ns   |
| t <sub>HZCE<sup>(2)</sup></sub> | $\overline{\text{CE}}$ to High-Z Output                       | 0    | 3    | 0    | 4    | ns   |
| t <sub>LZCE<sup>(2)</sup></sub> | $\overline{\text{CE}}$ to Low-Z Output                        | 3    | —    | 3    | —    | ns   |
| t <sub>BA</sub>                 | $\overline{\text{LB}}, \overline{\text{UB}}$ Access Time      | —    | 5.5  | —    | 6.5  | ns   |
| t <sub>HZB<sup>(2)</sup></sub>  | $\overline{\text{LB}}, \overline{\text{UB}}$ to High-Z Output | 0    | 3    | 0    | 3    | ns   |
| t <sub>LZB<sup>(2)</sup></sub>  | $\overline{\text{LB}}, \overline{\text{UB}}$ to Low-Z Output  | 0    | —    | 0    | —    | ns   |
| t <sub>PU</sub>                 | Power Up Time                                                 | 0    | —    | 0    | —    | ns   |
| t <sub>PD</sub>                 | Power Down Time                                               | —    | 8    | —    | 10   | ns   |

**Notes:**

1. Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0V to 3.0V and output loading specified in Figure 1.
2. Tested with the load in Figure 2. Transition is measured  $\pm 500$  mV from steady-state voltage.

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

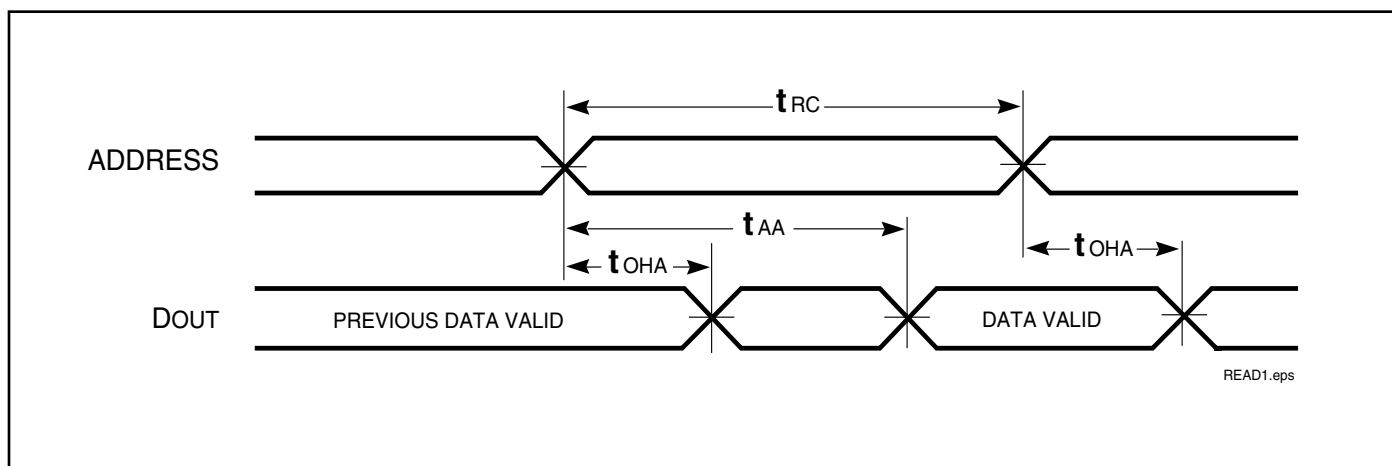
| Symbol                           | Parameter                                          | -20 ns |      | Unit |
|----------------------------------|----------------------------------------------------|--------|------|------|
|                                  |                                                    | Min.   | Max. |      |
| t <sub>RC</sub>                  | Read Cycle Time                                    | 20     | —    | ns   |
| t <sub>AA</sub>                  | Address Access Time                                | —      | 20   | ns   |
| t <sub>OH</sub>                  | Output Hold Time                                   | 2.5    | —    | ns   |
| t <sub>ACE</sub>                 | $\overline{CE}$ Access Time                        | —      | 20   | ns   |
| t <sub>DOE</sub>                 | $\overline{OE}$ Access Time                        | —      | 8    | ns   |
| t <sub>HZOE</sub> <sup>(2)</sup> | $\overline{OE}$ to High-Z Output                   | 0      | 8    | ns   |
| t <sub>LZOE</sub> <sup>(2)</sup> | $\overline{OE}$ to Low-Z Output                    | 0      | —    | ns   |
| t <sub>HZCE</sub> <sup>(2)</sup> | $\overline{CE}$ to High-Z Output                   | 0      | 8    | ns   |
| t <sub>LZCE</sub> <sup>(2)</sup> | $\overline{CE}$ to Low-Z Output                    | 3      | —    | ns   |
| t <sub>BA</sub>                  | $\overline{LB}$ , $\overline{UB}$ Access Time      | —      | 8    | ns   |
| t <sub>HZB</sub>                 | $\overline{LB}$ , $\overline{UB}$ to High-Z Output | 0      | 8    | ns   |
| t <sub>LZB</sub>                 | $\overline{LB}$ , $\overline{UB}$ to Low-Z Output  | 0      | —    | ns   |

### Notes:

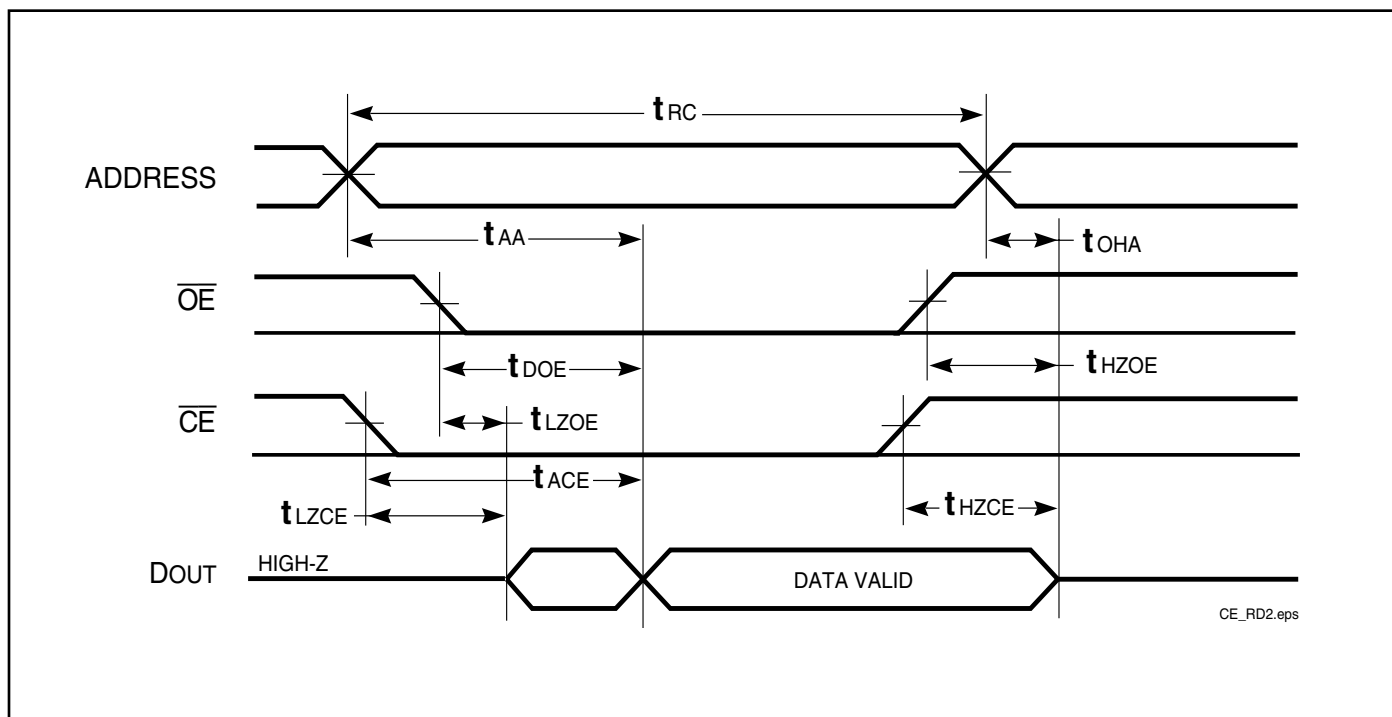
1. Test conditions assume signal transition times of 1.5 ns or less, timing reference levels of 1.25V, input pulse levels of 0.4V to V<sub>DD</sub>-0.3V and output loading specified in Figure 1a.
2. Tested with the load in Figure 1b. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.
3. Not 100% tested.

## AC WAVEFORMS

### READ CYCLE NO. 1<sup>(1,2)</sup> (Address Controlled) ( $\overline{CE} = \overline{OE} = V_{IL}$ )



### READ CYCLE NO. 2<sup>(1,3)</sup> ( $\overline{CE}$ and $\overline{OE}$ Controlled)



#### Notes:

1.  $\overline{WE}$  is HIGH for a Read Cycle.
2. The device is continuously selected.  $\overline{OE}$ ,  $\overline{CE} = V_{IL}$ .
3. Address is valid prior to or coincident with  $\overline{CE}$  LOW transitions.

## WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1,3)</sup> (Over Operating Range)

| Symbol                           | Parameter                                               | -8   |      | -10  |      | Unit |
|----------------------------------|---------------------------------------------------------|------|------|------|------|------|
|                                  |                                                         | Min. | Max. | Min. | Max. |      |
| t <sub>WC</sub>                  | Write Cycle Time                                        | 8    | —    | 10   | —    | ns   |
| t <sub>SCE</sub>                 | $\overline{CE}$ to Write End                            | 6.5  | —    | 8    | —    | ns   |
| t <sub>AW</sub>                  | Address Setup Time to Write End                         | 6.5  | —    | 8    | —    | ns   |
| t <sub>HA</sub>                  | Address Hold from Write End                             | 0    | —    | 0    | —    | ns   |
| t <sub>SA</sub>                  | Address Setup Time                                      | 0    | —    | 0    | —    | ns   |
| t <sub>PWB</sub>                 | $\overline{LB}$ , $\overline{UB}$ Valid to End of Write | 6.5  | —    | 8    | —    | ns   |
| t <sub>PWE1</sub>                | $\overline{WE}$ Pulse Width                             | 6.5  | —    | 8    | —    | ns   |
| t <sub>PWE2</sub>                | $\overline{WE}$ Pulse Width ( $\overline{OE}$ = LOW)    | 8.0  | —    | 10   | —    | ns   |
| t <sub>SD</sub>                  | Data Setup to Write End                                 | 5    | —    | 6    | —    | ns   |
| t <sub>HD</sub>                  | Data Hold from Write End                                | 0    | —    | 0    | —    | ns   |
| t <sub>HZWE</sub> <sup>(2)</sup> | $\overline{WE}$ LOW to High-Z Output                    | —    | 3.5  | —    | 5    | ns   |
| t <sub>LZWE</sub> <sup>(2)</sup> | $\overline{WE}$ HIGH to Low-Z Output                    | 2    | —    | 2    | —    | ns   |

### Notes:

1. Test conditions assume signal transition times of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0V to 3.0V and output loading specified in Figure 1.
2. Tested with the load in Figure 2. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.
3. The internal write time is defined by the overlap of  $\overline{CE}$  LOW and  $\overline{UB}$  or  $\overline{LB}$ , and  $\overline{WE}$  LOW. All signals must be in valid states to initiate a Write, but any one can go inactive to terminate the Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signal that terminates the write. Shaded area product in development

# WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1,2)</sup> (Over Operating Range)

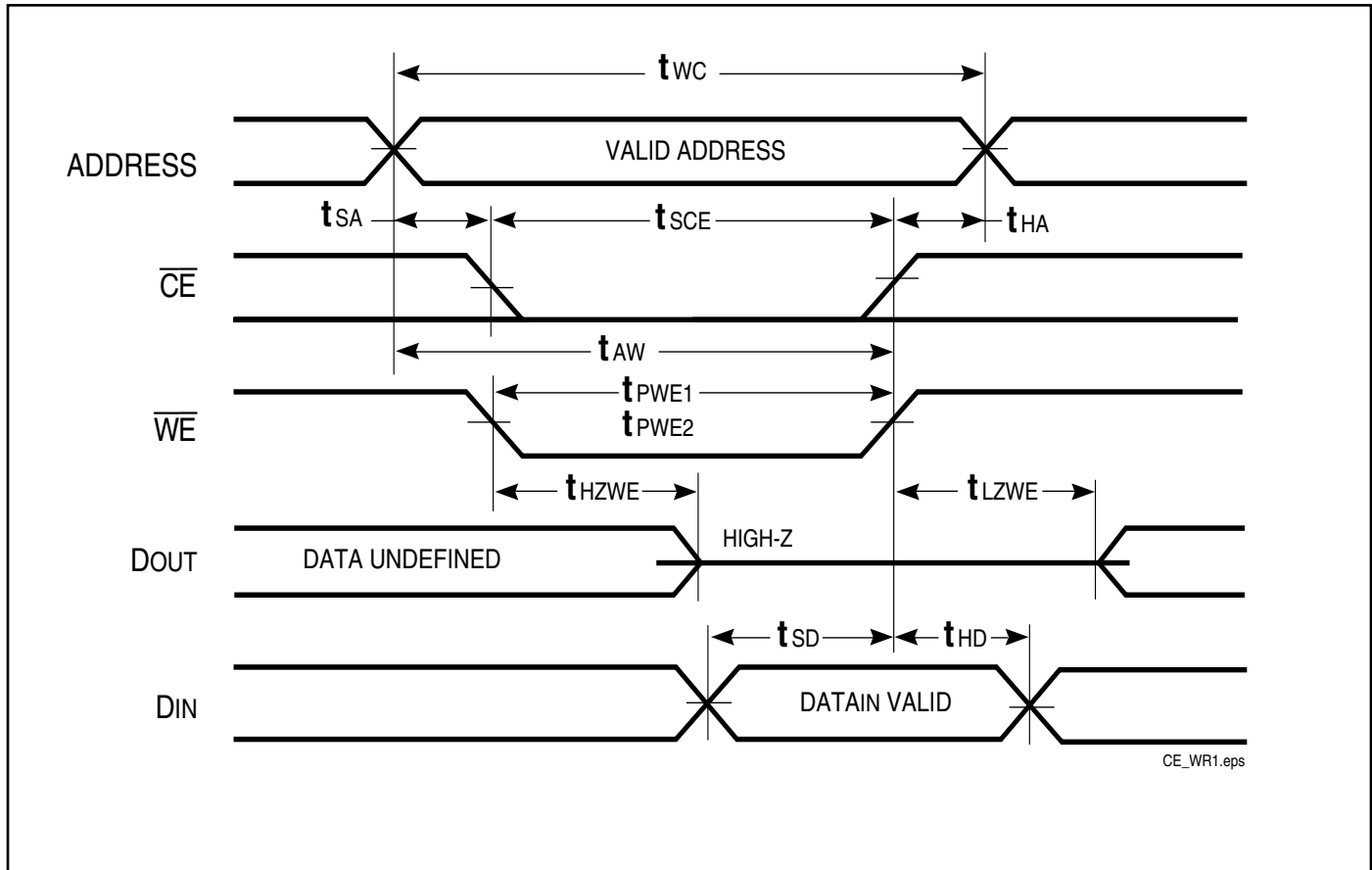
| Symbol                           | Parameter                                               | -20 ns |      | Unit |
|----------------------------------|---------------------------------------------------------|--------|------|------|
|                                  |                                                         | Min.   | Max. |      |
| t <sub>WC</sub>                  | Write Cycle Time                                        | 20     | —    | ns   |
| t <sub>SCE</sub>                 | $\overline{CE}$ to Write End                            | 12     | —    | ns   |
| t <sub>AW</sub>                  | Address Setup Time to Write End                         | 12     | —    | ns   |
| t <sub>HA</sub>                  | Address Hold from Write End                             | 0      | —    | ns   |
| t <sub>SA</sub>                  | Address Setup Time                                      | 0      | —    | ns   |
| t <sub>PWB</sub>                 | $\overline{LB}$ , $\overline{UB}$ Valid to End of Write | 12     | —    | ns   |
| t <sub>PWE1</sub>                | $\overline{WE}$ Pulse Width ( $\overline{OE}$ = HIGH)   | 12     | —    | ns   |
| t <sub>PWE2</sub>                | $\overline{WE}$ Pulse Width ( $\overline{OE}$ = LOW)    | 17     | —    | ns   |
| t <sub>SD</sub>                  | Data Setup to Write End                                 | 9      | —    | ns   |
| t <sub>HD</sub>                  | Data Hold from Write End                                | 0      | —    | ns   |
| t <sub>HZWE</sub> <sup>(3)</sup> | $\overline{WE}$ LOW to High-Z Output                    | —      | 9    | ns   |
| t <sub>LZWE</sub> <sup>(3)</sup> | $\overline{WE}$ HIGH to Low-Z Output                    | 3      | —    | ns   |

## Notes:

1. Test conditions for IS61WV6416LL assume signal transition times of 1.5ns or less, timing reference levels of 1.25V, input pulse levels of 0.4V to V<sub>DD</sub>-0.3V and output loading specified in Figure 1a.
2. Tested with the load in Figure 1b. Transition is measured  $\pm 500$  mV from steady-state voltage. Not 100% tested.
3. The internal write time is defined by the overlap of  $\overline{CE}$  LOW and  $\overline{UB}$  or  $\overline{LB}$ , and  $\overline{WE}$  LOW. All signals must be in valid states to initiate a Write, but any one can go inactive to terminate the Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signal that terminates the write.

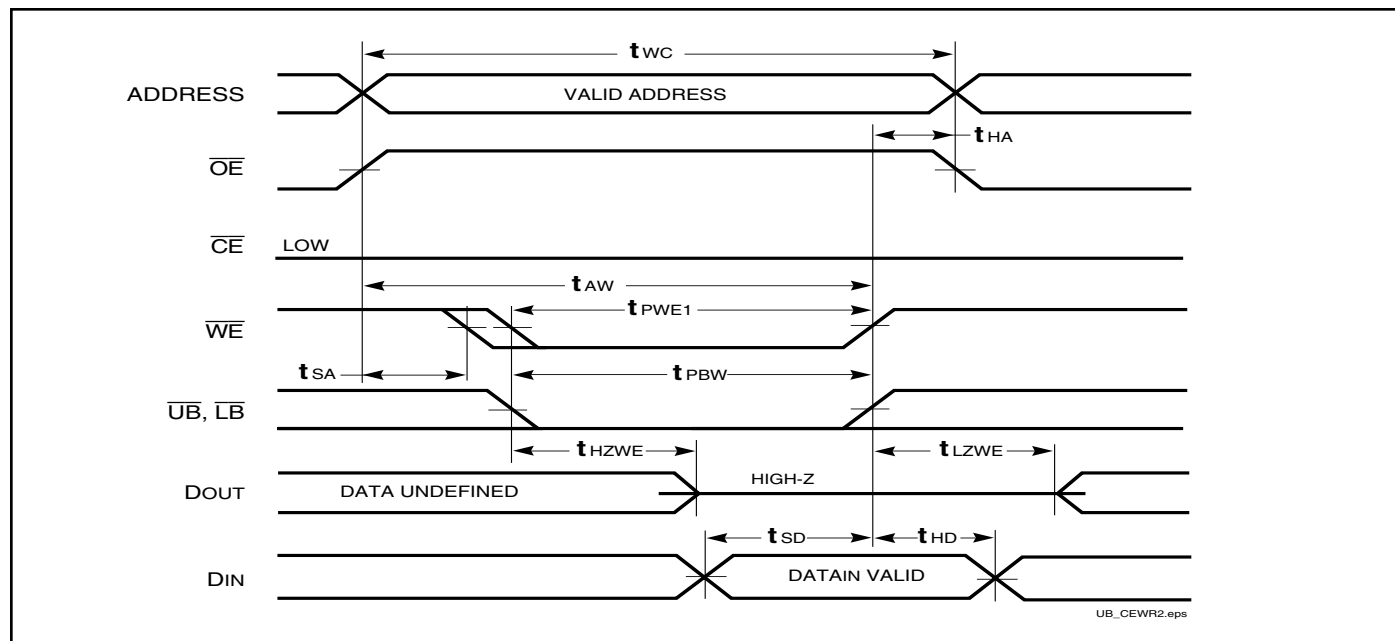
## AC WAVEFORMS

**WRITE CYCLE NO. 1<sup>(1,2)</sup>** ( $\overline{CE}$  Controlled,  $\overline{OE}$  = HIGH or LOW)

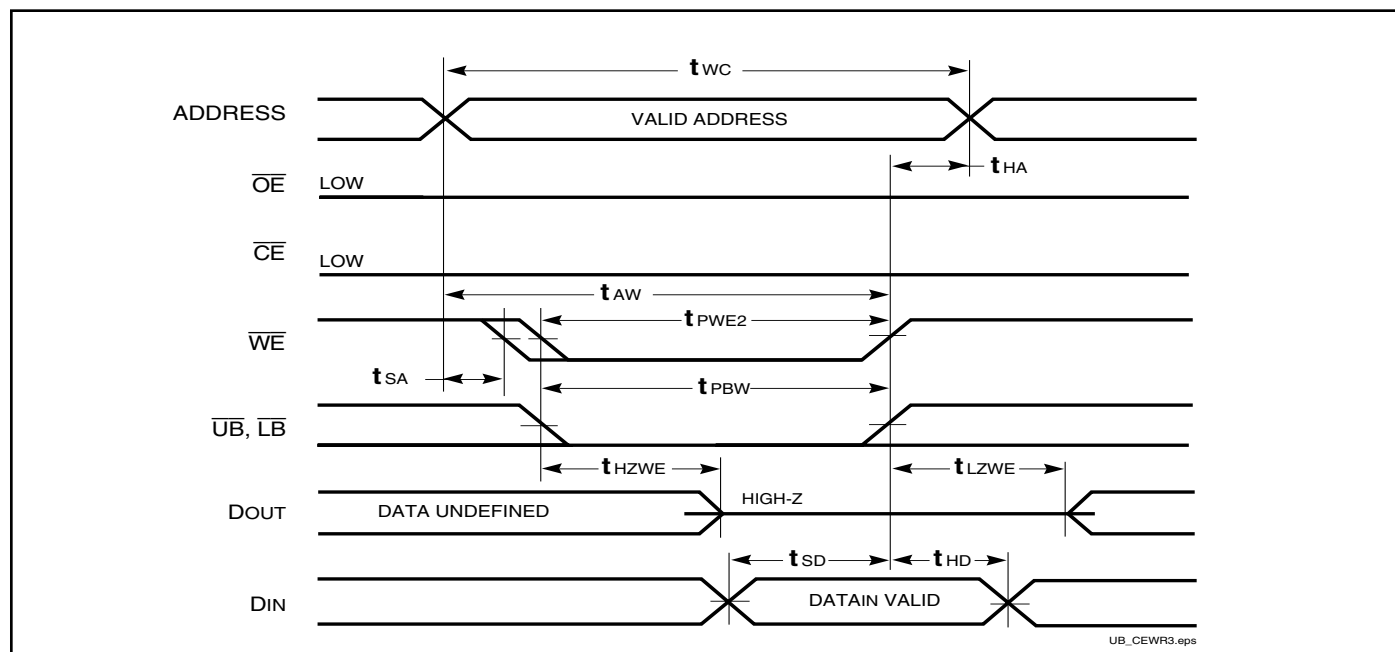


## AC WAVEFORMS

### WRITE CYCLE NO. 2 ( $\overline{WE}$ Controlled. $\overline{OE}$ is HIGH During Write Cycle) <sup>(1,2)</sup>

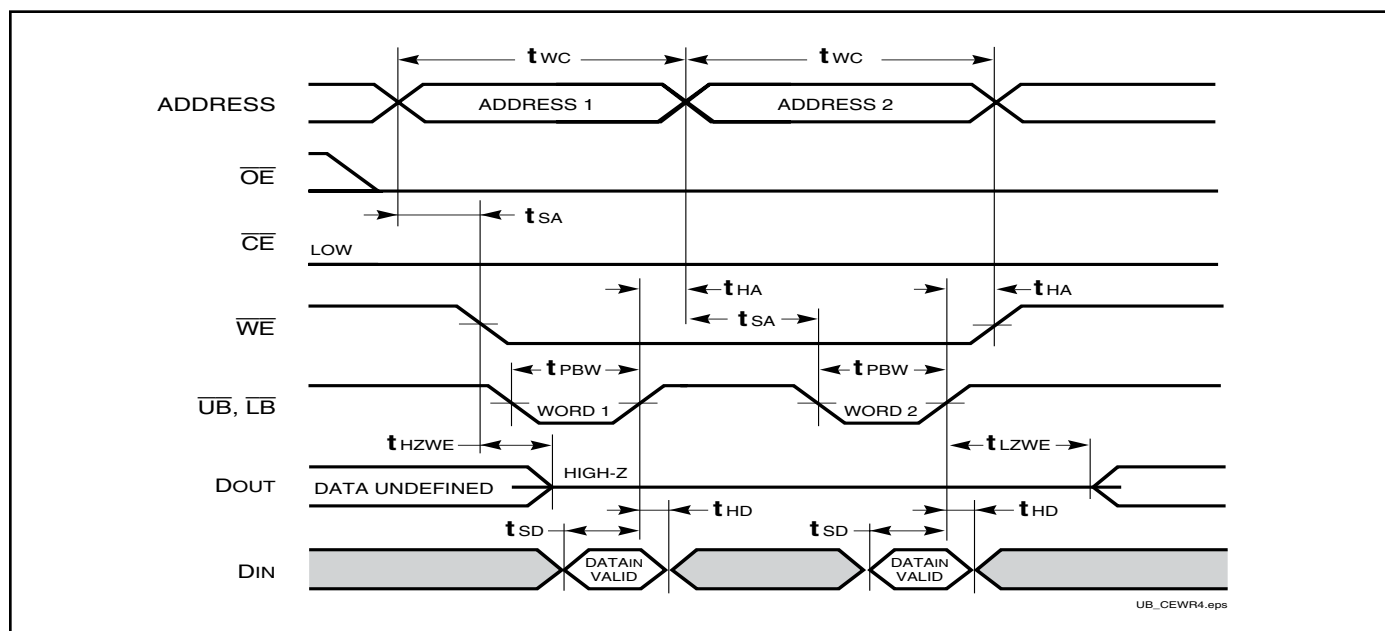


### WRITE CYCLE NO. 3 ( $\overline{WE}$ Controlled. $\overline{OE}$ is LOW During Write Cycle) <sup>(1)</sup>



## AC WAVEFORMS

### WRITE CYCLE NO. 4 ( $\overline{\text{LB}}$ , $\overline{\text{UB}}$ Controlled, Back-to-Back Write) <sup>(1,3)</sup>



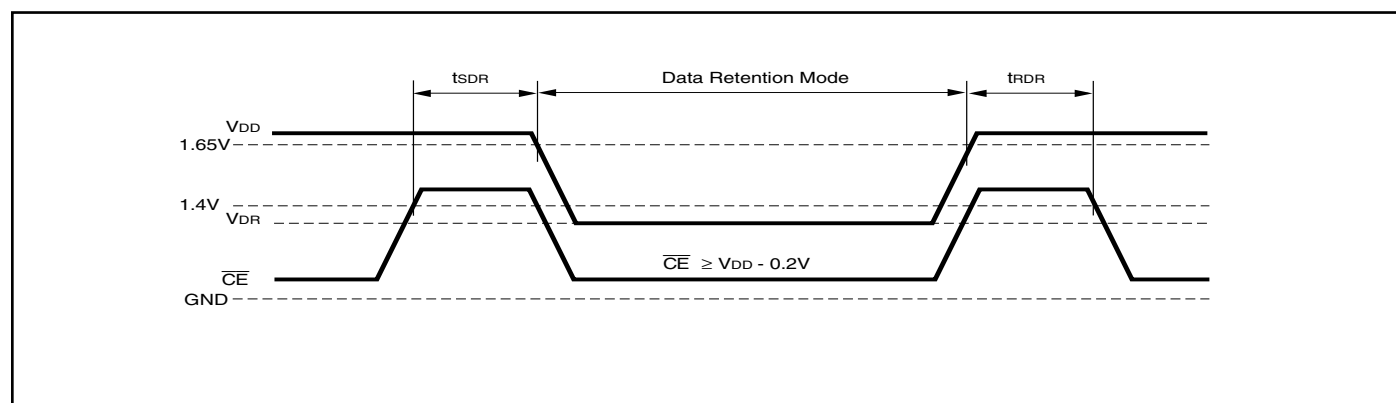
#### Notes:

1. The internal Write time is defined by the overlap of  $\overline{\text{CE}} = \text{LOW}$ ,  $\overline{\text{UB}}$  and/or  $\overline{\text{LB}} = \text{LOW}$ , and  $\overline{\text{WE}} = \text{LOW}$ . All signals must be in valid states to initiate a Write, but any can be deasserted to terminate the Write. The  $t_{\text{SA}}$ ,  $t_{\text{HA}}$ ,  $t_{\text{SD}}$ , and  $t_{\text{HD}}$  timing is referenced to the rising or falling edge of the signal that terminates the Write.
2. Tested with  $\overline{\text{OE}}$  HIGH for a minimum of 4 ns before  $\overline{\text{WE}} = \text{LOW}$  to place the I/O in a HIGH-Z state.
3.  $\overline{\text{WE}}$  may be held LOW across many address cycles and the  $\overline{\text{LB}}$ ,  $\overline{\text{UB}}$  pins can be used to control the Write function.

## DATA RETENTION SWITCHING CHARACTERISTICS

| Symbol    | Parameter                   | Test Condition                                       | Min.     | Max. | Unit |
|-----------|-----------------------------|------------------------------------------------------|----------|------|------|
| $V_{DR}$  | $V_{DD}$ for Data Retention | See Data Retention Waveform                          | 1.2      | 3.6  | V    |
| $I_{DR}$  | Data Retention Current      | $V_{DD} = 1.2V$ , $\overline{CE} \geq V_{DD} - 0.2V$ | —        | 20   | mA   |
|           |                             | Ind.<br>Auto.                                        | —        | 50   |      |
| $t_{SDR}$ | Data Retention Setup Time   | See Data Retention Waveform                          | 0        | —    | ns   |
| $t_{RDR}$ | Recovery Time               | See Data Retention Waveform                          | $t_{RC}$ | —    | ns   |

## DATA RETENTION WAVEFORM ( $\overline{CE}$ Controlled)



## ORDERING INFORMATION

**Industrial Range: -40°C to +85°C**

**Voltage Range: 2.4V to 3.6V**

| Speed (ns)           | Order Part No.        | Package                             |
|----------------------|-----------------------|-------------------------------------|
| 10 (8 <sup>1</sup> ) | IS61WV102416BLL-10MI  | 48 mini BGA (9mm x 11mm)            |
|                      | IS61WV102416BLL-10MLI | 48 mini BGA (9mm x 11mm), Lead-free |
|                      | IS61WV102416BLL-10TLI | TSOP (Type I), Lead-free            |

Note:

1. Speed = 8ns for  $V_{DD} = 3.3V \pm 5\%$ . Speed = 10ns for  $V_{DD} = 2.4V - 3.6V$

**Industrial Range: -40°C to +85°C**

**Voltage Range: 1.65V to 2.2V**

| Speed (ns) | Order Part No.        | Package                  |
|------------|-----------------------|--------------------------|
| 20         | IS61WV102416ALL-20MI  | 48 mini BGA (9mm x 11mm) |
|            | IS61WV102416ALL-20TLI | TSOP (Type I), Lead-free |

**Automotive Range: -40°C to +125°C**

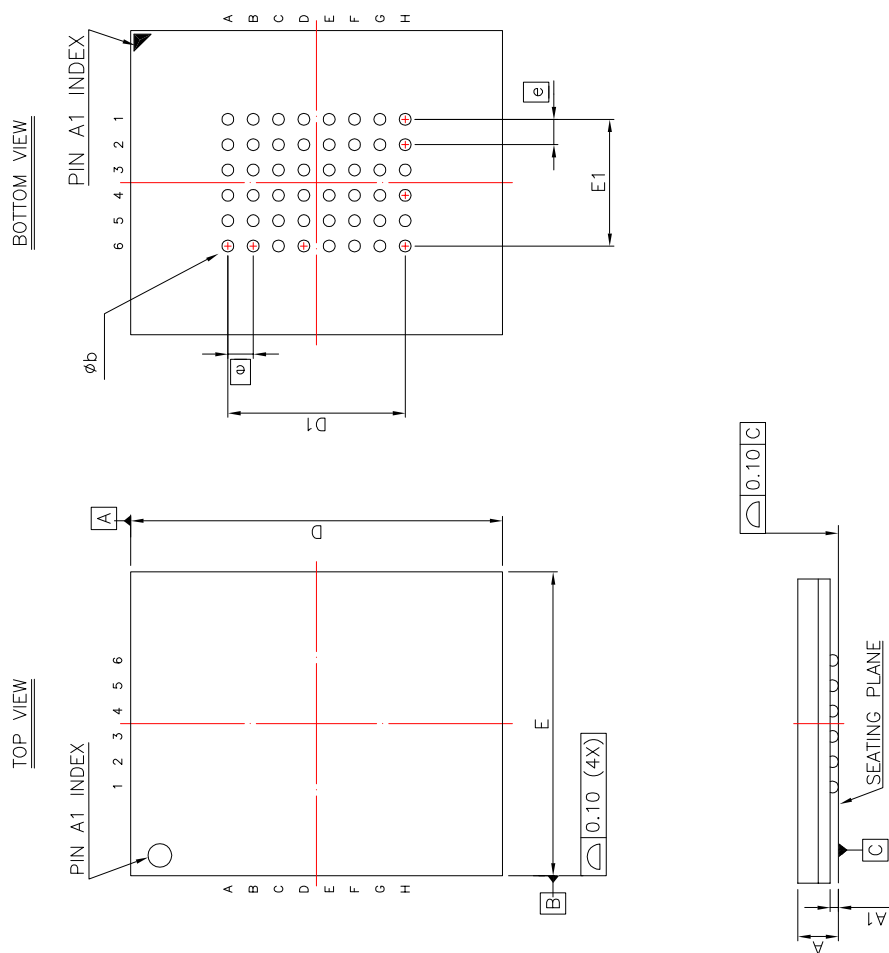
**Voltage Range: 2.4V to 3.6V**

| Speed (ns) | Order Part No.          | Package                                    |
|------------|-------------------------|--------------------------------------------|
| 10         | IS64WV102416BLL-10MA3   | 48 mini BGA (9mm x 11mm)                   |
|            | IS64WV102416BLL-10MLA3  | 48 mini BGA (9mm x 11mm), Lead-free        |
|            | IS64WV102416BLL-10CTLA3 | TSOP (Type I), Copper Leadframe, Lead-free |

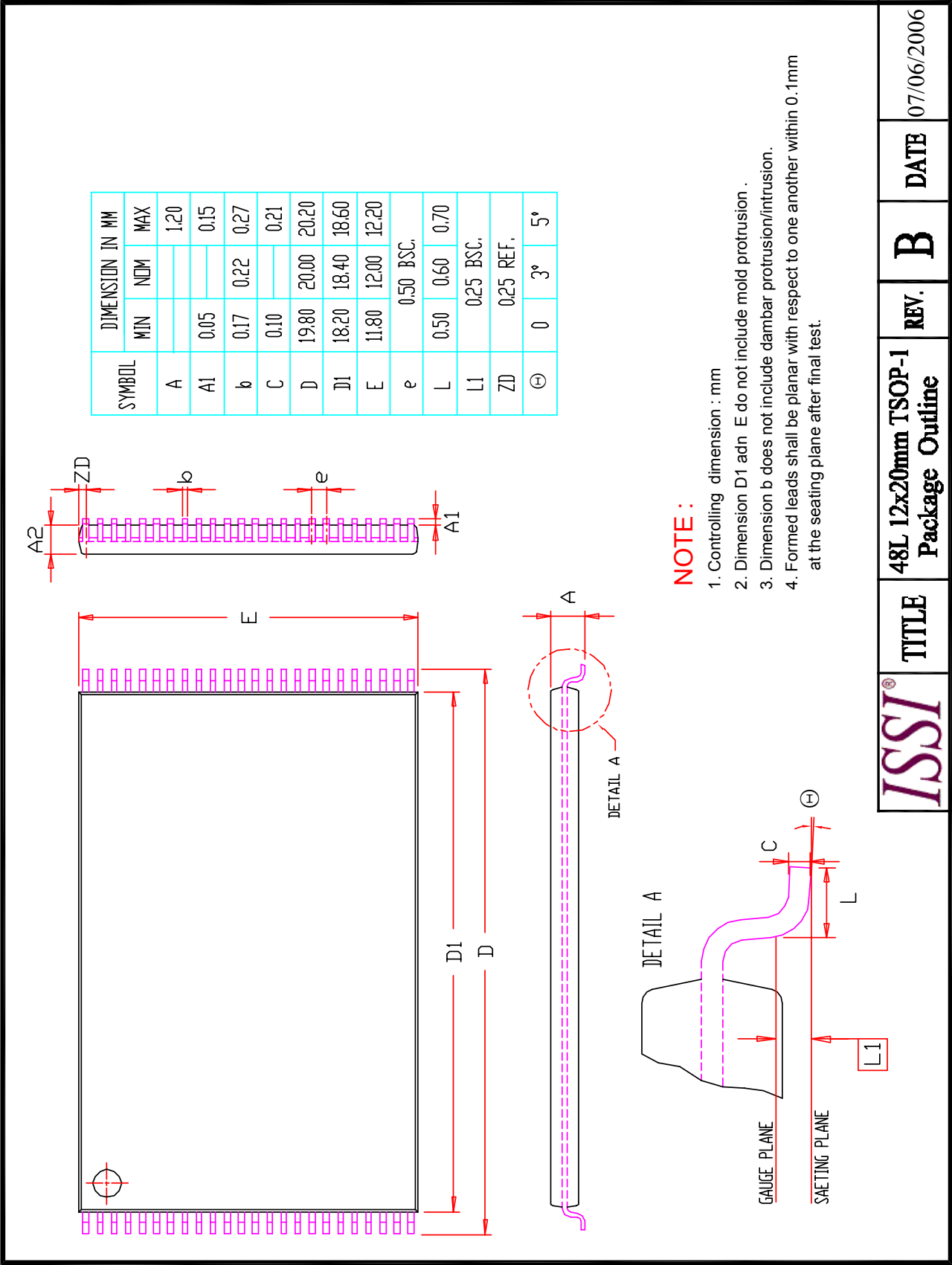
| SYM. | DIMENSION (mm) |       |       | DIMENSION (INCH) |       |       |
|------|----------------|-------|-------|------------------|-------|-------|
|      | MIN.           | NOM.  | MAX.  | MIN.             | NOM.  | MAX.  |
| A    | —              | —     | 1.20  | —                | —     | 0.047 |
| A1   | 0.20           | —     | 0.30  | 0.008            | —     | 0.012 |
| b    | 0.30           | 0.35  | 0.40  | 0.012            | 0.014 | 0.016 |
| D    | 10.90          | 11.00 | 11.10 | 0.429            | 0.433 | 0.437 |
| D1   | 5.25 BSC       |       |       | 0.207 BSC        |       |       |
| E    | 8.90           | 9.00  | 9.10  | 0.350            | 0.354 | 0.358 |
| E1   | 3.75 BSC       |       |       | 0.148 BSC        |       |       |
| e    | 0.75 BSC       |       |       | 0.030 BSC        |       |       |

**NOTE :**

1. CONTROLLING DIMENSION : MM .
2. Reference document : JEDEC MO-207



|      |       |                                      |      |   |      |            |
|------|-------|--------------------------------------|------|---|------|------------|
| ISSI | TITLE | 48L 9x11mm TF-BGA<br>Package Outline | REV. | B | DATE | 08/21/2008 |
|------|-------|--------------------------------------|------|---|------|------------|



|       |       |                                       |        |                 |
|-------|-------|---------------------------------------|--------|-----------------|
| ISSI® | TITLE | 48L 12x20mm TSOP-1<br>Package Outline | REV. B | DATE 07/06/2006 |
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