

Document Title

64Kx8 bit Low Power CMOS Static RAM

Revision History

| <u>Revision No.</u> | <u>History</u>   | <u>Draft Data</u> | <u>Remark</u> |
|---------------------|--|-------------------|---------------|
| 0.0                 | Initial draft  | November 28, 1993 | Design target |
| 0.1                 | Revision   | May 13, 1994      | Preliminary   |
| 1.0                 | Finalize   | December 1, 1994  | Final         |
| 2.0                 | Revision<br>- Add 45ns part with 30pf test load.   | August 12, 1995   | Final         |
| 3.0                 | Revision<br>- Change Data Sheet format :<br>One data sheets for industrial and commercial product  | April 15, 1996    | Final         |
| 4.0                 | Revision<br>- Change Data Sheet format<br>- Remove 45ns part from commercial product and 100ns part from industrial product<br>- Remove low power part form TSOP package | January 9, 1998   | Final         |

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## 64Kx8 bit Low Power CMOS Static RAM

### FEATURES

- Process Technology: Poly Load
- Organization: 64Kx8
- Power Supply Voltage: 4.5~5.5V
- Low Data Retention Voltage: 2V(Min)
- Three state output and TTL Compatible
- Package Type: 32-SOP-525, 32-TSOP1-0820F

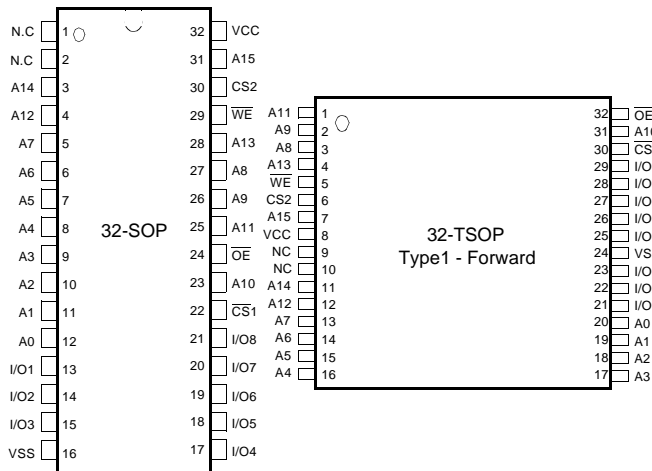
### GENERAL DESCRIPTION

The KM68512A families are fabricated by SAMSUNG's advanced CMOS process technology. The families support various operating temperature ranges and have various package types for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

### PRODUCT FAMILY

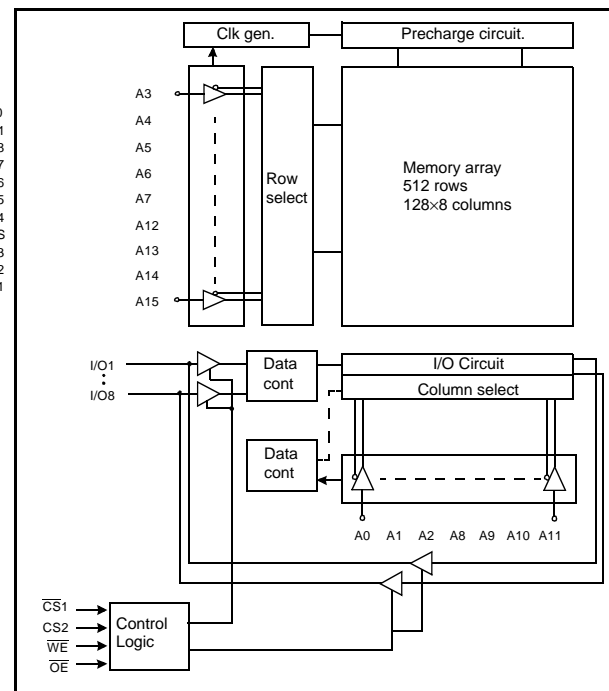
| Product Family             | Operating Temperature | Vcc Range   | Speed   | Power Dissipation                |                                    | PKG Type             |
|----------------------------|-----------------------|-------------|---------|----------------------------------|------------------------------------|----------------------|
|                            |                       |             |         | Standby (I <sub>SB1</sub> , Max) | Operating (I <sub>CC2</sub> , Max) |                      |
| KM68512AL<br>KM68512AL-L   | Commercial (0~70°C)   | 4.5 to 5.5V | 55/70ns | 100µA<br>20µA                    | 70mA                               | 32-SOP<br>32-TSOP1-F |
| KM68512ALI<br>KM68512ALI-L | Industrial (-40~85°C) |             | 70ns    | 100µA<br>50µA                    |                                    |                      |

### PIN DESCRIPTION



| Name                               | Function            |
|------------------------------------|---------------------|
| $\overline{CS}_1, \overline{CS}_2$ | Chip Select Inputs  |
| $\overline{OE}$                    | Output Enable Input |
| $\overline{WE}$                    | Write Enable Input  |
| A <sub>0</sub> ~A <sub>15</sub>    | Address Inputs      |
| I/O <sub>1</sub> ~I/O <sub>8</sub> | Data Inputs/Outputs |
| Vcc                                | Power               |
| Vss                                | Ground              |
| N.C                                | No Connection       |

### FUNCTIONAL BLOCK DIAGRAM



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## PRODUCT LIST

| Commercial Temperature Products(0~70°C) |                          | Industrial Temperature Products(-40~85°C) |                          |
|---|--------------------------|---|--------------------------|
| Part Name                               | Function                 | Part Name                                 | Function                 |
| KM68512ALG-5                            | 32-SOP, 55ns, L-pwr      | KM68512ALGI-7                             | 32-SOP, 70ns, L-pwr      |
| KM68512ALG-5L                           | 32-SOP, 55ns, LL-pwr     | KM68512ALGI-7L                            | 32-SOP, 70ns, LL-pwr     |
| KM68512ALG-7                            | 32-SOP, 70ns, L-pwr      |   |                          |
| KM68512ALG-7L                           | 32-SOP, 70ns, LL-pwr     | KM68512ALTI-7L                            | 32-TSOP1-F, 70ns, LL-pwr |
| KM68512ALT-5L                           | 32-TSOP1-F, 55ns, LL-pwr |   |                          |
| KM68512ALT-7L                           | 32-TSOP1-F, 70ns, LL-pwr |   |                          |

## FUNCTIONAL DESCRIPTION

| $\overline{CS}_1$ | $CS_2$          | $\overline{OE}$ | $\overline{WE}$ | I/O Pin | Mode            | Power   |
|-------------------|-----------------|-----------------|-----------------|---------|-----------------|---------|
| H                 | X <sup>1)</sup> | X <sup>1)</sup> | X <sup>1)</sup> | High-Z  | Deselected      | Standby |
| X <sup>1)</sup>   | L               | X <sup>1)</sup> | X <sup>1)</sup> | High-Z  | Deselected      | Standby |
| L                 | H               | H               | H               | High-Z  | Output Disabled | Active  |
| L                 | H               | L               | H               | Dout    | Read            | Active  |
| L                 | H               | X <sup>1)</sup> | L               | Din     | Write           | Active  |

1. X means don't care.(Must be low or high state)

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

| Item                                  | Symbol                            | Ratings                 | Unit | Remark    |
|---------------------------------------|-----------------------------------|-------------------------|------|-----------|
| Voltage on any pin relative to Vss    | V <sub>IN</sub> ,V <sub>OUT</sub> | -0.5 to 7.0             | V    | -         |
| Voltage on Vcc supply relative to Vss | V <sub>CC</sub>                   | -0.5 to 7.0             | V    | -         |
| Power Dissipation                     | P <sub>D</sub>                    | 1.0                     | W    | -         |
| Storage temperature                   | T <sub>STG</sub>                  | -65 to 150              | °C   | -         |
| Operating Temperature                 | T <sub>A</sub>                    | 0 to 70                 | °C   | KM68512A  |
|                                       |                                   | -40 to 85               | °C   | KM68512AI |
| Soldering temperature and time        | T <sub>SOLDER</sub>               | 260°C, 10sec(Lead Only) | -    | -         |

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Functional operation should be restricted to recommended operating condition. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## RECOMMENDED DC OPERATING CONDITIONS<sup>1)</sup>

| Item               | Symbol          | Min                | Typ | Max                                 | Unit |
|--------------------|-----------------|--------------------|-----|-------------------------------------|------|
| Supply voltage     | V <sub>CC</sub> | 4.5                | 5.0 | 5.5                                 | V    |
| Ground             | V <sub>SS</sub> | 0                  | 0   | 0                                   | V    |
| Input high voltage | V <sub>IH</sub> | 2.2                | -   | V <sub>CC</sub> +0.5V <sup>2)</sup> | V    |
| Input low voltage  | V <sub>IL</sub> | -0.5 <sup>3)</sup> | -   | 0.8                                 | V    |

Note

- Commercial Product : T<sub>A</sub>=0 to 70°C, unless otherwise specified  
Industrial Product : T<sub>A</sub>=-40 to 85°C, unless otherwise specified
- Overshoot : V<sub>CC</sub>+3.0V in case of pulse width≤30ns
- Undershoot : -3.0V in case of pulse width≤30ns
- Overshoot and undershoot are sampled, not 100% tested

## CAPACITANCE<sup>1)</sup>(f=1MHz, T<sub>A</sub>=25°C)

| Item                     | Symbol          | Test Condition      | Min | Max | Unit |
|--------------------------|-----------------|---------------------|-----|-----|------|
| Input capacitance        | C <sub>IN</sub> | V <sub>IN</sub> =0V | -   | 6   | pF   |
| Input/Output capacitance | C <sub>IO</sub> | V <sub>IO</sub> =0V | -   | 8   | pF   |

- Capacitance is sampled, not 100% tested

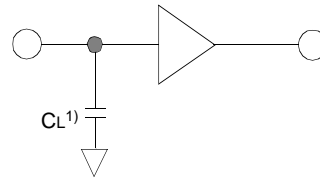
## DC AND OPERATING CHARACTERISTICS

| Item                           | Symbol           | Test Conditions  | Min           | Typ | Max | Unit |    |
|--------------------------------|------------------|--|---------------|-----|-----|------|----|
| Input leakage current          | I <sub>LI</sub>  | V <sub>IN</sub> =V <sub>SS</sub> to V <sub>CC</sub>  | -1            | -   | 1   | μA   |    |
| Output leakage current         | I <sub>LO</sub>  | $\overline{CS}_1=V_{IH}$ or $CS_2=V_{IL}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ , V <sub>IO</sub> =V <sub>SS</sub> to V <sub>CC</sub>                                      | -1            | -   | 1   | μA   |    |
| Operating power supply current | I <sub>CC</sub>  | I <sub>IO</sub> =0mA, $\overline{CS}_1=V_{IL}$ , CS <sub>2</sub> =V <sub>IH</sub> , V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub>  | -             | 7   | 15  | mA   |    |
| Average operating current      | I <sub>CC1</sub> | Cycle time=1μs, 100% duty, I <sub>IO</sub> =0mA<br>$\overline{CS}_1 \leq 0.2V$ , CS <sub>2</sub> ≥V <sub>CC</sub> -0.2V, V <sub>IN</sub> ≤0.2V or V <sub>IN</sub> ≥V <sub>CC</sub> -0.2V | -             | -   | 10  | mA   |    |
|                                | I <sub>CC2</sub> | Cycle time=Min, 100% duty, I <sub>IO</sub> =0mA, $\overline{CS}_1=V_{IL}$ , CS <sub>2</sub> =V <sub>IH</sub> , V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub>                       | -             | -   | 70  | mA   |    |
| Output low voltage             | V <sub>OL</sub>  | I <sub>OL</sub> =2.1mA   | -             | -   | 0.4 | V    |    |
| Output high voltage            | V <sub>OH</sub>  | I <sub>OH</sub> =-1.0mA  | 2.4           | -   | -   | V    |    |
| Standby Current(TTL)           | I <sub>SB</sub>  | $\overline{CS}_1=V_{IH}$ , CS <sub>2</sub> =V <sub>IL</sub> , Other inputs =V <sub>IH</sub> or V <sub>IL</sub>   | -             | -   | 3   | mA   |    |
| Standby Current (CMOS)         | KM68512AL/L-L    | I <sub>SB1</sub><br>$\overline{CS}_1 \geq V_{CC}-0.2V$ , CS <sub>2</sub> ≥V <sub>CC</sub> -0.2V or CS <sub>2</sub> ≤0.2V<br>Other inputs =0 - V <sub>CC</sub>                            | Low Power     | -   | 2   | 100  | μA |
|                                |                  |  | Low Low Power | -   | 1   | 20   |    |
|                                | KM68512ALI/LI-L  |  | Low Power     | -   | 2   | 100  | μA |
|                                |                  |  | Low Low Power | -   | 1   | 50   |    |

## AC OPERATING CONDITIONS

### TEST CONDITIONS (Test Load and Input/Output Reference)

Input pulse level : 0.8 to 2.4V  
 Input rising and falling time : 5ns  
 Input and output reference voltage : 1.5V  
 Output load(see right) :  $CL=100pF+1TTL$



1. Including scope and jig capacitance

## AC CHARACTERISTICS ( $V_{CC}=4.5\sim 5.5V$ , KM68512A Family: $T_A=0$ to $70^\circ C$ , KM68512AI Family: $T_A=-40$ to $85^\circ C$ )

| Parameter List |                                 | Symbol                              | Speed Bins |     |      |     | Units |
|----------------|---------------------------------|-------------------------------------|------------|-----|------|-----|-------|
|                |                                 |                                     | 55ns       |     | 70ns |     |       |
|                |                                 |                                     | Min        | Max | Min  | Max |       |
| Read           | Read cycle time                 | t <sub>RC</sub>                     | 55         | -   | 70   | -   | ns    |
|                | Address access time             | t <sub>AA</sub>                     | -          | 55  | -    | 70  | ns    |
|                | Chip select to output           | t <sub>CO1</sub> , t <sub>CO2</sub> | -          | 55  | -    | 70  | ns    |
|                | Output enable to valid output   | t <sub>OE</sub>                     | -          | 25  | -    | 35  | ns    |
|                | Chip select to low-Z output     | t <sub>LZ</sub>                     | 10         | -   | 10   | -   | ns    |
|                | Output enable to low-Z output   | t <sub>OLZ</sub>                    | 5          | -   | 5    | -   | ns    |
|                | Chip disable to high-Z output   | t <sub>HZ</sub>                     | 0          | 20  | 0    | 25  | ns    |
|                | Output disable to high-Z output | t <sub>OHZ</sub>                    | 0          | 20  | 0    | 25  | ns    |
|                | Output hold from address change | t <sub>OH</sub>                     | 10         | -   | 10   | -   | ns    |
| Write          | Write cycle time                | t <sub>WC</sub>                     | 55         | -   | 70   | -   | ns    |
|                | Chip select to end of write     | t <sub>CW</sub>                     | 45         | -   | 60   | -   | ns    |
|                | Address set-up time             | t <sub>AS</sub>                     | 0          | -   | 0    | -   | ns    |
|                | Address valid to end of write   | t <sub>AW</sub>                     | 45         | -   | 60   | -   | ns    |
|                | Write pulse width               | t <sub>WP</sub>                     | 40         | -   | 50   | -   | ns    |
|                | Write recovery time             | t <sub>WR</sub>                     | 0          | -   | 0    | -   | ns    |
|                | Write to output high-Z          | t <sub>WHZ</sub>                    | 0          | 20  | 0    | 25  | ns    |
|                | Data to write time overlap      | t <sub>DW</sub>                     | 25         | -   | 30   | -   | ns    |
|                | Data hold from write time       | t <sub>DH</sub>                     | 0          | -   | 0    | -   | ns    |
|                | End write to output low-Z       | t <sub>OW</sub>                     | 5          | -   | 5    | -   | ns    |

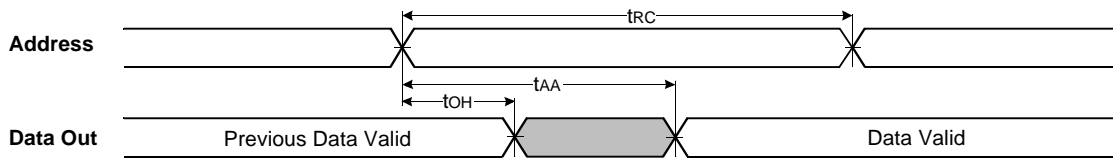
## DATA RETENTION CHARACTERISTICS

| Item                               | Symbol           | Test Condition  | Min    | Typ | Max | Unit |         |
|------------------------------------|------------------|---|--------|-----|-----|------|---------|
| V <sub>CC</sub> for data retention | V <sub>DR</sub>  | $\overline{CS}_1 \geq V_{CC}-0.2V$  | 2.0    | -   | 5.5 | V    |         |
| Data retention current             | I <sub>DR</sub>  | $V_{CC}=3.0V$ $\overline{CS}_1 \geq V_{CC}-0.2V$<br>$CS_2 \geq V_{CC}-0.2V$ or $CS_2 \leq 0.2V$ | L-Ver  | -   | 1   | 50   | $\mu A$ |
|                                    |                  |   | LL-Ver | -   | 0.5 | 10   |         |
|                                    |                  |   | L-Ver  | -   | -   | 50   |         |
|                                    |                  |   | LL-Ver | -   | -   | 25   |         |
| Data retention set-up time         | t <sub>SDR</sub> | See data retention waveform   | 0      | -   | -   | ms   |         |
| Recovery time                      | t <sub>RDR</sub> |   | 5      | -   | -   |      |         |

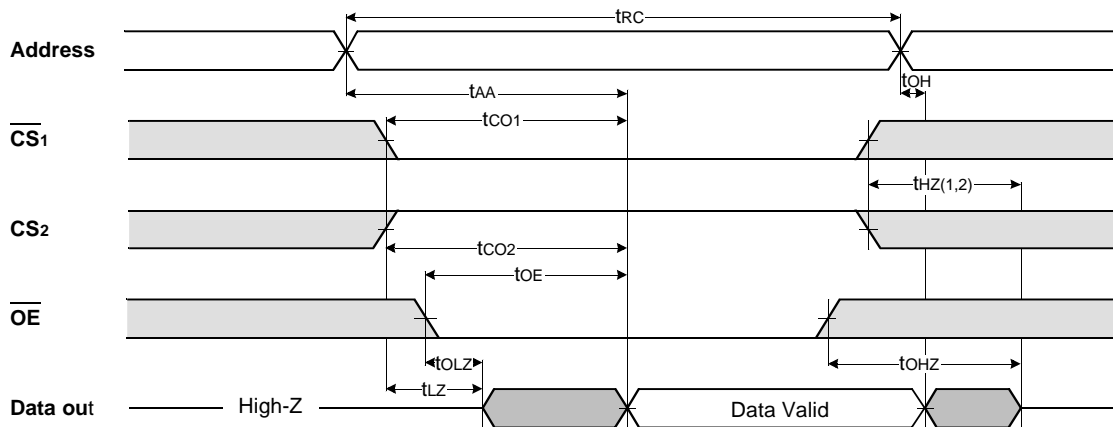
1.  $\overline{CS}_1 \geq V_{CC}-0.2V$ ,  $CS_2 \geq V_{CC}-0.2V$  ( $\overline{CS}_1$  controlled) or  $CS_2 \leq 0.2V$  ( $CS_2$  controlled).

TIMMING DIAGRAMS

TIMING WAVEFORM OF READ CYCLE(1) (Address Controlled,  $\overline{CS1}=\overline{OE}=V_{IL}$ ,  $\overline{WE}=V_{IH}$ )



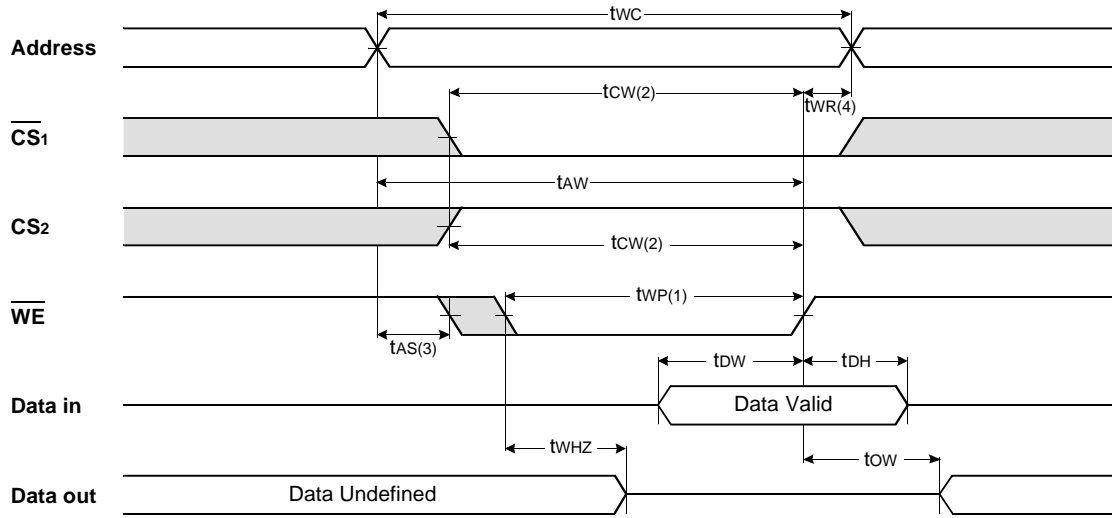
TIMING WAVEFORM OF READ CYCLE(2) ( $\overline{WE}=V_{IH}$ )



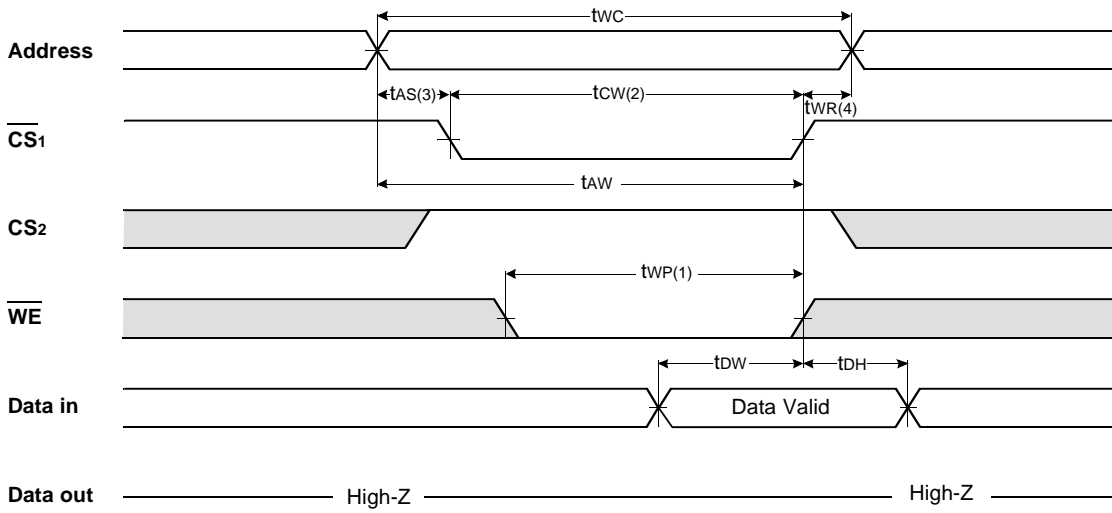
NOTES (READ CYCLE)

1.  $t_{HZ}$  and  $t_{OHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
2. At any given temperature and voltage condition,  $t_{HZ}(\text{Max.})$  is less than  $t_{LZ}(\text{Min.})$  both for a given device and from device to device interconnection.

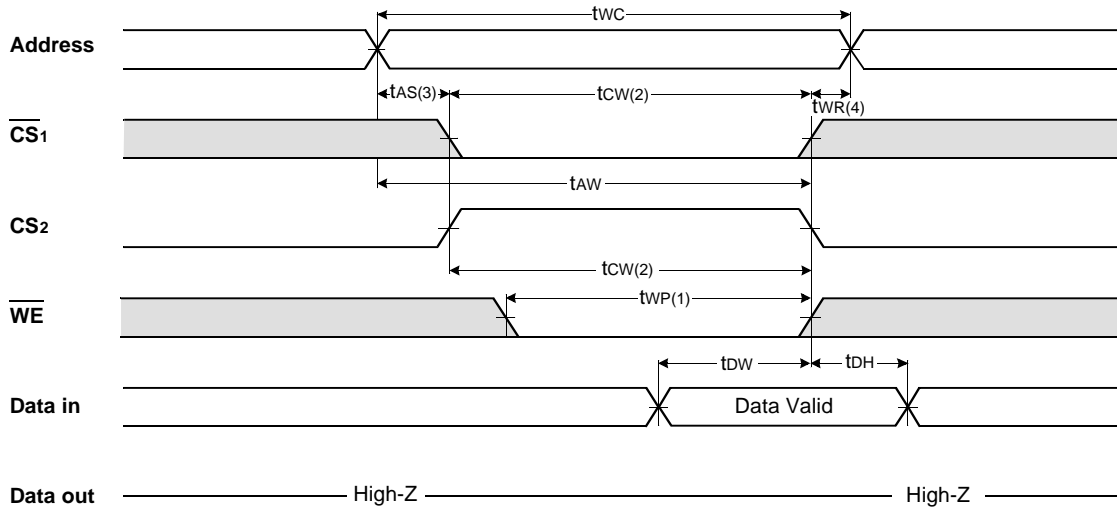
TIMING WAVEFORM OF WRITE CYCLE(1) ( $\overline{WE}$  Controlled)



TIMING WAVEFORM OF WRITE CYCLE(2) ( $\overline{CS1}$  Controlled)



TIMING WAVEFORM OF WRITE CYCLE(3) (CS<sub>2</sub> Controlled)

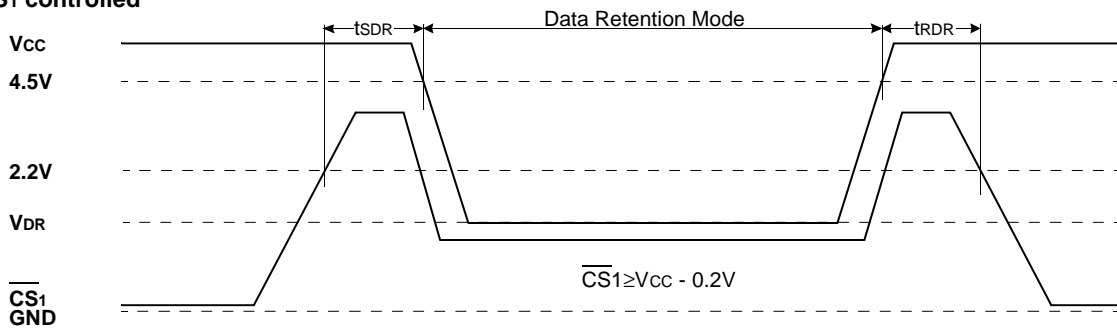


NOTES (WRITE CYCLE)

1. A write occurs during the overlap of a low  $\overline{CS}_1$ , a high  $\overline{CS}_2$  and a low  $\overline{WE}$ . A write begins at the latest transition among  $\overline{CS}_1$  going low,  $\overline{CS}_2$  going high and  $\overline{WE}$  going low : A write ends at the earliest transition among  $\overline{CS}_1$  going high,  $\overline{CS}_2$  going low and  $\overline{WE}$  going high,  $t_{WP}$  is measured from the beginning of write to the end of write.
2.  $t_{CW}$  is measured from the  $\overline{CS}_1$  going low or  $\overline{CS}_2$  going high to the end of write.
3.  $t_{AS}$  is measured from the address valid to the beginning of write.
4.  $t_{WR}$  is measured from the end of write to the address change.  $t_{WR(1)}$  applied in case a write ends as  $\overline{CS}_1$  or  $\overline{WE}$  going high  $t_{WR(2)}$  applied in case a write ends as  $\overline{CS}_2$  going to low.

DATA RETENTION WAVE FORM

$\overline{CS}_1$  controlled



CS<sub>2</sub> controlled

