

# 8Mb LOW VOLTAGE, ULTRA LOW POWER PSEUDO CMOS STATIC RAM

## Features

- High-Speed access time :
  - 70ns ( IS66WV51216EALL )
  - 60ns (IS66/67WV51216EBLL )
- CMOS Lower Power Operation
- Single Power Supply
  - VDD =1.7V~1.95V( IS66WV51216EALL )
  - VDD =2.5V~3.6V (IS66/67WV51216EBLL )
- Three State Outputs
- Data Control for Upper and Lower bytes
- Lead-free Available

## DESCRIPTION

The ISSI/IS66WV51216EALL and IS66/67WV51216EBLL are high-speed, 8M bit static RAMs organized as 512K words by 16 bits. It is fabricated using ISSI's high performance CMOS technology.

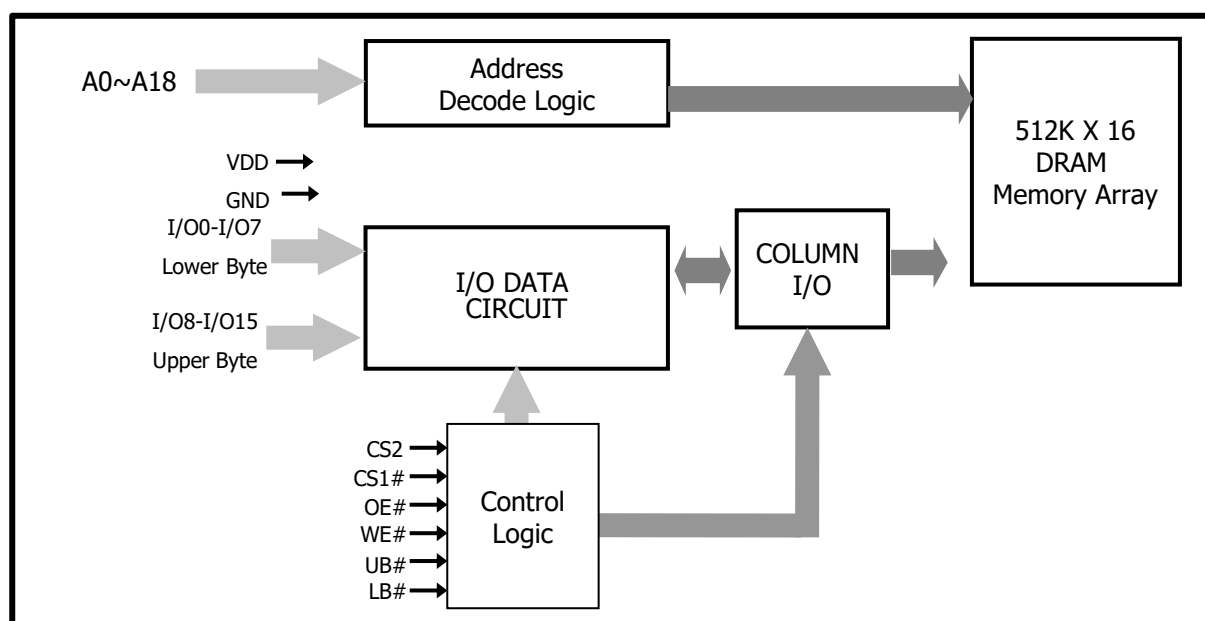
This highly reliable process coupled with innovative circuit design techniques, yields high-performance and low power consumption devices.

When CS1# is HIGH (deselected) or when CS2 is LOW (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. The active LOW Write Enable (WE#) controls both writing and reading of the memory. A data byte allows Upper Byte (UB#) and Lower Byte (LB#) access.

The IS66WV51216 EALL and IS66/67WV51216EBLL are packaged in the JEDEC standard 48-ball mini BGA (6mm x 8mm) and 44-Pin TSOP(TYPE-II). The device is also available for die sales.

## FUNCTIONAL BLOCK DIAGRAM



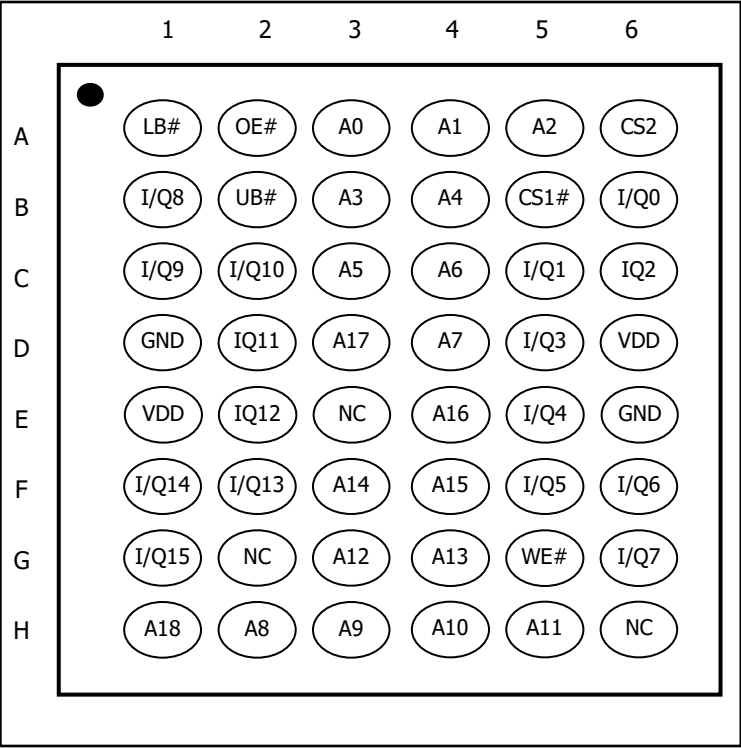
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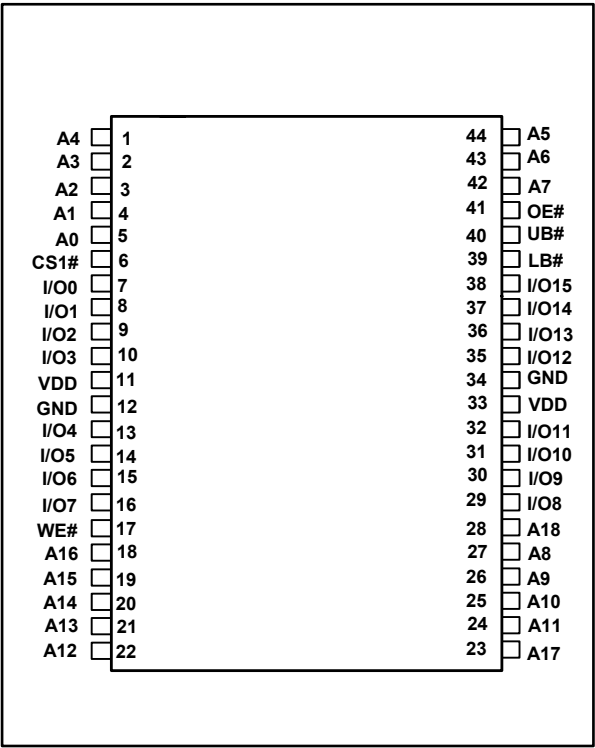
- the risk of injury or damage has been minimized;
- the user assume all such risks; and
- potential liability of Integrated Silicon Solution, Inc is adequately protected under the circumstances

PIN CONFIGURATIONS

48-Ball miniBGA (6mm x 8mm) Ball Assignment



44-pin TSOP (Type II)

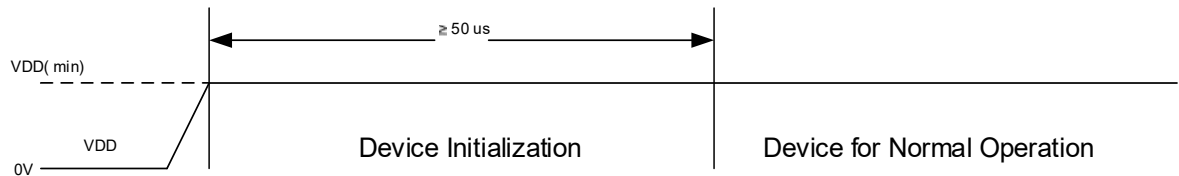


PIN DESCRIPTIONS

| Symbol     | Type           | Description         |
|------------|----------------|---------------------|
| A0~A18     | Input          | Address Inputs      |
| I/Q0~I/Q15 | Input / Output | Data Inputs/Outputs |
| CS1#, CS2  | Input          | Chip Enable         |
| OE#        | Input          | Output Enable       |
| WE#        | Input          | Write Enable        |
| UB#        | Input          | Upper Byte select   |
| LB#        | Input          | Lower Byte select   |
| VDD        | Power Supply   | Power               |
| GND        | Power Supply   | Ground              |

POWER UP INITIALIZATION

IS66WV51216EALL and IS66/67WV51216EBLL include an on-chip voltage sensor used to launch the power-up initialization process. When VDD reaches a stable level at or above the VDD (min) the device will require 50µs to complete its self-initialization process. During the initialization period, CS1# should remain HIGH. When initialization is complete, the device is ready for normal operation.



TRUTH TABLE

| Mode            | WE#         | CS1#        | CS2         | OE#         | LB#         | UB#         | I/O0 – I/O7            | I/O8 – I/O15           | VDD Current              |
|-----------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------------|------------------------|--------------------------|
| Not Selected    | X<br>X      | H<br>X      | X<br>L      | X<br>X      | X<br>X      | H<br>X      | High-Z<br>High-Z       | High-Z<br>High-Z       | ISB1, ISB2<br>ISB1, ISB2 |
| Output Disabled | H<br>H      | L<br>L      | H<br>H      | H<br>H      | L<br>X      | X<br>L      | High-Z<br>High-Z       | High-Z<br>High-Z       | ICC<br>ICC               |
| Read            | H<br>H<br>H | L<br>L<br>L | H<br>H<br>H | L<br>L<br>L | L<br>H<br>L | H<br>L<br>L | DOUT<br>High-Z<br>DOUT | High-Z<br>DOUT<br>DOUT | ICC<br>ICC<br>ICC        |
| Write           | L<br>L<br>L | L<br>L<br>L | H<br>H<br>H | X<br>X<br>X | L<br>H<br>L | H<br>L<br>L | Din<br>High-Z<br>Din   | High-Z<br>Din<br>Din   | ICC<br>ICC<br>ICC        |

Notes:

CS2 input signal pin is only available for 48-ball mini BGA package part. CS2 input is internally enabled for 44-pin TSOP II package part.

OPERATING RANGE (VDD)

| Range           | Ambient Temperature | IS66WV51216EALL (70ns) | IS66WV51216EBLL (55ns, 70ns) | IS66WV51216EBLL (55ns, 70ns) |
|-----------------|---------------------|------------------------|------------------------------|------------------------------|
| Industrial      | –40°C to +85°C      | 1.7V – 1.95V           | 2.5V – 3.6V                  | –                            |
| Automotive , A1 | –40°C to +85°C      | –                      | –                            | 2.5V – 3.6V                  |
| Automotive , A2 | –40°C to +105°C     | –                      | –                            | 2.5V – 3.6V                  |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter                            | Value             | Unit |
|--------|--------------------------------------|-------------------|------|
| VTERM  | Terminal Voltage with Respect to GND | -0.2 to VDD + 0.3 | V    |
| TBIAS  | Temperature Under BIAS               | -40 to +85        | °C   |
| VDD    | VDD Related to GND                   | -0.2 to +3.8      | V    |
| TSTG   | Storage Temperature                  | -65 to +150       | °C   |
| PT     | Power Dissipation                    | 1.0               | W    |

Notes:

Stresses greater than those listed 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 this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

VDD = 2.5V-3.6V (IS66/67WV51216EBLL)

| Symbol | Parameter             | Test Conditions                       | VDD      | Min. | Max.      | Unit |
|--------|-----------------------|---------------------------------------|----------|------|-----------|------|
| VOH    | Output HIGH Voltage   | IOH = -1 mA                           | 2.5-3.6V | 2.2  | —         | V    |
| VOL    | Output LOW Voltage    | IOL = 2.1 mA                          | 2.5-3.6V | —    | 0.4       | V    |
| VIH    | Input HIGH Voltage(1) |                                       | 2.5-3.6V | 2.2  | VDD + 0.3 | V    |
| VIL    | Input LOW Voltage(1)  |                                       | 2.5-3.6V | -0.2 | 0.6       | V    |
| ILI    | Input Leakage         | GND ≤ VIN ≤ VDD                       |          | -1   | 1         | µA   |
| ILO    | Output Leakage        | GND ≤ VOUT ≤ VDD,<br>Outputs Disabled |          | -1   | 1         | µA   |

Notes:

1. VILL (min.) = -2.0V AC (pulse width < 10ns). Not 100% tested.  
VIHH (max.) = VDD + 2.0V AC (pulse width < 10ns). Not 100% test

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

VDD = 1.7V-1.95V(IS66WV51216EALL)

| Symbol | Parameter             | Test Conditions                       | VDD       | Min. | Max       | Unit |
|--------|-----------------------|---------------------------------------|-----------|------|-----------|------|
| VOH    | Output HIGH Voltage   | IOH = -0.1 mA                         | 1.7-1.95V | 1.4  | —         | V    |
| VOL    | Output LOW Voltage    | IOL = 0.1 mA                          | 1.7-1.95V | —    | 0.2       | V    |
| VIH    | Input HIGH Voltage(1) |                                       | 1.7-1.95V | 1.4  | VDD + 0.2 | V    |
| VIL    | Input LOW Voltage(1)  |                                       | 1.7-1.95V | -0.2 | 0.4       | V    |
| ILI    | Input Leakage         | GND ≤ VIN ≤ VDD                       |           | -1   | 1         | µA   |
| ILO    | Output Leakage        | GND ≤ VOUT ≤ VDD,<br>Outputs Disabled |           | -1   | 1         | µA   |

Notes:

1. VILL (min.) = -1.0V AC (pulse width < 10ns). Not 100% tested.  
VIHH (max.) = VDD + 1.0V AC (pulse width < 10ns). Not 100% test

CAPACITANCE

| Symbol          | Description                   | Conditions            | MIN | MAX | Unit |
|-----------------|-------------------------------|-----------------------|-----|-----|------|
| C <sub>IN</sub> | Input Capacitance             | V <sub>IN</sub> = 0V  | -   | 8   | pF   |
| C <sub>IO</sub> | Input/Output Capacitance (DQ) | V <sub>out</sub> = 0V | -   | 10  | pF   |

Notes:

1. Tested initially and after any design or process changes that may affect these parameters.

AC TEST CONDITIONS

| Parameter                                   | 1.7V – 1.95V<br>( Unit )       | 2.5V – 3.6V<br>( Unit )        |
|---------------------------------------------|--------------------------------|--------------------------------|
| Input Pulse Level                           | 0.4V to V <sub>DD</sub> – 0.2V | 0.4V to V <sub>DD</sub> – 0.3V |
| Input Rise and Fall Time                    | 5ns                            | 5ns                            |
| Input and Output Timing and Reference Level | V <sub>REF</sub>               | V <sub>REF</sub>               |
| Output Load                                 | See Figures 1 and 2            | See Figures 1 and 2            |

| Symbol           | 1.7V – 1.95V | 2.5V – 3.6V |
|------------------|--------------|-------------|
| R1(Ω)            | 3070         | 1029        |
| R2(Ω)            | 3150         | 1728        |
| V <sub>REF</sub> | 0.9V         | 1.4V        |
| V <sub>TM</sub>  | 1.8V         | 2.8V        |

AC TEST LOADS

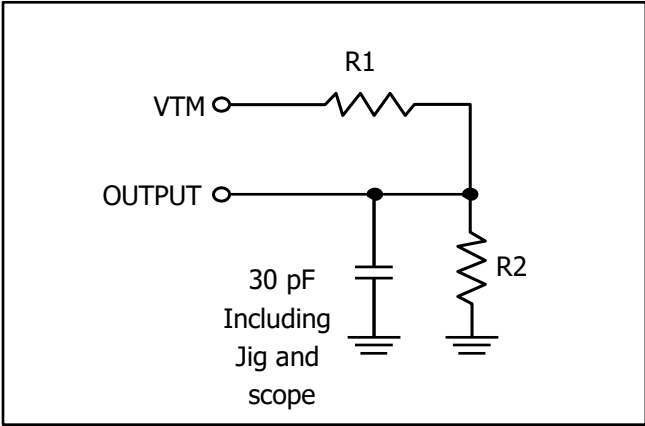


Figure 1

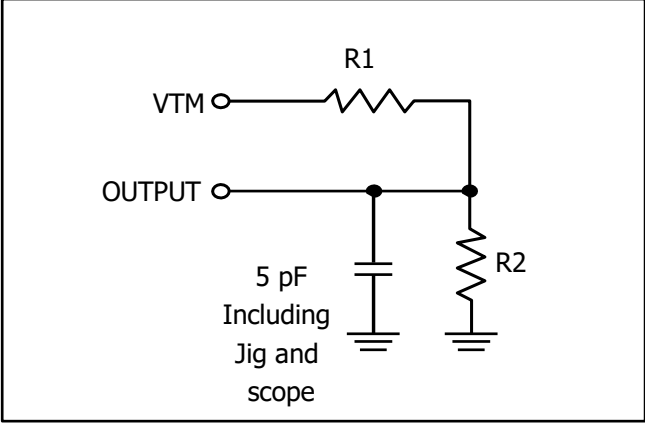


Figure 2

1.7V-1.95V POWER SUPPLY CHARACTERISTICS (Over Operating Range)

| Symbol           | Parameter                            | Conditions                                                                                                                  | Device | TYP. | MAX.<br>70ns | Unit |
|------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------|------|--------------|------|
| I <sub>CC</sub>  | VDD Dynamic Operating Supply Current | VDD=Max., I <sub>OUT</sub> =0mA,<br>f=f <sub>MAX</sub> , All inputs = 0.4V<br>or VDD – 0.2V                                 | Com.   | -    | 20           | mA   |
|                  |                                      |                                                                                                                             | Ind.   | -    | 25           |      |
|                  |                                      |                                                                                                                             | Auto   | -    | 30           |      |
| I <sub>CC1</sub> | Operating Supply Current             | VDD=Max., CS1#=0.2V,<br>WE# = VDD – 0.2V,<br>f=1MHz                                                                         | Com.   | -    | 8            | mA   |
|                  |                                      |                                                                                                                             | Ind.   | -    | 8            |      |
|                  |                                      |                                                                                                                             | Auto   | -    | 10           |      |
| I <sub>SB1</sub> | TTL Standby Current (TTL Inputs)     | VDD=Max., V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> ,<br>CS1# = V <sub>IH</sub> , CS2=V <sub>IL</sub> ,<br>f=1MHz | Com.   | -    | 0.6          | mA   |
|                  |                                      |                                                                                                                             | Ind.   | -    | 0.6          |      |
|                  |                                      |                                                                                                                             | Auto   | -    | 1            |      |
| I <sub>SB2</sub> | CMOS Standby Current (CMOS Inputs)   | VDD=Max.,<br>CS1# ≥ VDD – 0.2V,<br>CS2 ≤ 0.2V, V <sub>IN</sub> > VDD – 0.2V<br>or V <sub>IN</sub> < 0.2V, f=0               | Com.   | -    | 100          | uA   |
|                  |                                      |                                                                                                                             | Ind.   | -    | 120          |      |
|                  |                                      |                                                                                                                             | Auto   | -    | 150          |      |

Notes:  
1. At f=f<sub>MAX</sub>, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.

2.5V-3.6V POWER SUPPLY CHARACTERISTICS (Over Operating Range)

| Symbol           | Parameter                            | Conditions                                                                                                                  | Device             | TYP | MAX<br>55ns | Unit |
|------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------|-----|-------------|------|
| I <sub>CC</sub>  | VDD Dynamic Operating Supply Current | VDD=Max., I <sub>OUT</sub> =0mA,<br>f=f <sub>MAX</sub> , All inputs = 0.4V<br>or VDD – 0.3V                                 | Com.               | -   | 25          | mA   |
|                  |                                      |                                                                                                                             | Ind.               | -   | 28          |      |
|                  |                                      |                                                                                                                             | Auto A2<br>Typ.(2) | -   | 35<br>15    |      |
| I <sub>CC1</sub> | Operating Supply Current             | VDD=Max., CS1#=0.2V,<br>WE# = VDD – 0.2V,<br>f=1MHz                                                                         | Com.               | -   | 8           | mA   |
|                  |                                      |                                                                                                                             | Ind.               | -   | 8           |      |
|                  |                                      |                                                                                                                             | Auto A2            | -   | 10          |      |
| I <sub>SB1</sub> | TTL Standby Current (TTL Inputs)     | VDD=Max., V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> ,<br>CS1# = V <sub>IH</sub> , CS2=V <sub>IL</sub> ,<br>f=1MHz | Com.               | -   | 0.6         | mA   |
|                  |                                      |                                                                                                                             | Ind.               | -   | 0.6         |      |
|                  |                                      |                                                                                                                             | Auto A2            | -   | 1           |      |
| I <sub>SB2</sub> | CMOS Standby Current (CMOS Inputs)   | VDD=Max.,<br>CS1# ≥ VDD – 0.2V,<br>CS2 ≤ 0.2V, V <sub>IN</sub> > VDD – 0.2V<br>or V <sub>IN</sub> < 0.2V, f=0               | Com.               | -   | 100         | uA   |
|                  |                                      |                                                                                                                             | Ind.               | -   | 130         |      |
|                  |                                      |                                                                                                                             | Auto A2<br>Typ.(2) | -   | 150<br>75   |      |

Notes:  
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 VDD = 3.0V, Ta = 25 °C, and not 100% tested.

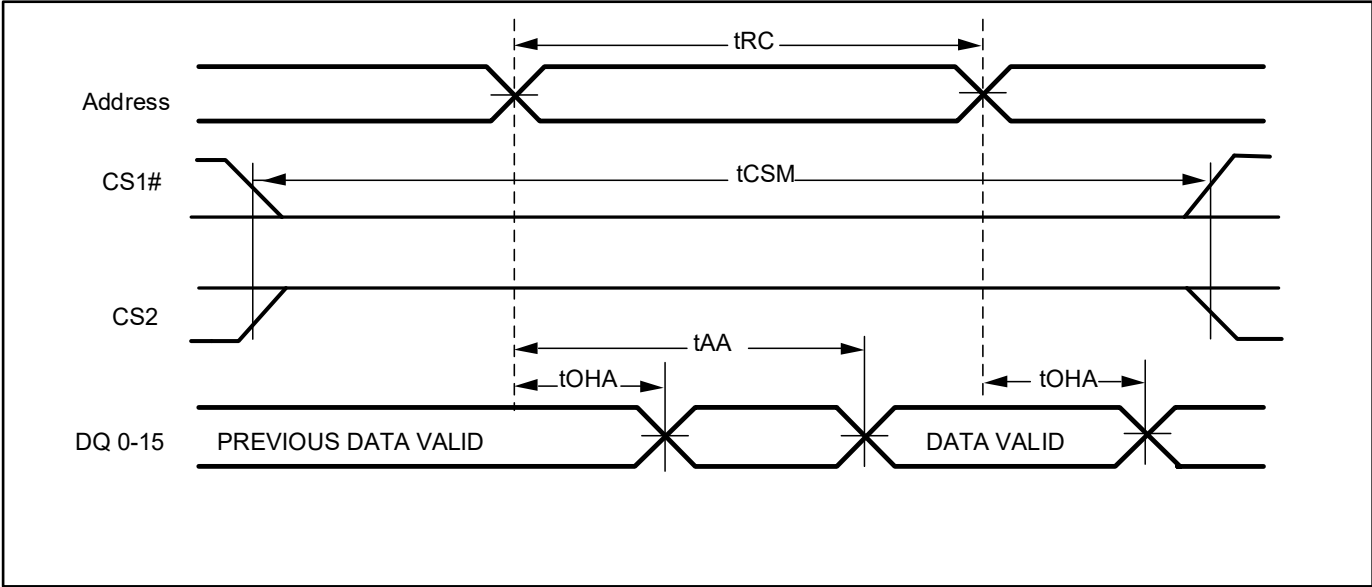
READ CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup>(Over Operating Range)

| Symbol                   | Parameter                    | -55 |     | -70 |     | Unit | Notes |
|--------------------------|------------------------------|-----|-----|-----|-----|------|-------|
|                          |                              | Min | Max | Min | Max |      |       |
| t <sub>RC</sub>          | Read cycle time              | 60  | -   | 70  | -   | ns   |       |
| t <sub>AA</sub>          | Address Access Time          | -   | 60  | -   | 70  | ns   | 1     |
| t <sub>OHA</sub>         | Output Hold Time             | 10  | -   | 10  | -   | ns   |       |
| t <sub>ACS1/ACS2</sub>   | CS1#/CS2 Access Time         | -   | 60  | -   | 70  | ns   |       |
| t <sub>DOE</sub>         | OE# Access Time              | -   | 25  | -   | 35  | ns   | 1     |
| t <sub>HZOE</sub>        | OE# to High-Z output         | -   | 20  | -   | 25  | ns   | 2     |
| t <sub>LZOE</sub>        | OE# to Low-Z output          | 5   | -   | 5   | -   | ns   | 2     |
| t <sub>CSM</sub>         | Maximum CS1#/CS2 pulse width | -   | 15  | -   | 15  | us   |       |
| t <sub>HZCS1/HZCS2</sub> | CS1#/CS2 to High-Z output    | 0   | 20  | 0   | 25  | ns   | 2     |
| t <sub>LZCS1/HZCS2</sub> | CS1#/CS2 to Low-Z output     | 10  | -   | 10  | -   | ns   | 2     |
| t <sub>BA</sub>          | UB#/LB# Access Time          | -   | 60  | -   | 70  | ns   | 1     |
| t <sub>HZB</sub>         | UB#/LB# to High-Z output     | 0   | 20  | 0   | 25  | ns   | 2     |
| t <sub>LZB</sub>         | UB#/LB# to Low-Z output      | 0   | -   | 0   | -   | ns   | 2     |
| t <sub>CPH</sub>         | CS1# HIGH (CS2 LOW) time     | 5   | -   | 5   | -   | ns   |       |

- Notes:
- 1. Test conditions and output loading are specified in the AC Test Conditions and AC Test Loads (Figure 1) on page 5.
  - 2. Tested with the load in Figure 2. Transition is measured ±100 mV from steady-state voltage. Not 100% tested.

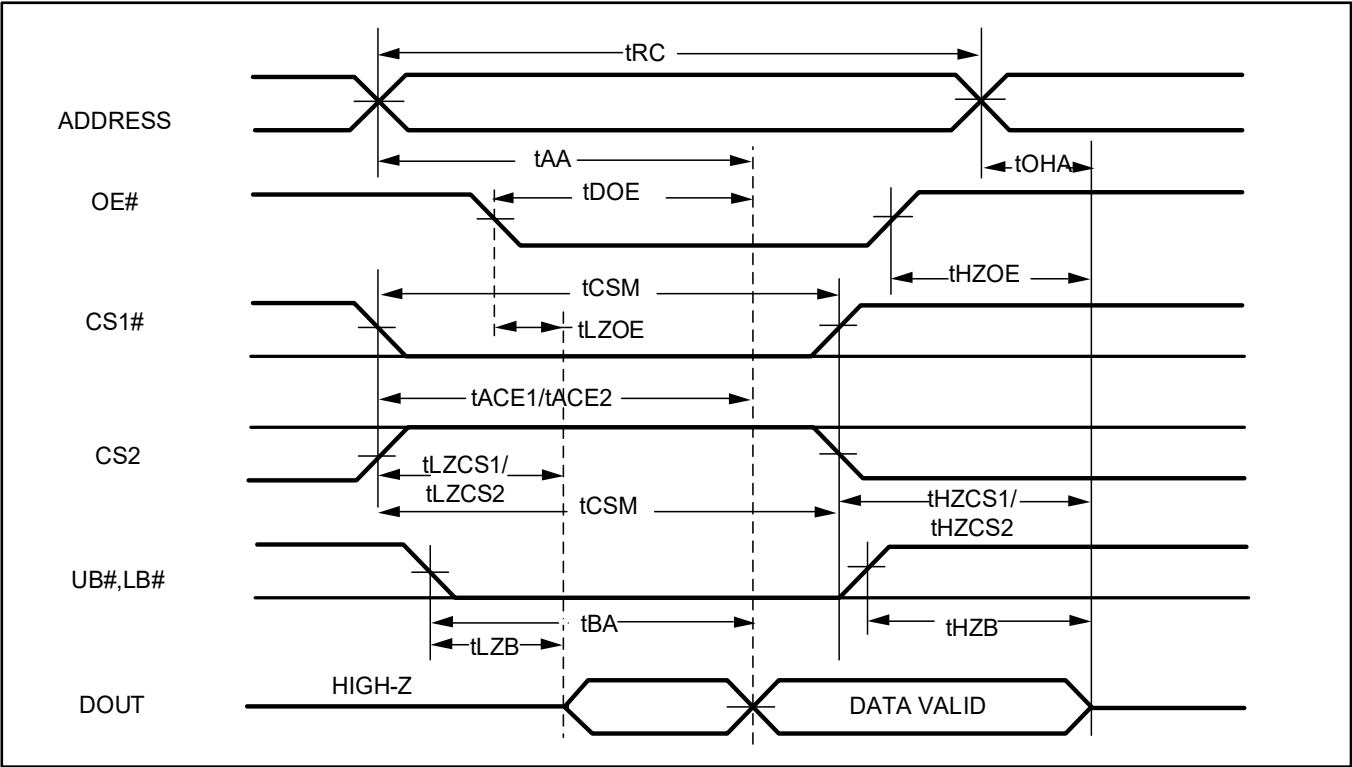
AC WAVEFORMS

READ CYCLE NO. 1<sup>(1)</sup> (Address Controlled, OE#= V<sub>IL</sub>, WE#=V<sub>IH</sub>, UB# or LB# = V<sub>IL</sub>)



- Notes:
- 1. WE# is HIGH for a Read Cycle.

READ CYCLE NO. 2<sup>(1)</sup> (CS1#, CS2, OE# and UB#/LB# Controlled)



- Notes:
1. Address is valid prior to or coincident with CS1# LOW (CS2 HIGH) transition, and is valid after or coincident with CS1# HIGH (CS2 LOW) transition.

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

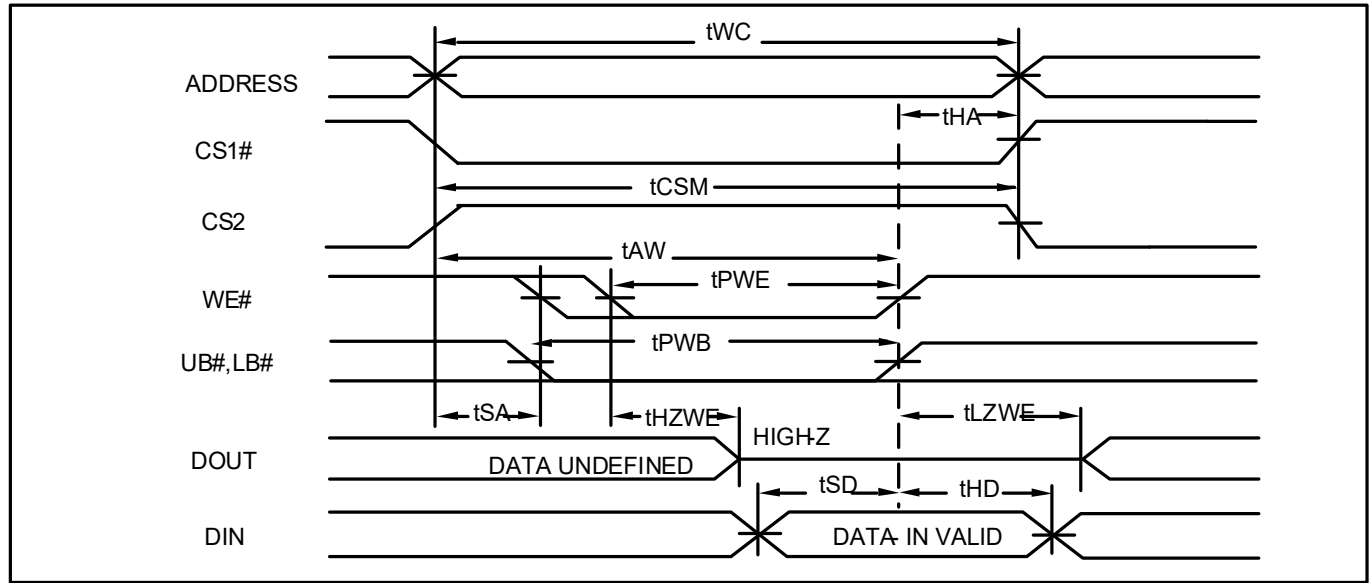
| Symbol          | Parameter                     | -55 |     | -70 |     | Unit | Notes |
|-----------------|-------------------------------|-----|-----|-----|-----|------|-------|
|                 |                               | Min | Max | Min | Max |      |       |
| $t_{WC}$        | Write Cycle Time              | 55  | -   | 70  | -   | ns   |       |
| $t_{SCS1/SCS2}$ | CS1#/CS2 to Write End         | 45  | -   | 60  | -   | ns   |       |
| $t_{CSM}$       | Maximum CS1#/CS2 pulse width  | -   | 15  | -   | 15  | us   |       |
| $t_{AW}$        | Address Setup to Write Time   | 45  | -   | 60  | -   | ns   |       |
| $t_{HA}$        | Address Hold to End of Write  | 0   | -   | 0   | -   | ns   |       |
| $t_{SA}$        | Address Setup Time            | 0   | -   | 0   | -   | ns   |       |
| $t_{PWB}$       | UB#/LB# Valid to End of Write | 45  | -   | 60  | -   | ns   |       |
| $t_{PWE}$       | WE# Pulse Width               | 45  | -   | 60  | -   | ns   |       |
| $t_{SD}$        | Data Setup Time               | 25  | -   | 30  | -   | ns   |       |
| $t_{HZWE}$      | WE# LOW to High-Z output      | -   | 20  | -   | 30  | ns   | 3     |
| $t_{LZWE}$      | WE# HIGH to Low-Z output      | 5   | -   | 5   | -   | ns   | 3     |
| $t_{CPH}$       | CS1# HIGH (CS2 LOW) time      | 5   | -   | 5   | -   | ns   |       |

**Notes:**

1. Test conditions and output loading are specified in the AC Test Conditions and AC Test Loads (Figure 1) on page 5.
2. The internal write time is defined by the overlap of CS1#, UB#, LB# and WE# LOW, CS2 HIGH. All signals must be in valid states to initiate a Write, but anyone can go inactive to terminate Write. The Data Input Setup and Hold timing are referenced to the rising or falling edge of the signals that terminates the Write.
3. Tested with the load in Figure 2. Transition is measured  $\pm 100$  mV from steady-state voltage. Not 100% tested.
4.  $t_{PWE} > t_{HZWE} + t_{SD}$  when OE# is LOW.
5. Chip Select Active Time (both CS1# LOW and CS2 HIGH) must not be longer than  $t_{CMS}$  of 15 us.

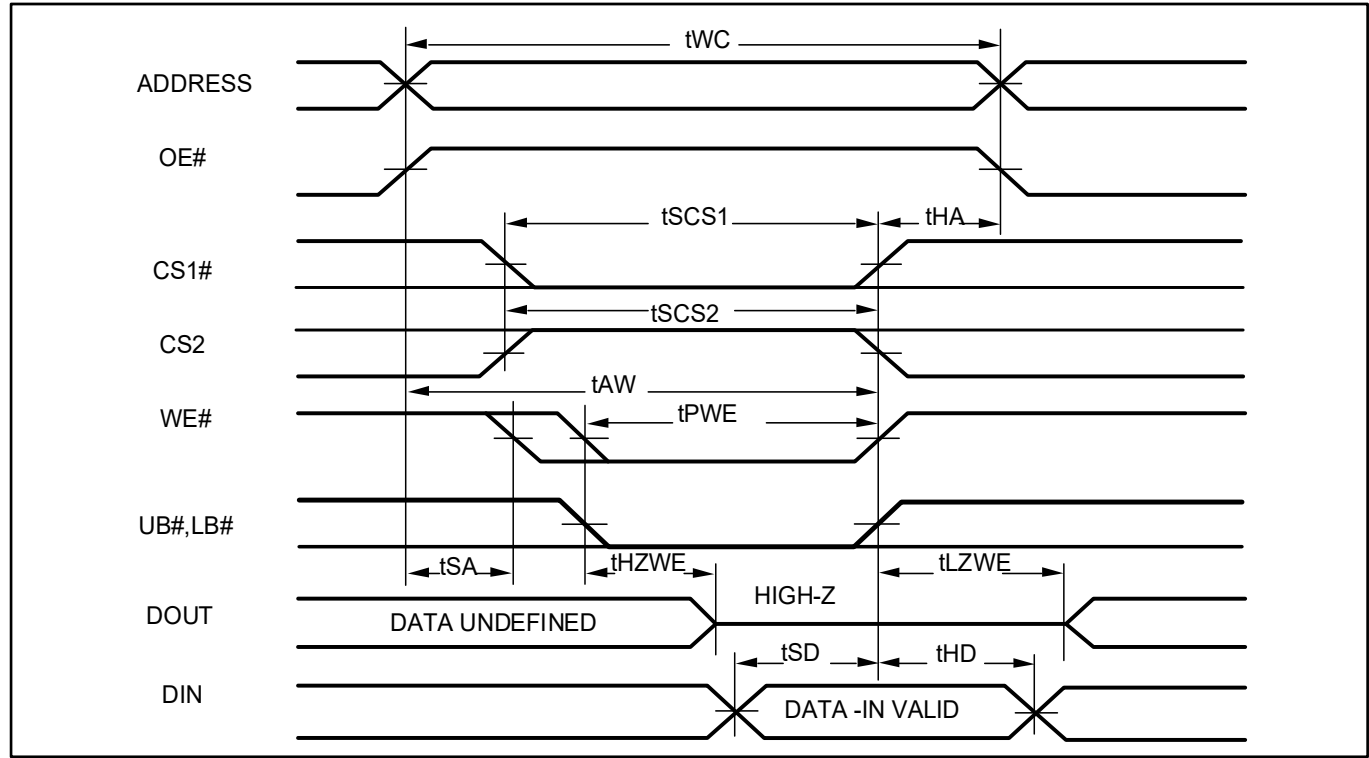
AC WAVEFORMS

WRITE CYCLE NO. 1<sup>(1)</sup> (CS1# Controlled, OE# = HIGH or LOW)

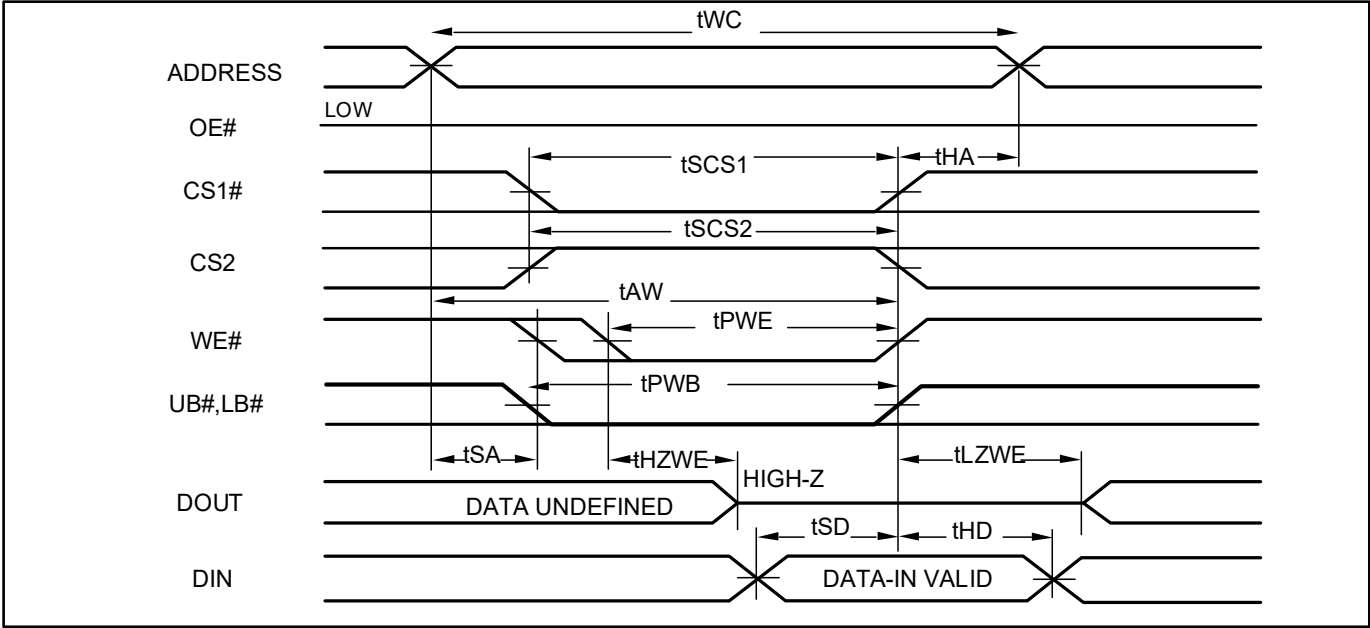


- Notes:
1. Write address is valid prior to or coincident with CS1# LOW (CS2 HIGH) transition, and is valid after or coincident with CS1# HIGH (CS2 LOW) transition.

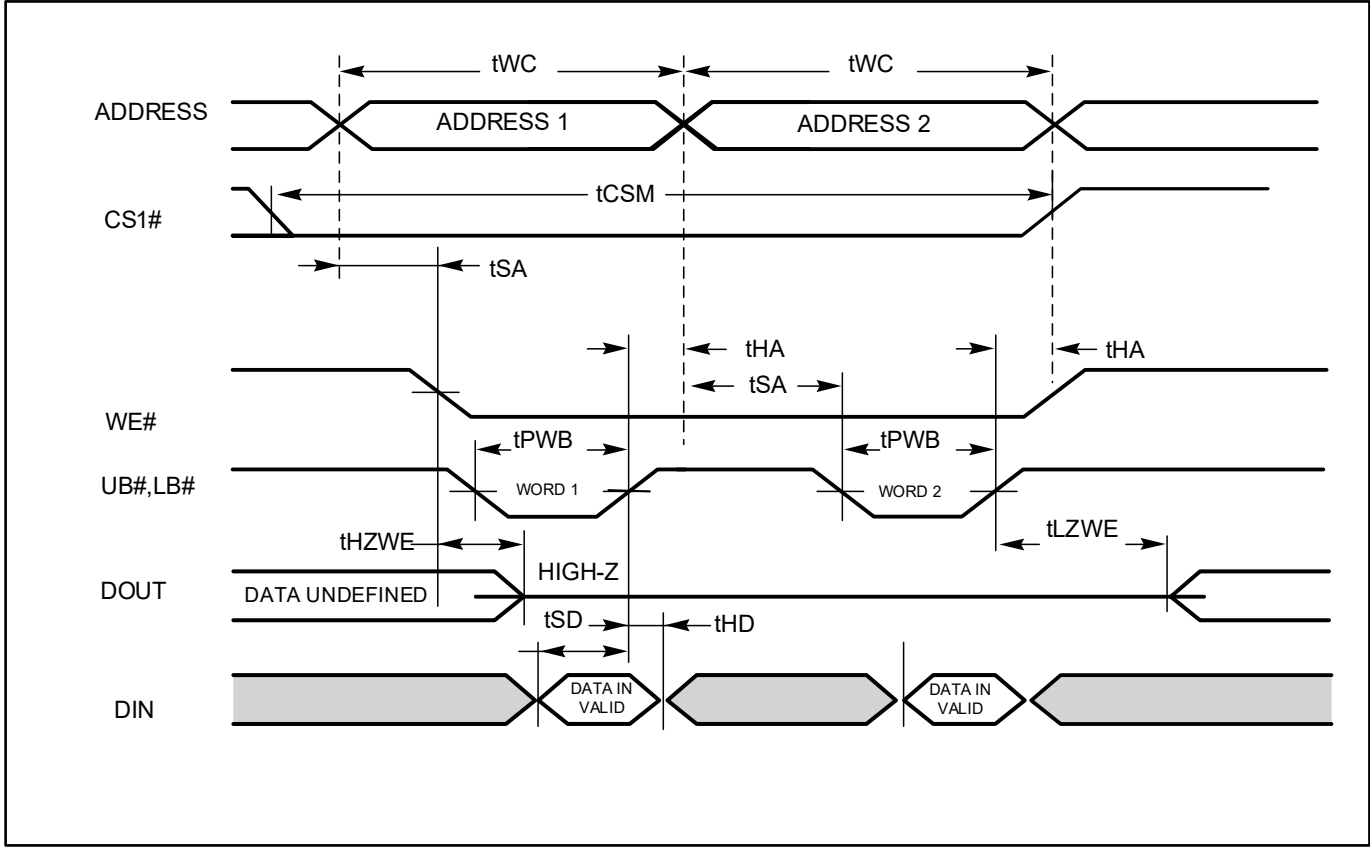
WRITE CYCLE NO. 2 (WE# Controlled, OE# = HIGH during Write Cycle)



WRITE CYCLE NO. 3 (WE# Controlled, OE#= LOW during Write Cycle)



WRITE CYCLE NO. 4 (UB# / LB# Controlled, CS2 is HIGH during Write Cycle)



AVOIDABLE TIMING and RECOMMENDATIONS

Figure 3a : tCSM Violation

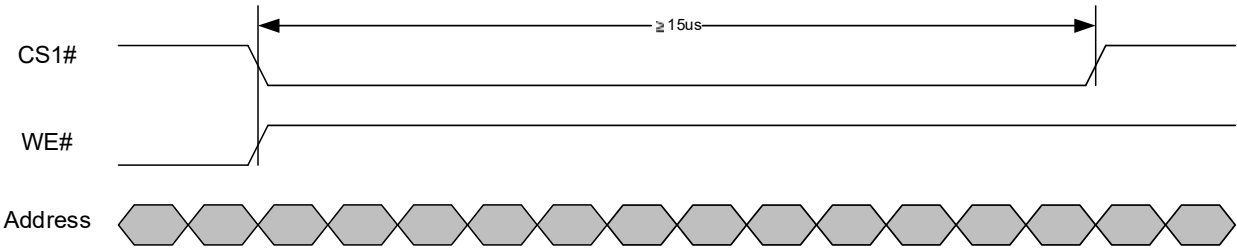
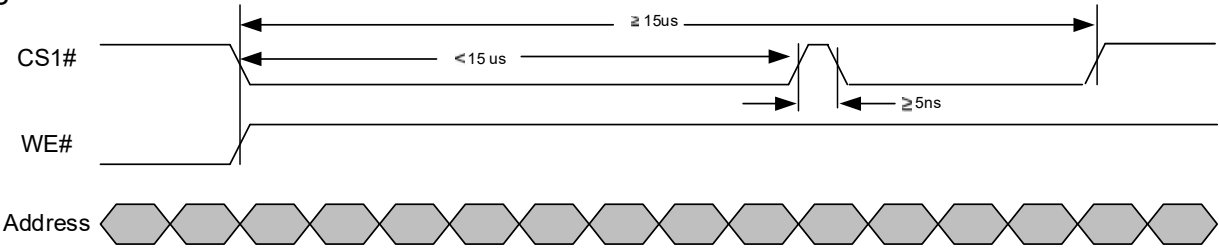


Figure 3b : Recommendation



## AVOIDABLE TIMING and RECOMMENDATIONS

**Figure 4a : tCSM Violation**

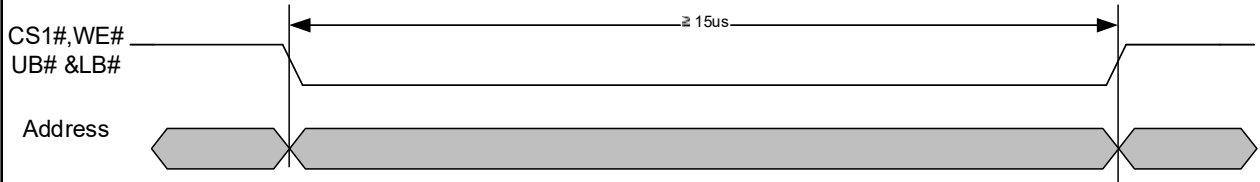
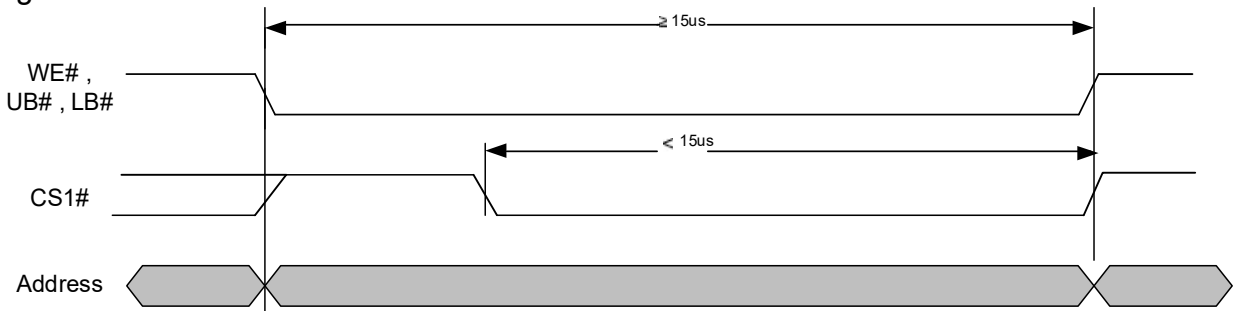


**Figure 4b : Recommendation**



### Notes:

1. PSRAM uses DRAM cell which needs a REFRESH action periodically to retain the information. This REFRESH action is performed only when the device is not selected (Chip Select Pins are Disabled). A hidden REFRESH action has to be executed by the device at least once every 15  $\mu$ s of tCSM.
2. **Figure 3a** shows a timing example in which consecutive READ cycles for more than 15  $\mu$ s. This timing should be avoided for proper REFRESH operation.  
 REFRESH operation can begin only during Chip Select pins are Disabled (CS1# is High and CS2 is Low) for more than 5ns.  
 Example on how to avoid tCSM violation in Figure 3a is shown in Figure 3b.
3. **Figure 4a** shows a timing example in which a single WRITE operation is maintained for a period greater than 15  $\mu$ s. Since a proper REFRESH action cannot be performed during device is selected by Chip Select pins, information stored in the device will not be retained if this timing occurs.  
 Figure 4b is a timing example of using CS1# signal toggling for proper the WRITE operation

### **IS66WV51216EALL**

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

**Voltage Range : 1.7V to 1.95V**

| Config.  | Speed (ns) | Order Part No.                                 | Package                                              |
|----------|------------|------------------------------------------------|------------------------------------------------------|
| 512K x16 | 70         | IS66WV51216EALL-70TLI<br>IS66WV51216EALL-70BLI | TSOP-II, Lead-free<br>mini BGA(6mm x 8mm), Lead-free |

### **IS66WV51216EBLL**

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

**Voltage Range : 2.5V to 3.6V**

| Config.  | Speed (ns) | Order Part No.                                 | Package                                              |
|----------|------------|------------------------------------------------|------------------------------------------------------|
| 512K x16 | 55         | IS66WV51216EBLL-55TLI<br>IS66WV51216EBLL-55BLI | TSOP-II, Lead-free<br>mini BGA(6mm x 8mm), Lead-free |
|          | 70         | IS66WV51216EBLL-70TLI<br>IS66WV51216EBLL-70BLI | TSOP-II, Lead-free<br>mini BGA(6mm x 8mm), Lead-free |

### **IS67WV51216EBLL**

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

**Voltage Range : 2.5V to 3.6V**

| Config.  | Speed (ns) | Order Part No.                                   | Package                                              |
|----------|------------|--------------------------------------------------|------------------------------------------------------|
| 512K x16 | 55         | IS67WV51216EBLL-55TLA1<br>IS67WV51216EBLL-55BLA1 | TSOP-II, Lead-free<br>mini BGA(6mm x 8mm), Lead-free |
|          | 70         | IS67WV51216EBLL-70TLA1<br>IS67WV51216EBLL-70BLA1 | TSOP-II, Lead-free<br>mini BGA(6mm x 8mm), Lead-free |

**Notes :**

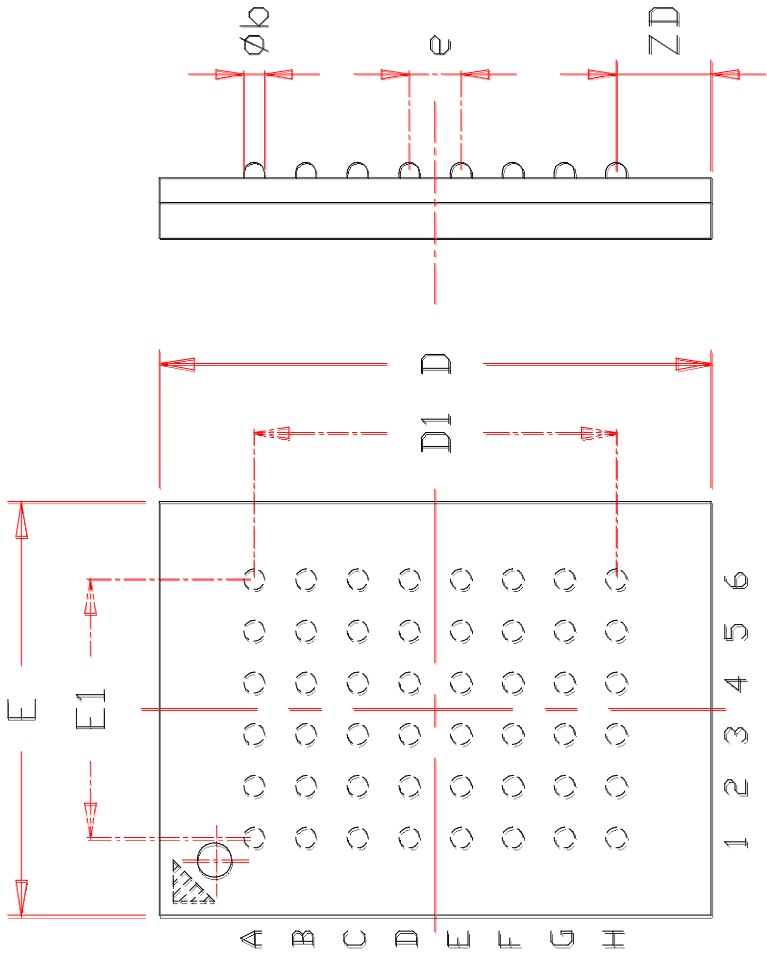
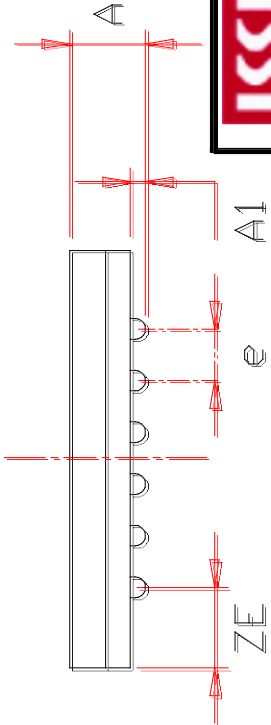
1. Please contact ISSI SRAM marketing at [sram@issi.com](mailto:sram@issi.com) if you need -40 °C to +105 °C product.

| SYMBOL | DIMENSION IN MM |      |      | DIMENSION IN INCH |       |       |
|--------|-----------------|------|------|-------------------|-------|-------|
|        | MIN.            | NOM. | MAX. | MIN.              | NOM.  | MAX.  |
| A      |                 |      | 1.20 |                   |       | 0.047 |
| A1     | 0.20            |      | 0.30 | 0.008             |       | 0.012 |
| øk     | 0.30            | 0.35 | 0.40 | 0.012             | 0.014 | 0.016 |
| D      | 7.90            | 8.00 | 8.10 | 0.311             | 0.315 | 0.319 |
| D1     | 5.25 BSC        |      |      | 0.207 BSC         |       |       |
| E      | 5.90            | 6.00 | 6.10 | 0.232             | 0.236 | 0.240 |
| E1     | 3.75 BSC        |      |      | 0.148 BSC         |       |       |
| e      | 0.75 BSC,       |      |      | 0.030 BSC,        |       |       |
| ZD     | 1.375 REF,      |      |      | 0.054 REF,        |       |       |
| ZE     | 1.125 REF,      |      |      | 0.044 REF,        |       |       |

NOTE :

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

TOP VIEW



TITLE

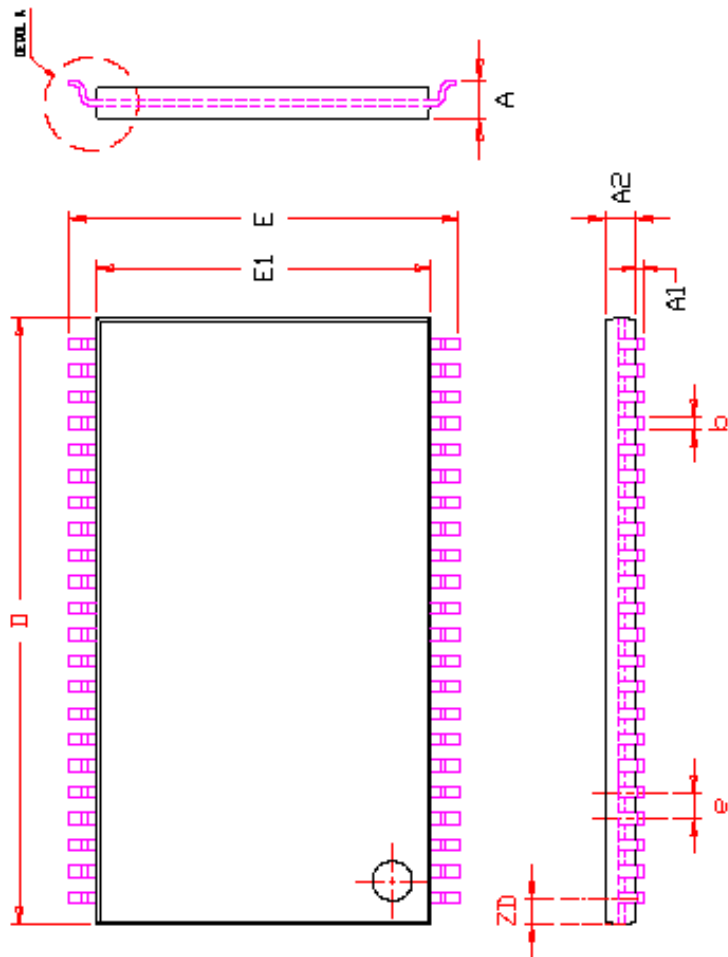
48L 6x8mm TF-BGA  
Package Outline

REV.

C

DATE

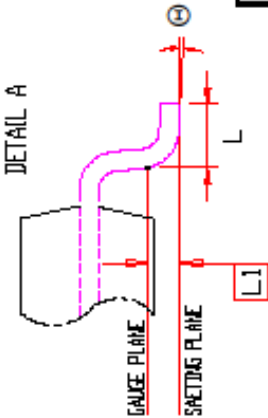
08/12/2008



| SYMBOL | DIMENSION IN MM |       |       | DIMENSION IN INCH |       |       |
|--------|-----------------|-------|-------|-------------------|-------|-------|
|        | MIN.            | NOM.  | MAX.  | MIN.              | NOM.  | MAX.  |
| A      | 1.00            | —     | 1.20  | 0.039             | —     | 0.047 |
| A1     | 0.05            | —     | 0.15  | 0.002             | —     | 0.006 |
| A2     | 0.95            | 1.00  | 1.05  | 0.037             | 0.039 | 0.041 |
| b      | 0.30            | —     | 0.45  | 0.012             | —     | 0.018 |
| D      | 18.28           | 18.41 | 18.54 | 0.720             | 0.725 | 0.730 |
| E      | 11.56           | 11.76 | 11.96 | 0.455             | 0.463 | 0.471 |
| E1     | 10.03           | 10.16 | 10.29 | 0.395             | 0.400 | 0.405 |
| e      | 0.80            | BSC.  | 0.031 | BSC.              | —     | —     |
| L      | 0.40            | —     | 0.69  | 0.016             | —     | 0.027 |
| L1     | 0.25            | BSC.  | 0.010 | BSC.              | —     | —     |
| ZD     | 0.805           | REF.  | 0.032 | REF.              | —     | —     |
| ⊖      | 0               | —     | 8°    | 0                 | —     | 8°    |

NOTE :

1. CONTROLLING DIMENSION : MM
2. DIMENSION D AND E1 DO NOT INCLUDE MOLD PROTRUSION.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION/INTRUSION.



| ISSI | TITLE | 44L 400mil TSOP-2<br>Package Outline | REV. | F | DATE | 06/04/2008 |
|------|-------|--------------------------------------|------|---|------|------------|
|------|-------|--------------------------------------|------|---|------|------------|